Environmental Impact Assessment

(DRAFT)

July 2013

SASEC Road Connectivity Sector Project

Asian Highway 2 (India /Nepal Border to India/Bangladesh Border)
Asian Highway 48 (India/Bhutan Border to India/Bangladesh Border)

Prepared by Ministry of Roads Transport and Highways, Government of India and Public Works Department, Government of West Bengal for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 30 April 2013)

Currency unit	–	Indian rupee (INR)
INR1.00	=	$ 0.01818
$1.00	=	INR 55.00

ABBREVIATION

AADT	Annual Average Daily Traffic
AAQ	Ambient air quality
AAQM	Ambient air quality monitoring
ADB	Asian Development Bank
AH	Asian Highway
ASI	Archaeological Survey of India
BDL	Below detectable limit
BGL	Below ground level
BOD	Biological oxygen demand
BOQ	Bill of quantity
CCE	Chief Controller of Explosives
CGWA	Central Ground Water Authority
CITES	Convention on International Trade in Endangered Species
CO	Carbon monoxide
COD	Chemical oxygen demand
CPCB	Central Pollution Control Board
CSC	Construction Supervision Consultant
DFO	Divisional Forest Officer
DG	Diesel generating set
DO	Dissolved oxygen
DPR	Detailed project report
E&S	Environment and social
EA	Executing agency
EAC	Expert Appraisal Committee
EFP	Environmental Focal Person
EHS	Environment Health and Safety
EIA	Environmental impact assessment
EMOP	Environmental monitoring plan
EMP	Environmental management plan
ESCAP	United Nations Economic and Social Commission for Asia and Pacific
GHG	Greenhouse gas
GIS	Geographical information system
GOI	Government of India
GRC	Grievance redress committee
GRM	Grievance redress mechanism
HFL	Highest flood level
IMD	Indian Meteorological Department
IRC	Indian Road Congress
IUCN	International Union for Conservation of Nature
IVI	Important value index
JDA	Jalpaiguri Development Authority
LCS	Land Custom Station

LHS	Left hand side
LPG	Liquefied petroleum gas
Max	Maximum
Min	Minimum
MJB	Major bridge
MNB	Minor bridge
MOEF	Ministry of Environment and Forests
MORSTH/ MORTH	Ministry of Road Surface Transport and Highways
MPRSD	Master Plan Road Sector Development
N, S, E, W, NE, SW, NW	Wind Directions (North, South, East, West or combination of Two directions like South West, North West)
NBU	North Bengal University
NGO	Non-governmental organization
NH	National highway
NOC	No Objection Certificate
NOx	Oxides of nitrogen
NPL	National Physical Laboratory, U.K.
NWBI	National Wildlife Board of India
PAH	Project Affected House Hold
PAP	Project Affected Persons
PAS	Protected Areas
PCC	Portland Cement Concrete
PCR	Public Community Resources
PCU	Passenger Car Units
PD	Project Director
PM	Particulate Matter
PIU	Project Implementation Unit
PPE	Personal protective equipment
PPT	parts per trillion
PPTA	Project Preparedness Technical Assistance
PUC	Pollution Under Control
PWD	Public Works Department
R & R	Rehabilitation and Resettlement
RCC	Reinforced cement concrete
RHS	Right hand side
ROB	Road Over Bridge
ROW	Right of way
RSPM	Respiratory suspended particulate matter
SAARC	South Asian Association for Regional Corporation
SEIAA	State Environmental Impact Assessment Authority
SEMU	Social and Environmental Management Unit
SH	State highway
SIA	Social Impact Assessment
SJDA	Siliguri Jalpaiguri Development Authority
SO_2	Sulphur Dioxide
SOI	Survey of India
SPCB	State Pollution Control Board
SPL	Sound Pressure Level
SPM	Suspended Particulate Matter

SPS	ADB Safeguard Policy Statement, 2009
TA	Technical assistance
TDS	Total dissolved solids
TSS	Total Suspended Solids
UA	Urban Agglomeration
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
UNESCO	United Nations Educational, Scientific and Cultural Organization
USEPA	United States Environmental Protection Agency
UT	Union Territories
WBHDC	West Bengal Highway Development Corporation
WBPWD	West Bengal Public Works Department
WBSPCB	Waste Bengal State Pollution Control Board
WHC	Water holding capacity
WWF	World Wildlife Fund
ZSI	Zoological survey of India

WEIGHTS AND MEASURES

dB (A)	–	A-weighted decibel
ha	–	hectare
km	–	kilometre
km^2	–	square kilometre
KWA	–	kilowatt ampere
Leq	–	equivalent continuous noise level
µg	–	microgram
m	–	meter
MW (megawatt)	–	megawatt
PM 2.5 or 10	–	Particulate Matter of 2.5 micron or 10 micron size

NOTE

In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

A. INTRODUCTION

1. Need of the Project

1. ADB has a regional cooperation program in four South Asian countries: Bangladesh, Bhutan, India and Nepal, called South Asia Economic Cooperation (SASEC[1]), which has been supporting regional cooperation in the transport sector through SAARC[2] and BIMSTEC[3] over a decade. Major contributions in this regard include assisting the SAARC Regional Multimodal Transport Study (SRMTS)[4] and BIMSTEC Transport Infrastructure and Logistics Study (BTILS).[5] A series of SASEC Trade Facilitation and Transport Working Group meetings have endorsed ADB preparation of a project to improve the most critical corridors connecting Nepal, India, Bangladesh and Bhutan in the northern part of West Bengal, so called the "chicken neck" area of India.

2. The transport division of ESCAP (United Nations Economic and Social Commission for Asia and Pacific has initiated the Asian Highway Network with the aim of promoting the development of international road transport in the region. The regional road connectors between Nepal and Bangladesh through India are designated as Asian Highway No.2 (AH-2) and between Bhutan and Bangladesh through India is designated as Asian Highway No.48 (AH-48). The road sections selected for improvement under this project not only forms part of these two Asian highways but also provide shortest distance connectivity through Chicken neck part of West Bengal State of India. The trade and people movement is on rise gradually through these selected corridors. The improved road conditions will help people save substantial time of commuting and garner lager economic gains. The proposed sector loan will upgrade high priority trade corridors and facilities comprising National Highways (NH), State Highways (SH) and a Land Customs Terminal (LCS) connecting five countries: Bangladesh, Bhutan, India, Myanmar and Nepal in the north-eastern part of India including North Bengal. Given the large scale of the program and the need to carefully study priority corridors particularly in the India - Bangladesh - Myanmar region, a sector loan approach is proposed to finance the project. While approximately five road corridors have been identified for financing under the project, currently the scope of only two road corridors are well defined, therefore, these roads are selected as sample sub-projects. The list of sample subprojects and tentative non sample subprojects are provided below in **Table 1.**

Table 1 : List of Sub-Projects

No.	Name of Road/Facility	Length (km)
I	**Sample subprojects**	
1.	AH-2: Panitanki (Nepal border) – Fulbari (Bangladesh border)	48.7
2.	AH-48: Jaigaon (Bhutan border) – Changrabandha (Bangladesh border)	115
	SAMPLE TOTAL	163.7
II	**Potential non-sample subprojects**	
1.	Imphal – Moreh (Manipur)	107

[1] South Asia Economic Cooperation (SASEC). Member countries are Bangladesh, Bhutan, India and Nepal
[2] South Asian Association for Regional Cooperation (SAARC). Member countries are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka
[3] Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). Member countries are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand
[4] SAARC Secretariat. 2007. *Regional Multimodal Transport Study*. Kathmandu.
[5] ADB. 2008. *Final Report of RETA6335: BIMSTEC Transport Infrastructure and Logistics Study*. Manila.

No.	Name of Road/Facility	Length (km)
2.	Imphal-Moirang-Wangoo-Singhat-Behiang (Manipur)	120
3.	Jiribam-Parbung-Thanlon-Singhat-Behiang (Manipur)	150
4.	Mechi bridge (West Bengal)	0.600
	NON SAMPLE TOTAL (APPROXIMATE)	377.6
	GRAND TOTAL (APPROXIMATE)	**541.3**

2. Project Location

3. Both the above sample road corridors traverse through the northern part of West Bengal state in India and mostly pass through rural areas and few urban areas. Both these corridors will be improved to standard two lane roadways with some sections being expanded to four lane roadways. Few bypasses at Panitanki, Pasakha and Hasimara are proposed to avoid populated areas. The location of project alignment with other project component is shown at Figure 1 and 2.

3. Environmental Regulatory Requirement and Project Category

4. The project has been evaluated considering the outcome of the ADB Rapid Environmental Assessment (REA) checklist.. All environmentally sensitive areas along the proposed alignment have been critically analysed to assess the magnitude and extent of likely impacts. AH-48, one of the two projects passes through a protected area (Jaldapara National Park) for approximately 3 km, reserved forests for approximately 2 km and includes construction of a new bypass road of about 6.6 km which falls within 10 km of the Buxa Tiger Reserve. No environmentally sensitive areas exist in the other road AH-02. However, both roads fall under environment category A under the EIA notification of MOEF and require an environmental clearance since they fall within 10 km of an international boundary. Approval from the Wild Life Board for diversion of forest land to non-forest purpose will be required for AH-48 for the sections passing through the national park and reserved forests. Certain sections in both roads involve expansion of the existing road from double lane to four lane standard road where there will be substantial land use change and earthworks involved. The stretch crosses some of the water bodies and acquisition of land is involved at a few stretches. Due to these environmental sensitivities the project falls under category A as per ADB Safeguard Policy Statement 2009 hence an environmental impact assessment has been carried out.

4. Purpose and Extent of EIA Study

5. This report primarily focuses on the environmental impacts of the proposed two road corridor improvement and associated developments including design, construction and operation stages impacts and their mitigation. The impacts are identified for all project activities on physical, terrestrial, and aquatic ecology. Environmental management and monitoring programme are suggested to minimise these impacts and sustain the benefits. Institutional Mechanism is also suggested for effective implementation of EMP and EMoP.

B. DESCRIPTION OF THE PROJECT

1. The key project components and activities

6. The proposed roadway improvement will include upgrading the AH-2 and AH-48 roads corridor to National Highway Standards for two lane configuration for most of the road sections and four lane configuration at some sections. Both the above corridors traverse through north-eastern part of India mostly through rural areas and few urban areas. The total length of Nepal Bangladesh corridor is 48.7 km while Bhutan-Bangladesh corridor is about 115 km including additional corridor of 11.3 Km in AH-2. Both these corridors will be two lane roadways with a

number of major at-grade intersections. Four lanes are proposed at two sections in AH-2 with total 11.110 Km length and one section[6] of 13.7 Km length in AH-48 with high projected traffic volumes. Road over bridges and grade separations are proposed at select railroad level crossings, and congested intersections. Land Customs Station (LCS) at Panitanki and Pasakha are also proposed. The design criteria and salient features of the project are given at **Table 2**.

Table 2 : Design Criteria and Salient Features

Description	Design Criteria/Features
Cross Section Details for two lane (Typical) (Rural)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 1.5m X 2 Unpaved shoulder : 1.0m X2 Roadway width : 12m ROW[7] : 45 m
Cross Section Details for two lane (Typical) (Village/semi urban)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 2.0m X 2 Unpaved shoulder : 0.5 m X2 Roadway width : 12m ROW : 30 m
Cross Section Details for two lane (Typical) (Urban)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 2.250m X 2 Unpaved shoulder :2.25 m X2 Roadway width : 16m ROW : 30 m
Cross section Details for four lane (Typical)	Carriage way : 14m (7m X 2) Paved Shoulder : 1.5m X 2 Unpaved shoulder : 1.0m X 2 Median : 2 - 4.5m
Design Service Volume (PCU/day) (for Level of Service B as per IRC : 64-1990)	15,000 two Lane with earthen Shoulder 17250 two lane with .1.5 m paved shoulder (Plain Terrain) 40000 four lane with 1.5 m paved shoulder (Plain Terrain)
Design Speed (km/h)	Rural Section : 100-80 Urban Section : 50
Super Elevation	Limited to 7% (Two land Carriageway) Limited to 5% (Four land Divided Carriageway)
Minimum radii of curves (m) in (Plain Terrain)	360m @ 100 km/h design speed 240m @ 80 km/h design speed 150m @ 65 km/h design speed
Vertical Alignment (Max Gradient)	3.3% Plain Terrain 5.0% Rolling
Slide Slopes (hf = height of shoulder edge above the natural ground level) (hc : Height of cut)	hf < 1m : 1:2 1m<hf<3m : 1:1.5 hf>3m :1:1 Above 4m, retaining structures recommended
Pavement Design	As per IRC: 37 – 2001 with the design period

[6] This section between Mainaguri – Dhupguri bypass junction falls under NHAI jurisdiction and may developed by them and hence may not be included under this project.
[7] ROW will be restricted to minimum construction width to avoid fresh land acquisition.

Description	Design Criteria/Features
	of 15 years.
Bridge Design	As per IRC: 78 for foundation and sub structure and IRC SP : 73 for two lane bridge cross section
ROB	3 (level crossings at Panitanki, Naxalbari, and Rangapani). In AH-2 and 1(Level crossing at Hasimara Bypass) . in AH-48
Elephant Under Pass	3 no in Jaldapara National Park in AH48 at Chainage 85+760, 86+214, 86+953 with span of 5x20m and clear height of 6m. Existing Halang Bridge is also considered as elephant underpass.
Grade Separation	1 in AH-2 at Bagdogra
Intersection Improvement	4 Intersections in AH-2
Land custom stations	1 (Panitanki) in AH-2 And 1 (Pasakha) in AH-48
New Bypass	Panitanki in AH-2 of 1.55 KM,, Hasimara 3.55 KM in AH-48, Pasakha Bypass (6.62 Km)
Bus Bays	28 in AH2 and 44 in AH48
Truck Parking	2 in AH2 and 3 in AH 48
Bridge Reconstruction	1 no. in AH-48
Bridge Widening	All minor bridges 7 in AH 02 and 17 in AH-48

2. Implementation Schedule and Project Costs

7. The implementation period of 3 years is anticipated for completion of improvement work of both the corridor which is subjected to finance arrangement, land acquisition and necessary clearance from Ministry of Environment and Forests, Government of India. The estimated cost for both the project corridor is estimated as INR 9,007 Million.

C. DESCRIPTION OF THE ENVIRONMENT

8. The main purpose of the environmental baseline study is to assess the original status of the environment in the area before the commencement of the development work/project. Background information on physical, biological and social setting which are likely to be affected for a proposed developmental project are studied based on primary and secondary data collection and analysis. Key baseline features are summarised at **Table 3.**

Table 3 : Summary of Key Environmental Features

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road	Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road
1	**Ecological Environment**				
	a. Presence of Wildlife Sanctuary/ National Park	None, however movement of Elephant is	None, however occasional movement of	Jaldapara National Park. About 3 Km length of road passes	Jaldapara National Park and Buxa Tiger

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road	Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road
		seen near tea gardens, Naxalbari	wild life is noticed	through the National Park.	Reserve
	b. Reserved Forests	None	Yes	Yes, about 2 Km length of the road run along the reserved forests before Jaldapara National Park.	Yes
	c. Wetland	None	None	None	None
	d. Migratory route for wild animals	None, Occasional movement of elephant is seen in Tree garden near Naxalbari	None	Yes in Jaldapara National park.	Yes in Jaldapara National park and Buxa Tiger Reserve
	e. Migratory routes for birds	None	None	None	None
	f. Migratory routes for fishes	None,	None	None	None
	g. Presence of schedule 1[8] animal including in rivers	No habitat. Occasional movement of elephant is seen	None	Yes in the Jaldapara National Park	Yes in Jaldapara and Buxa Tiger Reserve
	h. Tree cover	Yes good amount of tree cover along the road	Yes good amount of tree and tea gardens	Yes good amount of tree cover along the road	Yes good amount of tree and tea gardens
	i. Aquatic Sensitivity	Minimal, Local specifies are present	Minimal, Local specifies are present	Minimal, Local specifies are present	Minimal, Local specifies are present
	j. Birds Nesting	None	None	None	None
2.	**Physical Environment**				
	Topography	Plain Topography	Plain Topography	Plain Topography	Plain Topography
	Seismicity	High damaged risk zone as per Seismic Zonal Map of	High damaged risk zone as per Seismic Zonal Map of	High damaged risk zone as per Seismic Zonal Map of India	High damaged risk zone as per Seismic Zonal Map of

[8] Schedule I as per Wildlife (Protection) Act 1972 requires list the Rare and Endangered animals requiring protection.

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m of either side, from centre of road	**Within 5 km either side, from centre of road**	**Within 100 m of either side, from centre of road**	**Within 5 km either side, from centre of road**
		India	India		India
	Surface Water Resources (Rivers)	Manza, Changa, Decomani, Tepu, Hali, and Laskar, rivers mostly perennial in nature.	Manza, Changa, Decomani, Tepu, Hali, Laskar Michi and Teesta rivers, mostly perennial in nature.	Torsha, Halang, Mujnai, Birpara, Dimdima, and Jaldhoka, rivers mostly perennial in nature.	Torsha, Halang, Mujnai, Birpara, Dimdima, Jaldhoka, and Raidak Rivers mostly perennial in nature.
	Groundwater	Falls in Safe Zone as per Central Ground Water Authority[9]	Falls in Safe Zone as per Central Ground Water Authority	Falls in Safe Zone as per Central Ground Water Authority	Falls in Safe Zone as per Central Ground Water Authority
	Soil and Land-use	Mixed sandy loam and loamy soil. Land use in 500m of road is primarily agricultural fallow land (55%), vegetation cover (11%), agriculture land (22%) and Settlements (7%)	Mixed sandy loam and loamy soil. Land use in 5 Km of road is primarily agricultural fallow land (52%), vegetation cover including dense forests (18%), agriculture land including tea gardens (10%) and settlements (14%)	Alluvial soil to sandy and clayey soil. Land use in 500m of road is primarily agricultural fallow land (36%), vegetation cover including dense forests (17%), agriculture land including tea gardens (37%), and settlements (8%)	Alluvial soil to sandy and clayey soil. Land use in 5 Km of road is primarily agricultural fallow land (48%), vegetation cover including dense forests (21%), agriculture land including tea gardens (19%) and settlements (2%)
3.	**Social Environment**				
	a. Physical Setting	Urban Rural Settings	Urban Rural Settings	Urban Rural Settings	Urban Rural Settings

[9] Central Ground Water Authority classify the ground water availability scenario in five category viz safe, semi critical, critical, over exploited and notified. No permission is required for withdrawal of water upto 100 KLD in an area or plant.

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road	Within 100 m of either side, from centre of road	Within 5 km either side, from centre of road
	b. Physically sensitive receptors	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)
	c. Archaeological Monuments	None	None	None	None

9. The northern region of Bengal, which lies between West Bengal, Bangladesh Nepal and Bhutan, experiences a varied climatic condition throughout the year. In general the weather of this region particularly is reported to vary from sub-humid to pre-humid. The annual rainfall is generally about 900 mm in the project road area. The region is close to tropic of cancer which could be a contributory factor to its higher temperature range. The advent of Monsoon from June to August initiates a tremendous increase in their discharge volume, causing most rivers to swell overflowing their banks. Naxalbari, Naukaghat, Dhupguri and Mainaguri are major flood prone areas along the project corridor. Ambient air Quality meets the prescribed National Ambient Air Quality Standards at most of the locations. An ambient Noise level exceeds the prescribed National Ambient Noise Quality Standards at various monitoring locations located close to the road.

D. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

10. Environmental impacts have been assessed considering present environmental setting of the project area, nature, and extent of the proposed activities. Suitable approach and methodology was adopted to ascertain likely impacts during design and construction and operation stage.

1. Impacts and Mitigation during Design Stage

11. **Physical Environment**: Developmental projects like Asian Highway, which is passing through forests and adjoining areas and requiring felling or clearing of trees and vegetation, may alter the local micro-climate. Both the project corridor is located in seismic zone IV which is high damage risk zone. This may cause failure of civil structures in the event of earthquake if design consideration related to seismicity is not taken into consideration. Road widening may affect various utilities mostly water pipes and telecommunication cables which are mostly located in urban areas. The road widening and increase traffic may damage drainage system and create safety concern to people residing along the road. Noise level may increase during construction and operation stages of project near the sensitive receptors like hospitals, schools. It is assessed that incremental noise level due to current traffic and project traffic is of the order of only 2 dB(A). Since, widening is planned within ROW except bypasses no significant adverse environmental impact is anticipated on the land use pattern. No significant impact is anticipated on any of the river water due to bridge re-construction or minor bridges widening. However, siltation of river water may affect the aquatic life of the river. Cutting of large number of trees may alter the local micro-climate.

12. **Biological Environment**: The AH-48 road corridor passes through 2700m within Jaldapara National Park causing severe disturbance and loss of fauna. This section also falls within Asian Elephant migratory corridor. Various other animal (deer & bison in particular)

crossing the road leads to Man-Animal conflict as well. Asian Elephant also crosses the road near Kiran Chand Tea estate, Naxalbari in AH-2. Improved road condition with increased speed will worsen the situation.

13. About 3,500 and 9000 numbers of trees are proposed to fell for widening and improvement of project road corridor in AH-2 and AH-48 respectively which would lead to substantial loss of local flora. About 5.0 ha of Khairbari reserved forest land before Jaldapara National Park and 3 Ha land within Jaldapara National Park will be diverted for non-forest purposes for the road improvement and construction of Elephant underpasses for elephant movement. Vulnerable species Delonix Regia (Gulmohar) the only vulnerable specie may get affected due to project activity. But this is an exotic species of the region..

14. **Socio-Economic Environment**: About 120 PAH, 95 structures completely and 44 structures partially are likely to be affected in AH-02. Similarly about 310 PAH and 250 structures completely and 145 structures partially are likely to be affected in AH-48. People at large have raised concern of safety during public consultation stage. Many accident cases are reported in the past safety, which is of major concern around schools and hospitals. The significant impacts during design stage are mainly associated with alterations in local micro-climate due to felling of trees.

15. **Mitigation: Faunal Protection**: Protection of Asian Elephant and other wild animals is give high priority. Interactions are made with concerned Wild Life Authorities and forests officials. Interactions were made with local NGOs and international NGOs active in that area WWF. As per the inputs and acceptance of wildlife authorities and concurrence from NGOs following measures are proposed for the protection of wild life:

- **Provision of Elephant under Passes**: It is observed that Asian Elephant crosses the road at three locations in Jaldapara NP section of the road in AH-48. Accordingly three underpasses shall be constructed for safe passage of Asian Elephant in the Jaldapara National Park at chainage 85+760, 86+214, 86+953. Each underpass will be 100m wide with five span of 20m width each and height of 6m. Existing Halang Bridge is also considered as elephant underpass. Guide rails shall be installed along the both side of the underpass to direct the elephant and animal movement to the underpass. Camouflaging plantations shall be made along the rails to provide privacy to the elephants. Top soil of the diverted area of the reserved forests or National Park shall be preserved and used for reforestation activates as these soil are very rich in nutrients.

- **Provision of Warning Sign Boards**: Provision of retro-reflective warning sign boards shall be made in the elephant movement area near Kiran Chand Tea estate in Ah-2 and between Hasimara and Pasakha Bypass area in AH-48.

16. **Floral Protection**: The project envisages approximately 37,500 trees as a compensatory plantation on 1:3 basis against cutting of 12,500 trees for both road sections. These trees shall be planted with the involvement of Village Panchayats (Village Administration) and Women Self Help Group and under the supervision of Social Forestry Department for plantation over PWD and Irrigation department land. Plantation in forest area and forests land shall be made through forests department. Vulnerable species Delonix Regia (Gulmohar) shall be planted more in numbers. Strong monitoring mechanism is proposed to ensure tree survivability rate of minimum 70%. To maintain and further enhance the micro climate and aesthetics, it is recommended that avenue plantation of at least one row shall be done along roadside during up-gradation of the project road.

17. It is proposed to plant trees as a natural barrier to noise propagation along the road. The provision of noise barriers (24 nos) are made for all the sensitive receptors (schools and hospitals) located within 200 ft or 61 Meter of the road in AH-2 and AH-48.

18. Construction of bridges on water body will be undertaken during dry period. Flow of water shall be maintained in a channel with a pond and puddle upstream (about 50 m) for aquatic flora and fauna. Provision of adequate cross drainage structure is to be made in the all the three bypass road sections. Additional balancing culverts shall be provided in flood prone areas. The embankment height shall be designed consistent with the existing topography of the region and shall be higher than the HFL.

19. . Relevant IS codes shall be adopted while designing the civil structures to sustain the earthquake of highest magnitude in Seismic zone IV.

20. About 120 PAH, 95 structures completely and 44 structures partially are likely to be affected in AH-02. Similarly about 310 PAH and 250 structures completely and 145 structures partially are likely to be affected in AH-48. People at large have raised concern of safety during public consultation stage. Many accident cases are reported in the past safety, which is of major concern around schools and hospitals. A separate SIA and R & R study is undertaken as per SPS09. This aspect will be dealt with as per finding or these assessments. The provision of Land compensation Act 1898, National Highway Act 1956 and National R & R policy 2007 and ADB SPS09 provision will be followed for land acquisition. Adequate provision shall be made in project design for safety near schools, hospitals and other sensitive locations. Provision of adequate caution signage near school, sensitive locations, shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Common property resources structures even falling within ROW but out of required formation width shall be saved to the extend feasible through engineering measures.

2. Impacts and Mitigation during Construction Stage

21. The significant impact during construction are mainly associated with (i) dust from earth works (during site preparation), (ii) emissions from the operation of construction equipment and machines, (iii) fugitive emissions from vehicles plying on the road, (iv) fugitive emissions during the transport of construction materials, (v) air emissions other than dust arise from combustion of hydrocarbons particularly from the hot mix plants, and (vi) localised increased traffic congestion in construction areas. Ambient noise level may increase temporarily in the close vicinity of various construction activities, maintenance workshops and vehicles and earthmoving equipment. Some impacts on soil and land use which are likely to occur would include loss of burrow areas, soil erosion, soil contamination due to inappropriate disposal of liquid waste (lubricating oil and fuel spills, waste oil and lubricant and vehicle/equipment washing effluent) and domestic solid waste and sewage from construction camps. Construction material and waste may contaminate or clog small drains if stored or disposed close to water body or pond.

22. Material will be transported under covered truck. Periodic spraying of water on earthworks. Noise making equipment like diesel generating sets shall be fitted with silencers. Provision of temporary noise barrier (Barricading) shall be made near identified sensitive locations or near the noise and dust source during construction. Plantation along the boundary wall shall be made at start of construction itself. Care shall also to be taken to prevent activities which are likely to generate noise related disturbance during night time especially near the sensitive locations. Excavation of borrow areas should be excavated as per the Indian Road Congress (IRC):10-1961. Fuel and lubricants shall be stored at the predefined storage location and away from drainage channels. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. Construction waste shall be stored away from water body. It

will be ensured that no construction material is disposed near any after body except for reusing it for enhancement measures such as embankment raising. Construction camps will be located on unproductive land and 1 Km away from habitat areas. All construction camps shall be provided sanitary latrines and urinals with provision of septic tanks attached with soak pits or mobile toilets fitted with anaerobic digestion system. Storm water drains shall be provided for the flow of used water outside the camp. During the construction phase, contractors shall be required to adopt and maintain safe working practices. Contractor shall also arrange required PPEs for workers, as well as first aid and fire fighting equipment at construction sites.

3. Impacts and Mitigation During Operation Stage

23. The subproject road is located in vast open agricultural land, which will provide adequate dispersion of gaseous emission from vehicle. Further, proposed plantation will ameliorate/enhance the micro climate. No adverse climatic changes/impacts are anticipated during operation stage other than GHG (CO2) emission due to increased traffic, which would be largely offset with better fuel efficiency and reduced vehicle idling due to improved road conditions. During the operational Stage, movement of traffic will be the prime source of noise. Traffic congestion and pedestrian interferences increase the use of horns. This may result in increased noise levels at nearby schools and religious places. Provision of tree plantation and noise barrier is made in design to minimise this impact.

24. Positive impacts on terrestrial ecology are expected during the project operation stage due to the increase in vegetation and landscaping along the state highway. The project will coordinate with the local communities to maintain and enhance the trees planted along the state road. ”No adverse impact is anticipated during operation stage except accidental damages or absence of proper tree management. Post project scenario is expected to reduce the Man-Animal conflict. However, strict vigil will be required to prevent such conflicts.

25. The improved road will provide better connectivity which will 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. Important issues related with safety during operational phase are monitoring of emergencies and establishing procedures to carry out rescues during sudden emergency such as accidents. Adequate caution signage near school, sensitive locations, speed control, caution notes shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Crash barrier shall also be installed at appropriate locations particularly near school to provide safety to school children. Provision of sped breakers shall be made near schools and religious places.

26. **Induced Environmental Impacts:** An assessment is made of likely induced impacts due to improved project activities. The trade level between border countries is on rise since a very long period. The damaged road condition have little deterrent on trade in the past through, it has posed substantial inconvenience to people and trading community. The region to which both the road traverse is already developed in terms of industry and trade aspects for supply of commodities required by neighbouring countries. The improved road is expected to increase transport through this region but is unlikely to trigger exponential development in this region. Setting up few new industries and increase in trade volume though cannot be ruled out. As such no significant induced environmental impact is anticipated due to proposed project activity.

E. ALTERNATIVE ANALYSIS

27. This project is site specific and involves improvement of roads along the existing road alignment. The road improvement is necessitated to cater to increasing trade and traffic between Nepal Border (Kakarbita-Panitanki) to Bangladesh Border (Fulbari -Banlabandha) part of AH-2 and Bhutan Border (Pheuntsholing-Jaigaon) to Bangladesh border (Chandrabandha-Burimari) part of AH-48. Required ROW is mostly available along the proposed project road sections of AH-2 and AH-48. Therefore, no alternative analysis from location aspect is undertaken. Road is very congested due to slow moving traffic and/or less ROW availability or encroachments at Panitanki (Nepal Border), Hasimara town, and Pasakha Access (Bhutan Border). The alternative analysis is carried out for possible bypasses or realignment options at these three locations and for 'do nothing' options.

28. Under the circumstance, and in light of the assessment of the available alternatives, the 'with-project' option is deemed as the optimal solution, as far as its feasibility and sustainability during its project life and beyond can be ascertained. Considering the environmental, social and technical consideration the proposed bypass alternatives at Panitanki (1.55 Km long along Michi river and agricultural area), Hasimara Bypass (3.55 KM, along western side of existing alignment) and Phaska Bypass (6.22 Km long starting right hand side of BRO road at Km 102.700 and ending at Barsa river Bank) is considered to be most suitable and is are recommended as preferred options.

F. ENVIRONMENTAL MANAGEMENT PLAN AND GRIEVANCES REDRESS MECHANISM

29. The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring and institutional measures to be taken up during the design, construction and operation stages of the project. The major components of the Environmental Management Plan includes Mitigation of potentially adverse impacts, Monitoring during project implementation and operation, Institutional Capacity Building and Training, Implementation Schedule and Environmental Cost Estimates, Integration of EMP with Project planning, design, construction and operation and Grievance Redress Mechanism

30. The plan also includes the actions needed for implementation of these measures. The environmental budget is estimated as INR 352.79 Mn or US$ 6.41. The mitigation cost including monitoring is estimated as INR. 267.52 Mn during design and construction phase and INR 30.78 Million during operation phase. The costs of establishment, and training and awareness are estimated as INR 37.5 million. The environmental budget includes costs for compensatory tree plantation at the rate of 1:5, diversion of forests land for non-forestry purposes, development of floral nurseries, and various other mitigative measures such as dust management, soul contamination prevention, water and waste water management, noise berries and Environmental Monitoring. The costs towards engineering measures such as elephant underpass in Jaldapara National Park is considered part engineering costs and not included in above EMP budget.

Sl. No.	Description	Budget (Rs in Million)
1.	**Design and Construction Stage**	**267.53**
	Technical Support for preparation of environmental Guidelines and performance indicators	1.50
	Clearing of plantation and compensatory plantation	187.5
	Additional Tree plantation for climate change consideration of 1:5 basis considering woody trees of 34%. (This includes plantation of fodder and shade trees for elephant habitat improvement)	42.5

	Diversion of Forest land for Non forestry Purposes (Diversion of Reserved Forests and National Park land	12.8 + Net Present Value
	Development of earthen water bodies (ponds upstream of the road of elephant crossing area) for Elephant habitat improvement	1.8
	Developing floral Nurseries and Fisheries	6.25
	Health Check-up Camps for construction workers and Safety signage	2.96
	Environmental Monitoring during Construction Stage	7.66
	Installation of Oil and Grease traps and waste water collection and disposal system at construction camp, construction of noise barrier. The costs towards various mitigative measures such dust management, soil contamination prevention, drainage congestion and disposal of accumulated water, water management, and safety aspects are considered part of engineering costs and not separately indicated as EMP costs	4.56
2.	**Operation Stage**	**30.78**
	Costs of visual Checks are considered part of project management costs and separately identified as EMP costs	-
	Emergency Preparedness – Provision of Ambulances	25.5
	Environmental Monitoring during operation stage	5.28
3.	**Training and Awareness**	**4.60**
4.	**Establishment & Management systems**	**32.90**
5.	**Contingencies (@5%)**	**16.79**
	Total	**352.60 Or say US $ 6.41** (@ 1 US $ = Rs 55)

31. An officer in MORTH (with the support of WBPWD), WBHDC and respective EA for LCS will be responsible for ensuring that all environment safeguard requirements are complied with during implementation of the project. WBPWD, SJDA, JDA and WBHDC at the IA or PIU level will be directly responsible for implementing the detailed requirements of the EIA and EMP at the project office and site level.

32. Grievances related to the implementation of the project, particularly regarding the environmental management plan will be acknowledged, evaluated, and responded to the complainant with corrective action proposed using understandable and transparent processes that are gender responsive, culturally appropriate, and readily accessible to all segments of the affected people. Records of grievances received, corrective actions taken and their outcomes will be properly maintained and form part of the semi-annual environmental monitoring report to ADB

G. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

33. Public consultation was carried out twice as per ADB safeguard requirements. The different stakeholders viz Govt. officials, NGOs , Village Panchayats (Village Administration), people (male, female) were contacted and consulted during the course of the study. Stakeholders were informed about the project components and likely environmental impacts before seeking their views. In each consultation all efforts were made to have adequate participation from women as well. The community members, Government officials and NGO members voiced that the proposed project will contribute in social and economic development of the region. The proposed

project shall contribute to increase employment opportunities for the local people during and after project implementation. The communities welcomed the project and all were in favour of the project. The community raised few concerned regarding air, and noise impact, safety and man – animal conflict. Villagers suggested making provision for safe passage of student and people near sensitive locations. They have also suggested to make provisions air pollution control and noise barrier near sensitive locations like schools and religious places. Pradhan (President) of the Gram Panchayats on both the highways, suggested that widening shall be done for four lanes instead of two lanes at this stage itself since land acquisition and all other activities may be difficult in second phase. NGOs have raised concern for tree loss and Man – Animal conflict. They have suggested to plant trees on minimum 1:3 ratio. Wildlife authorities have suggested to make provision of elephant underpass in the Jaldapara National Park.

34. In the second stage consultation, EIA findings were presented to the participants in the three separate workshops. While participants has accepted the findings of the EIA, have suggested to strengthen the compensatory tree implementation mechanism. They have suggested to involve Village Panchayts and women self-help groups maximum possible. In Second stage consultation international NGOs active in the area WWF were also consulted and their suggestions were incorporated in the project design.

35. Each of the issues raised by stakeholders were analysed for practical and scientific basis, used for identifying impacts and developing management and monitoring plan, depending on their importance and practicality.

H. CONCLUSIONS AND RECOMMENDATIONS

36. The project is unlikely to cause significant environmental impacts except in protected area where it will have impact on elephant movement and its land use. As per findings of detailed EIA, the environmental impacts are largely temporary in nature in most of the section of the roads except in forests & protected areas. Impacts can be mitigated with minimal residual impacts in all impacted areas. The project involves land acquisition, diversion of forests land, and movement of elephant, shifting of physical cultural structures and borrowing of earth. Most major impacts are associated with these activities.

37. The EIA was carried out while the feasibility study was being prepared and initial finding of DPR preparation stage. Therefore, the detailed engineering design was not available. In this regard, any major changes during detailed design, or any major additional work other than the proposed project activities will require updating this environmental assessment. Also it may have to be sent to ADB for concurrence before civil works commence. Moreover, the executing agencies have to submit the detailed engineering designs to ADB, which will review them and examine whether major changes or major additional works have been included. In this context, changes with respect to alignment, and any significant change in design specification of the project components need to be reported to ADB.

38. Adequate provision is made for safety of the people in the EMP budget. Institutional mechanism shall be evolved for utilising the emergency Ambulance facility proposed under the EMP.

39. The mitigation measures proposed will form part of BOQ for construction contract for its effective implementation.

40. Mechanism to monitor the tree plantation and effectiveness of measures for preventing Man-animal conflict shall be strengthened. It is proposed to form committee consisting of

concerned EA Sr. official, DFO and one officer from revenue department who shall oversee the implementation of floral and faunal measures.

41. For effective implementation of the project in an environmentally sustainable manner, it is recommended to develop environmental guidelines and EHS management system supported by Environmental Management Information software/system. Performance indicators may also be developed as part of these guidelines to monitor and assess the effectiveness of the mitigation measures.

42. Adequate training shall be imparted as proposed under environmental management plan to enhance the capability of concerned EA officials. Awareness programme for contractor and workers shall also be organised for effective implementation of EMP.

43. EMP implementation progress and monitoring report shall be sent to ADB every half yearly.

I. INTRODUCTION

A. Project Background

5. Need of the Project

1. ADB has a regional cooperation program in four South Asian countries: Bangladesh, Bhutan, India and Nepal, called South Asia Economic Cooperation (SASEC[10]), which has been supporting regional cooperation in the transport sector through SAARC[11] and BIMSTEC[12] over a decade. Major contributions in this regard include assisting the SAARC Regional Multimodal Transport Study (SRMTS) [13] and BIMSTEC Transport Infrastructure and Logistics Study (BTILS).[14] A series of SASEC Trade Facilitation and Transport Working Group meetings have endorsed ADB preparation of a project to improve the most critical corridors connecting Nepal, India, Bangladesh and Bhutan in the northern part of West Bengal, so called the "chicken neck" area of India. Further, to initiate connectivity between South Asia and South East Asia and as a follow on activity of the BTILS, strategic roads connecting Bangladesh, India and Myanmar are currently being studied.

2. Regional Cooperation: The transport division of ESCAP (United Nations Economic and Social Commission for Asia and Pacific has initiated the Asian Highway Network with the aim of promoting the development of international road transport in the region. The regional road connectors between Nepal and Bangladesh through India is designated as Asian Highway No.2 (AH-2) and between Bhutan and Bangladesh through India is designated as Asian Highway No.48 (AH-48). The road sections selected for improvement under this project not only forms part of these two Asian highways but also provide shortest distance connectivity through Chicken neck part of West Bengal State of India. This area is also transit point for air, road and rail traffic to the neighbouring countries of Nepal, Bhutan and Bangladesh. The improvement of these roads is essential to promote trade, tourism, local investment and social development border countries Nepal, Bangladesh, Bhutan and India. All these bordering countries are also member of SAARC (South Asian Association for Regional Cooperation) and are committed to promote regional cooperation and trade for overall development of their countries.

3. Increasing Trade and Economic Activities: The trade and people movement is on rise gradually through these selected corridors. The improved road conditions will help people save substantial time of commuting and garner lager economic gains.

4. Increasing Traffic: The existing and increasing traffic also establishes the need for improvement of these corridors. The traffic volume in the Nepal – Bangladesh corridor is significantly high and is expected to increase fast in future. The traffic, though is lesser in Bangladesh – Bhutan corridor at present but it is also expected to increase at faster rate. The detail of existing and project traffic scenario is presented in Chapter 2. Improvement of these roads will be essential to accommodate the increasing traffic due to above factors.

5. The proposed sector loan will upgrade high priority trade corridors and facilities comprising National Highways (NH), State Highways (SH) and a Land Customs Terminal (LCS) connecting five countries: Bangladesh, Bhutan, India, Myanmar and Nepal in the northeastern part of India

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[10] South Asia Economic Cooperation (SASEC). Member countries are Bangladesh, Bhutan, India and Nepal

[11] South Asian Association for Regional Cooperation (SAARC). Member countries are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka

[12] Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). Member countries are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand

[13] SAARC Secretariat. 2007. *Regional Multimodal Transport Study*. Kathmandu.

[14] ADB. 2008. *Final Report of RETA6335: BIMSTEC Transport Infrastructure and Logistics Study*. Manila.

including North Bengal. Given the large scale of the program and the need to carefully study priority corridors particularly in the India - Bangladesh - Myanmar region, a sector loan approach is proposed to finance the project.

6. While approximately five road corridors have been identified for financing under the project, currently the scope of only two road corridors are well defined. The options and design for the remaining roads and facilities are still being studied and yet to be clearly defined. Therefore the former are selected as sample sub-projects and the latter as non-sample subprojects under the program. The list of sample subprojects and tentative non sample subprojects are provided below in Table 1.

Table 1: List of Subprojects

No.	Name of Road/Facility	Length (km)
I	**Sample subprojects**	
1.	AH-2: Panitanki (Nepal border) – Fulbari (Bangladesh border)	48.7
2.	AH-48: Jaigaon (Bhutan border) – Changrabandha (Bangladesh border)	115
	SAMPLE TOTAL	163.7
II	**Potential non-sample subprojects**	
1.	Imphal – Moreh (Manipur)	107
2.	Imphal-Moirang-Wangoo-Singhat-Behiang (Manipur)	120
3.	Jiribam-Parbung-Thanlon-Singhat-Behiang (Manipur)	150
4.	Mechi bridge (West Bengal)	0.600
	NON SAMPLE TOTAL (APPROXIMATE)	377.6
	GRAND TOTAL (APPROXIMATE)	**541.3**

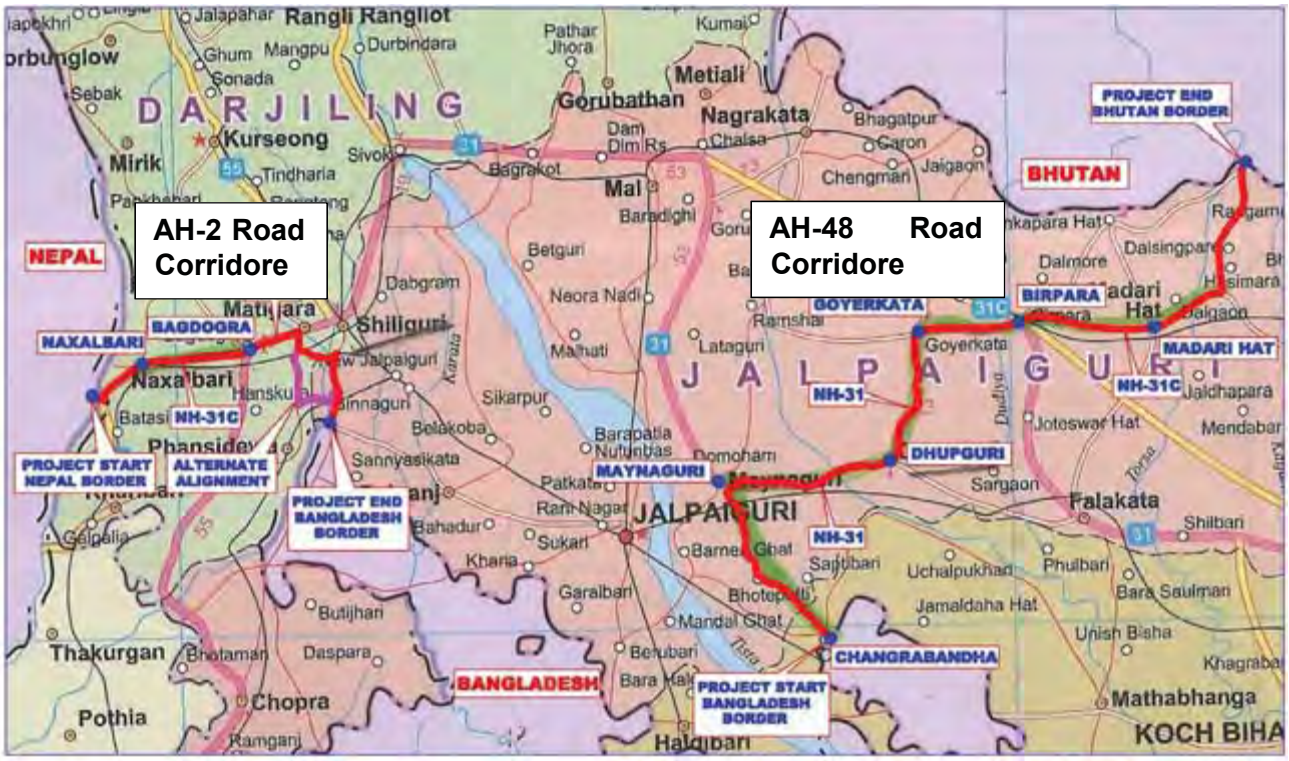
7. This Environmental Impact Assessment (EIA) covers the two sample subprojects and all discussions thereafter focus only on these two subprojects. The required environmental assessment reports for the non sample subprojects will be prepared during later stages after their scope is finalized.

6. Project Location/Setting

8. The project proposes improvement of two existing road corridors connecting Nepal Border (Kakarbita) to Bangladesh Border (Fulbari) and Bhutan Border (Jaigaon) to Bangladesh Border (Changrabandha). Both the above corridors traverse through the northern part of West Bengal state in India and mostly pass through rural areas and few urban areas. Both these corridors will improved to standard two lane roadways with some sections being expanded to four lane roadways. Few bypasses at Panitanki, Pasakha and Hasimara are proposed to avoid populated areas. The location of project alignment with other project component is shown at **Figure 1** and **2**.

Figure 1. Project Location Map

Figure 2. Project Alignments with other project components



7. Key Project Components

9. The project involves improvement of existing double lane national highways and state highways. Improvements will entail: geometric improvement, expansion to four lane standard in some sections, construction of bridges, construction of cross and longitudinal drainage structures and construction of a land customs depots (LCD) in border areas.

10. The project proposes following key improvements:

- Improvement of existing road to two lane roadways of 48.7 Km long of AH-2 and 115 Km of AH-48.
- New bypasses at Panitanki, (AH-2: 1.5km) Pasakha (AH-48: 6.62km) and Hasimara (AH48: 3.5km)
- Additional corridor of 11.3 Km in AH-2.
- Development of Land Custom Stations at Panitanki and Pasakha
- Road Over Bridges (3 Nos.) and grade separation (2 Nos.) at identified locations of AH-2 and AH-48
- Intersection improvement (4 No.) (3 in AH2 and 1 in AH48)
- Bridge reconstruction (1 No. in AH48) and bridge widening (67 No:18 in AH2 and 49 in AH48)

11. Detailed information on design criteria, project components are given at Chapter 2.

8. Stage of Project Preparation

12. This report is prepared based on feasibility study. The project is at DPR report preparation stage.

B. Policy, Legal and Administrative Framework

13. India has well defined institutional and legislative framework. The legislation covers all components of environment viz. air, water, soil, terrestrial and aquatic flora and fauna, natural resources, and sensitive habitats. India is also signatory to various international conventions and protocols. The environmental legislations in India are framed to protect the valued environmental components and comply with its commitment to international community under above conventions and protocols. Asian Development Bank have also defined its Environmental and Social Safeguard policies. This assessment is about the applicability of above laws and regulations, conventions, protocols, and safeguards. This section summaries the following:

- Overview of Key Indian Environmental Legislation and Legal Administrative Framework
- Applicability of various national and local laws and regulations at different stages of project implementations
- Social Regulatory Requirements
- ADB safeguard policies and categorisation of the project
- Summary of international treaties and applicability to the project

1. Overview of Key Indian Environmental Legislation and Legal Administrative Framework

14. The Government of India has framed various laws and regulations for protection and conservation of natural environment. The legislations are broadly divided under following categories:

- Environmental Protection
- Forests Conservation
- Wild Life Protection

15. The umbrella legislation under each of above category is highlighted below:

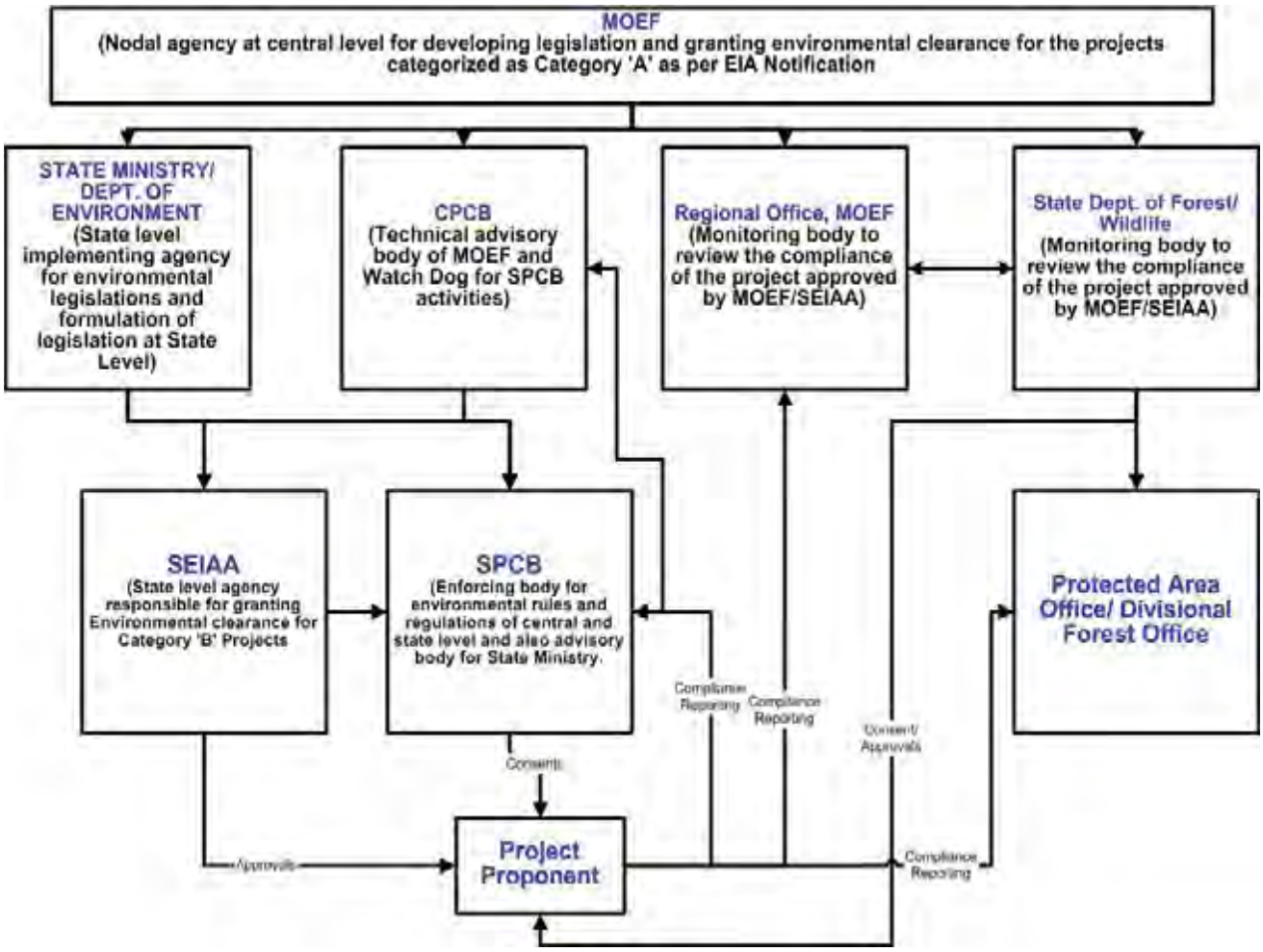
- **The Environment (Protection) Act 1986** was enacted with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. Various rules are framed under this Act for grant of environmental clearance for any developmental project, resources conservation and waste management.

- **The Forest Conservation Act 1980** was enacted to help conserve the country's forests. It strictly restricts and regulates the de-reservation of forests or use of forest land for non-forest purposes without the prior approval of Central Government. To this end the Act lays down the pre-requisites for the diversion of forest land for non-forest purposes.

- **Wild Life (Protection) Act** 1972 amended 2003 was enacted with the objective of effectively protecting the wild life of this country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. It defines rules for the protection of wild life and ecologically important protected areas.

16. The MoEF and the pollution control boards (CPCB i.e. Central Pollution Control Board and SPCBs i.e. State Pollution Control Boards) together form the regulatory and administrative core of the part. Other Ministries/Statutory Bodies/Departments responsible for ensuring environmental compliance and granting various clearances includes state ministry /dept. of environment, regional offices of MoEF and state forests/wildlife departments. Their key roles and responsibilities and interface among them have been concisely depicted through the flow diagram. The administrative framework defines the roles and responsibility of various ministries and Govt. departments at Central Level and State level. The administrative framework for environmental Protection, forests conservation and wildlife is given at **Figure 3.**

Figure 3. : Environmental Legal Administrative Frame Work



2. Environmental Regulatory Requirements of Government of India and State

17. A review is undertaken for all the environmental Rules and Regulation which might be applicable to proposed two road corridor improvement activities. These legislations with applicability to this project are summarised below in **Table 2** and approval and monitoring framework is depicted in **Figure 3**. There is no separate state level legislation. However various Acts like Water and Air are enforced through state level authority: State Pollution Control Board.

Table 2 : Summary of of Environmental and Other Legislations

Legislation	Key Requirement	Applicability	Reason and Stage of Applicability	Granting Agency	Type of permit and Indicative time frame for grant of permission	Responsibility And Stage of Applicability
APPLICABLE LEGISLATION						
Environmental Protection Legislation						
Environmental (Protection) Act, 1986 and rules there under including EIA Notification, 2006.amended 2009, and SO 1533	Requires prior environmental clearance for New State/National Highway or expansion of National/ State Highways greater than 30 km involving additional right of way greater than 20m with land acquisition or passing through ecologically sensitive areas Construction of building > 20,000 sq. meter at any location	Applicable	Both the road require environmental Clarence due to construction of new road (AH-2 Panitanki bypass) and Ah-48 due to Pasakha Bypass and passing through ecologically sensitive areas of Jaldapara National Park. As per project details available, no building will be more than 20,000 sq. meter at any location[15] and the Panitanki Land Customs Station is not covered.	MoEF/ SEIAA	Environmental Clearance. Process would require three main stages: TOR approval, Public Hearing and Environmental Clearance Process takes : 8- 9 months to complete	EA (Prior to Start of Construction)
Air (prevention and control of pollution) Act, 1981 and rules there under	An Act to prevent and control of Air Pollution	Applicable	Applicable during construction stage for the operation of air polluting units like Hot Mix Plant	SPCB	Consent to Establish and Consent to Operate 3-4 months	Contractor (To obtain Prior to setting up polluting units)
Water (prevention and control of pollution) Act, 1974 and rules there under	An Act to Prevent and Control of Water Pollution	Applicable	Applicable during construction stage for discharge of waste from construction camps or maintenance of construction equipment	-do-	Consent to Establish and Consent to Operate 3-4 months	Contractor (To obtain Prior to establishment)

[15] In case building construction is more than 20,000 sq. meter at any location, the environmental clearance will need to be obtained prior to start of construction from concerned State Impact Assessment Agency. If applicable, the clearance process would take 4 to 6 months time frame. EA as project proponent will be accountable and responsible to obtain this clearance.

Noise Pollution (Regulation And Control) Act, 2000	Ambient Noise Standards for different area/zone	Applicable	Primarily Applicable during construction Stage	MoEF/SPCB	No specific permission is required. To ensure compliance to the standard Norms	EA/Contractor
Hazardous Wastes (Management, Handling and Trans Boundary Movement,) Rules, 2008	Protection to the general public against improper handling, storage and disposal of hazardous wastes	Applicable	Hazardous wastes are likely to be generated in the form of waste oil and paints.	State Pollution Control Board	Authorization (3-4 Months)	Contractor (To obtain Prior to generation of Hazardous waste)
The Bio Medical Waste (Management and Handling rules) 1998	To control storage, transportation and disposal of Bio Medical Waste.	Applicable	Applicable for the disposal of Bio Medical waste from First Aid Centre and Dispensaries.	Disposal through authorized disposal agency	No specific permit is required. Just comply with the handling and disposal requirements of the rule	Contractor (During Construction Activities)
The Batteries (Management and Handling) Rules 2001	To regulate the disposal and recycling of lead acid batteries	Applicable	Disposal of used lead acid batteries if likely to be used in any equipment during construction and operation stage	MoEF	No specific registration required. Compulsion to buy and sale through registered vendor only.	Contractor/EA
Forests Conservation and Wild Life Protection Legislation						
Forest (conservation) Act, 1980 and rules there under	Restriction on the de-reservation of forests or use of forest land for non-forest purpose	Applicable	Diversion of Forest Land is involved in AH-48. Permission for cutting of trees forests area is required.	MoEF/ State Forest Department	Forest clearance from diversion of forest land for non-forestry purposes	EA (Before start of construction)
WB Private Forest Act, 1948, WB Forest Produce Transit Rules, 1959, The West Bengal Trees (Protection and Conservation in Non Forest	Restriction for felling tree and transit of tree grown on private land without permission	Applicable	Many tree need to be fell on private land being acquired particularly for bypasses	State Forest Department	Permission to fell and transit the trees 2-3 months	EA/Contractor

Areas) act, 2006.						
Wildlife (protection) Act, 1972 and rules there under	No person shall destroy, exploit or remove any wild life including forest produce from a sanctuary/National park or destroy or damage or divert the habitat of any wild animal by any act whatsoever or divert, stop or enhance the flow of water into or outside the sanctuary, except under and in accordance with a permit granted by the Chief Wild Life Warden	Applicable	AH-48 passes through the Jaldapara National Park. Sanctuary land will be required for construction of underpasses for animal movement and temporary diversion of traffic during construction stage.	Chief Wildlife Warden, State Wild Life Board , National Wild Life Board, Supreme Court	Permission for diversion of Sanctuary land for non-sanctuary purposes. 12 to 15 months	EA (Before Start of construction)
Safety and Other Related Legislation						
Central Motor Vehicles Rules, 1999	To control pollution from vehicle. Mandatory requirement of "Pollution Under Control Certificate" to control vehicular emissions.	Applicable	All construction and official vehicle to obtain maintain valid PUC for use	Authorized vendors	PUC for each vehicle. On the spot by the checking agency	Contractor or EA depending on the ownership of the vehicle
The Gas Cylinder Rules, 2004	To regulate the storage of gas / possession of gas cylinders more than exempted quantity	Applicable	Contractor may store more than the exempted quantity	Chief Controller of Explosive	Lenience to store Gas cylinders more than the regulated quantity 2-3 months	Contractor
Indian Petroleum Rules 2002	To regulate storage of petroleum more than prescribed quantity exempted for the license (Class A / B / C)	Applicable	Contractor may store more than the prescribed quantity at construction camp site	Chief Controller of Explosive	Licence to store petroleum beyond prescribed quantity 2-3 months	Contractor
State-Specific Laws and Regulations						
The West Bengal Town and County Planning and Development Act, 1977	To allocate areas or zones, control location, height, number of storeys, size of building, size of yards,open spaces, street alignment, set back distances, embankments, and	Land Customs Station in Panitanki	PWD will ensure consistency with the land use and zoning regulations before the start of construction	Development and Planning Department, Darjeeling District	Notify in writing the Development Authority of the details of the Land Custom Station in Panitanki at least 1 month prior to undertaking and seek a no-objection	PWD

	construction activities n the urban and rural areas of West Bengal.				and approval of proposal. Valid for 1 year.	
West Bengal Fire Services Act, 1950; Rules of WB Fire Services (Fire License), 2004	Requires the wner or occupier of building to make or carryout arrangements necessary for fire prevention and fire safety measures.	Land Customs Station in Panitanki	Pursuant to the National Building Code of India, Part 4 Fire and Life Safety. Bar to use of premises for storing or processing hazardous substances without licence.	West Bengal Fire and Emergency Services	N.O.C. to high rise and high risk buildings including multiplex and commercial complexes, hospitals, nursing homes, hotels, guest houses and marriage hall/community hall etc.	
NON APPLICABLE LEGISLATION						
Ancient Monuments and Archaeological sites and Remains Act 1958	To protect archaeological site and remains which is declared to be of national importance and Prohibited or regulated area around these sites	Not Applicable	No Protected monument is located within 300 m of the proposed project road alignment	ASI	Not Applicable	Not Applicable
Notification on Dumping and disposal of fly ash discharged from coal or lignite based thermal power plants on land, 1999 and 2003 amendment (from the point of view of utilization of fly ash for embankment construction as per applicability)	Mandatory Use of Fly Ash if the proposed alignment falls within 100 km radius of thermal power plant	Not Applicable	No thermal power plants falls within 100 Km radius of various of project road alignment.	MoEF	Not applicable	Not Applicable
The Environment (Protection) Act, 1986 : Withdrawal of	Permission is required for withdrawal of water from over exploited, critical or semi critical area.	Not Applicable	TThe entire project road corridor area falls in the safe zone	Central Ground Water Authority (CGWA)	Not Applicable	Not Applicable

Ground water						
Public Liability And Insurance Act,1991	Protection to the general public from accidents due to storage and handling of hazardous chemicals	Not Applicable	Applicable only if storage of specified Hazardous chemicals beyond the threshold limit	MoEF	Not Applicable	Not Applicable
Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Preparation to handle a chemical emergency.	Not Applicable	Applicable only to incident qualifying for Major accident Hazard Installation. Such installations are those which has storage of specified chemicals beyond the specified threshold limits.	MoEF	Not Applicable	Not Applicable
The Explosives Act, 1884 / Rules (1983)	To regulate storage, transportation, handling and use of authorized explosives (for blasting applications)	Not Applicable	No blasting is involved	CCE	Not Applicable	Not Applicable

3. Procedural Requirements for Obtaining Various Clearance :

18. The procedural requirement for grant of environmental, forests and Wild life clearance is given at **Figure 4, 5** and **6** respectively.

Figure 4. Environmental Clearance Procedure

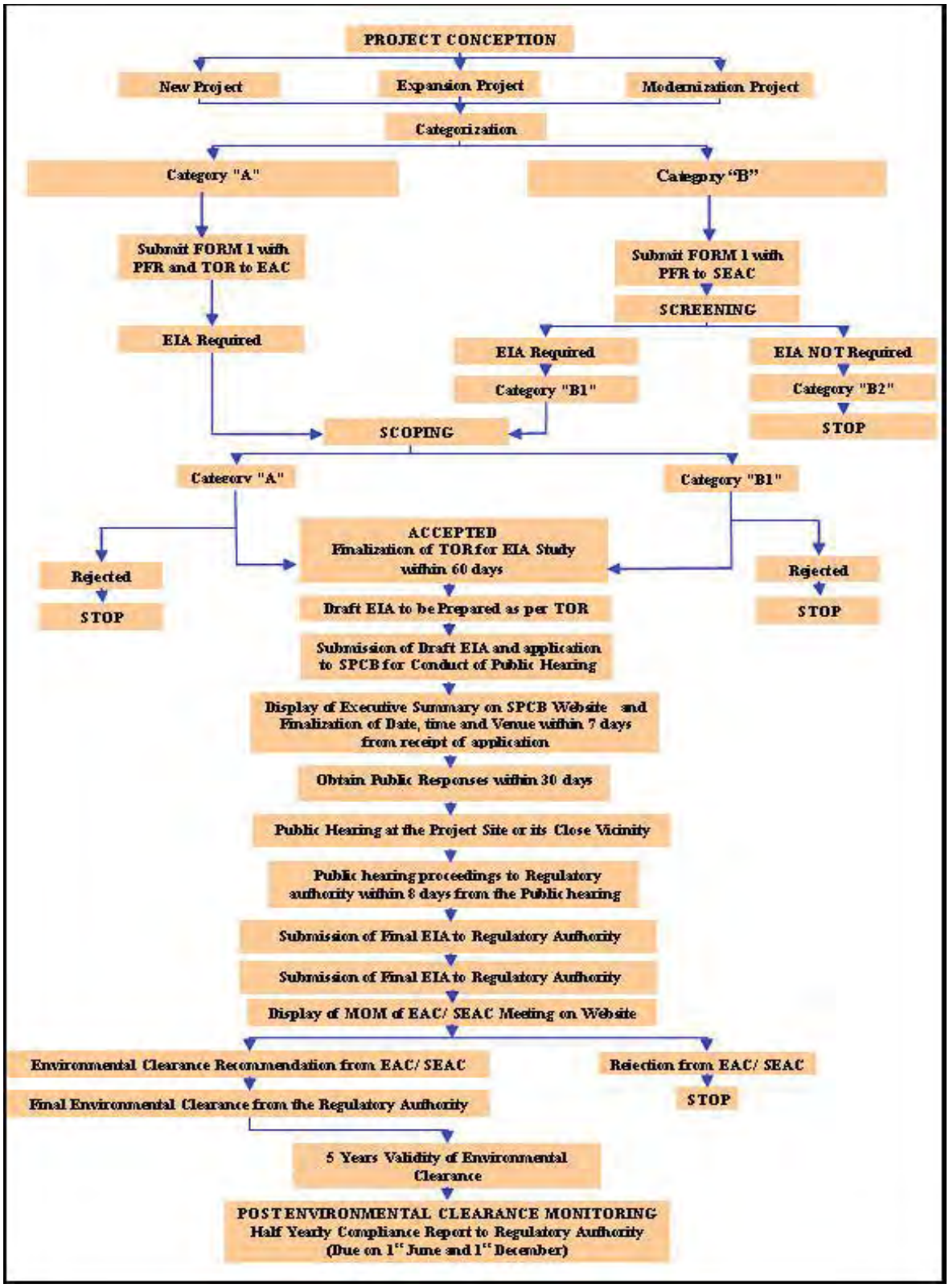


Figure 5. Procedural requirement for Wild Life Clearance

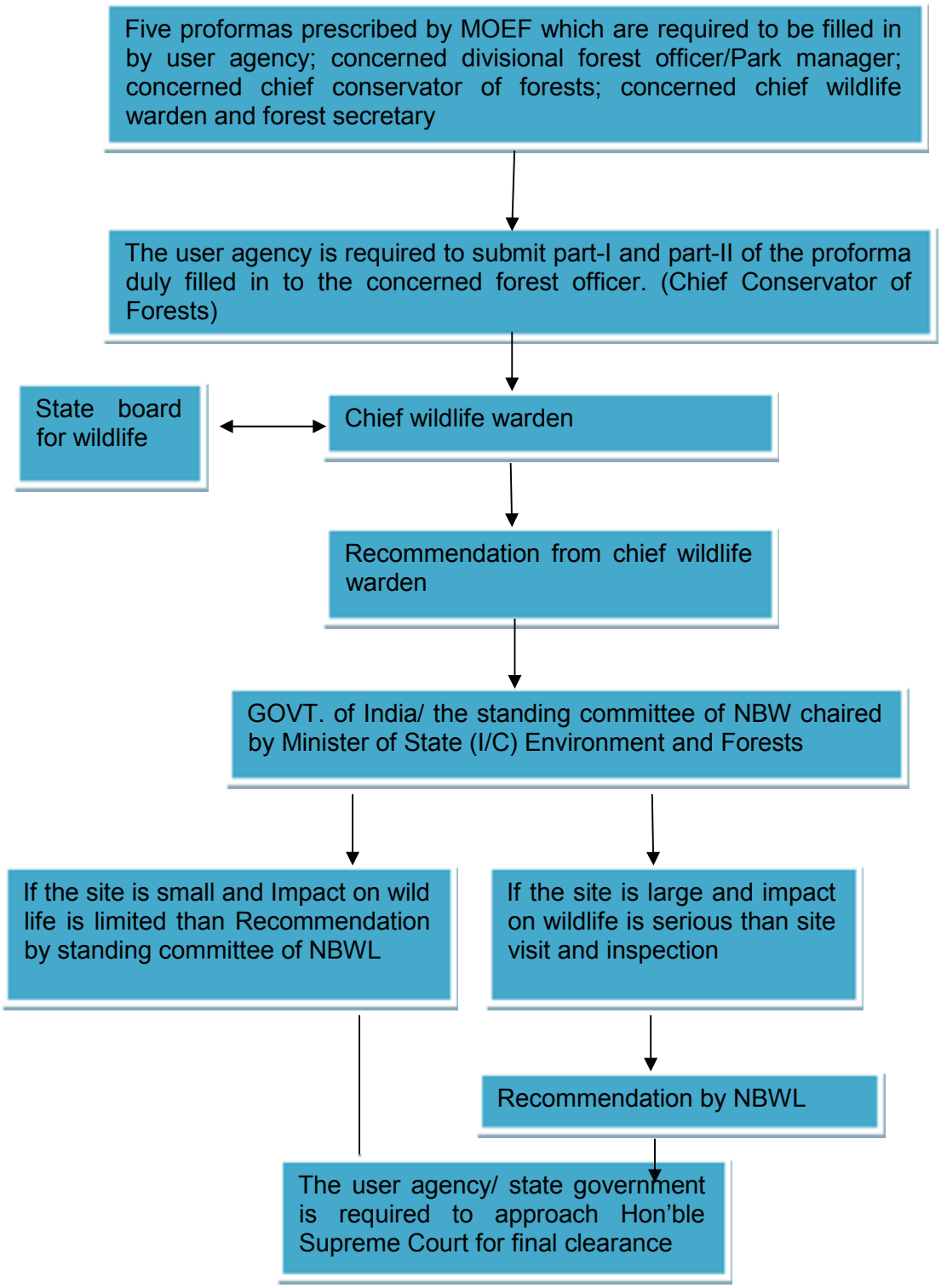
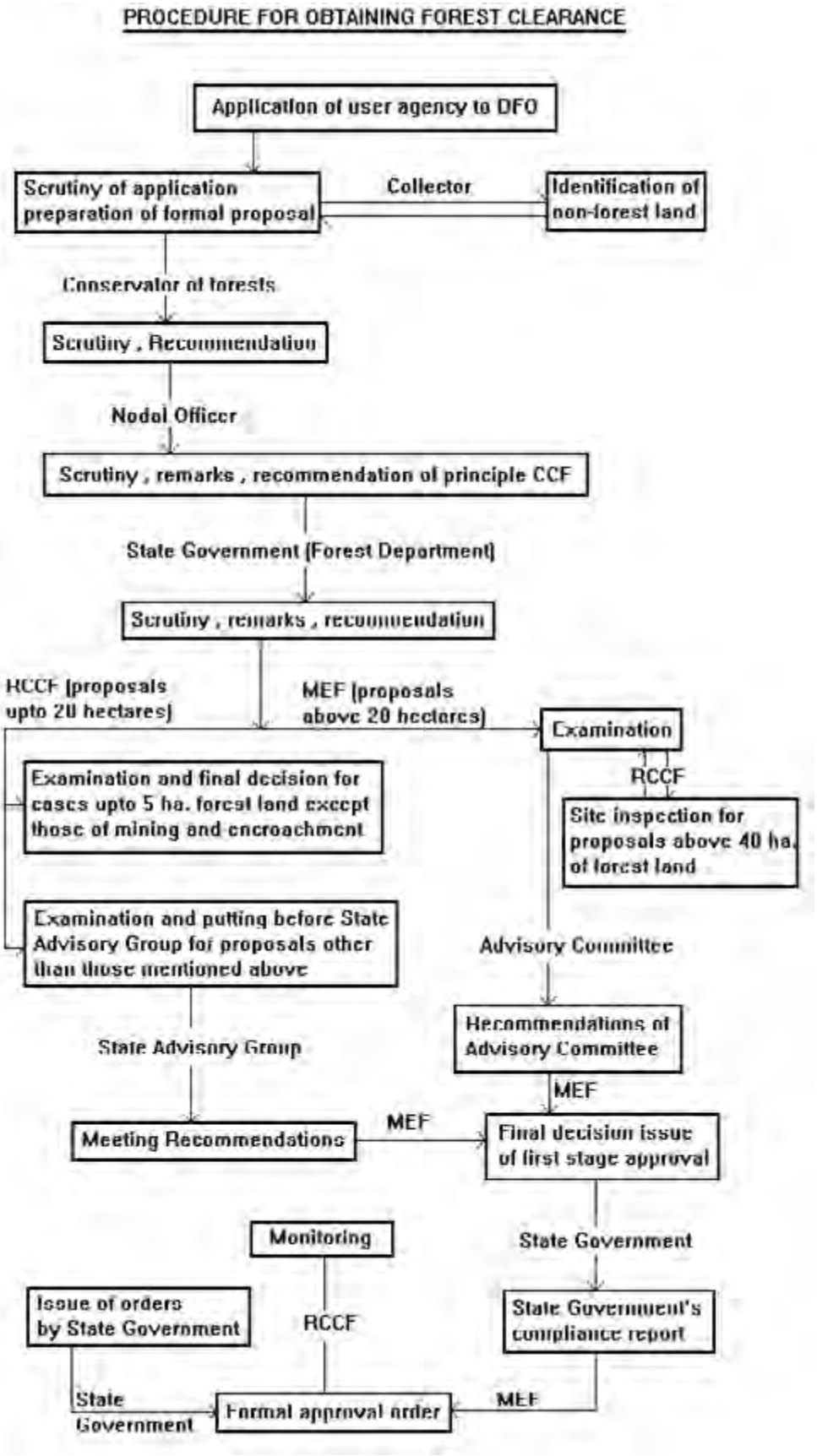


Figure 6. : Procedural Requirement for Forest Clearance



4. Social Regulatory Requirements of the Government of India and State

19. There are many rules and regulations framed by the Government of India for the protection of workers. Most of these legislations will be applicable to contractors in charge of construction. EA will ensure compliance to these social legislations through contractual obligation and regular checks & penalties. These legislations include The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, Child Labour (prohibition and Regulation) Act; 1986, Minimum Wages Act; 1948, Workmen Compensation Act 1923, Payment of Gratuity Act 1972, Employee State Insurance Act, Employees P.F. and Miscellaneous Provision Act 1952, Maternity Benefit Act 1951, Payment of Wages Act 1936, Equal Remuneration Act 1979, Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act 1979, Equal Remuneration Act 1979.

5. International Treaties and Relevance to the Project

20. Government of India has signed many international treaties. GOI has also framed various laws, regulations and guidelines to meet country's obligations under these treaties. The projects of this magnitude may contribute in meeting country's obligation directly or indirectly. A screening was carried out of these treaties regarding its applicability to this project. Outcome of these treaties. The relevant international Treaties are shown in **Table 3.**

Table 3 : International Treaties and its Relevance to the Project

S. No.	Convention	Key Features	Year of ratification/ support
1	Kyoto Protocol to the United Nations Framework Convention on Climate Change[16]	The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.	1997
2	Convention Concerning the Protection of the World Cultural and Natural Heritage [17] (World Heritage Convention)	The most significant feature of the 1972 World Heritage Convention is that it links together in a single document the concepts of nature conservation and the preservation of cultural properties. The Convention recognizes the way in which people interact with nature, and the fundamental need to preserve the balance between the two.	1972

Source: MoEF GOI

[16](http://unfccc.int/2860.php http://unfccc.int/resource/docs/convkp/kpeng.pdf)
[17] (http://whc.unesco.org/en/convention/)

C. Asian Development Bank Safeguard Policies and Category of the project

21. 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 SPS09 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.

1. Category of the Project

22. The project has been evaluated considering the outcome of the ADB Rapid Environmental Assessment (REA) checklist and the same is enclosed as **Appendix 1.1**. All environmentally sensitive areas along the proposed alignment have been critically analyzed to assess the magnitude and extent of likely impacts. AH-48, one of the two projects passes through a protected area (Jaldapara National Park) for approximately 3 km, government reserved forests for approximately 2 km and includes construction of a new bypass road of about 11km which falls within 10 km of the Buxa Tiger Reserve. No environmentally sensitive areas exist in the other road AH-02. However, both roads fall under environment category A under the EIA notification of MOEF and require an environmental clearance since they fall within 10 km of an international boundary. Approval from the Wild Life Board for diversion of forest land to non-forest purpose will be required for AH-48 for the sections passing through the national park and government reserved forests.

23. Certain sections in both roads involve expansion of the existing road from double lane to four lane standard road where there will be substantial land use change and earthworks involved. The stretch crosses some of the water bodies and acquisition of land is involved at a few stretches. Due to these environmental sensitivities the project falls under category A as per ADB Safeguard Policy Statement 2009 hence an environmental impact assessment has been carried out.

D. Environmental Assessment

24. The environmental assessment is carried out in line project categorisation and compliance to SPS 2009 requirement.

1. Objective of the Study

25. The prime objective of the study was to identify the likely environmental impacts and their magnitude during various stages (design, construction and operation) of the project, avoid significant impacts through design alteration and develop cost effective mitigation and monitoring measures along with institutional mechanism to enhance the environmental sustainability.

2. Purpose of the Report

26. This report primarily focuses on the environmental impacts of the proposed two road corridor improvement and associated developments including design, construction and operation stages impacts and their mitigation. The impacts are identified for all project activities on physical, terrestrial, and aquatic ecology. Environmental management and monitoring programme are suggested to minimise these impacts and sustain the benefits. Institutional Mechanism is also suggested for effective implementation of EMP and EMoP.

3. Extent of the EIA Study

27. The environmental assessment was done in tandem with the preparation of the feasibility report. The EIA is based on up-to-date project details provided by the ADB PPTA feasibility assessment team and Design Team during the preparation of this report. The initial inputs of Detail design team findings are also considered. During design finalisation minor changes may occur in the structural components, but these changes are unlikely to cause any significant impact.

28. The EIA study covered all activities proposed under the road corridor improvement activities. The impact of the project covers area within 100 m on either side of the proposed road corridor alignment including bypasses and LCS. The study area was extended to cover a buffer zone of 5 km wide on either side of the proposed alignment, to analyse the land-use, identify environmentally sensitive locations, if any and understand the overall drainage pattern of the area. Geographical Information System (GIS) techniques were used based on recent satellite data of the project area to analyse the baseline physical and ecological landscapes and to gather the relevant data for EIA purpose. Impact on aquatic life, including migratory route of fishes if any, is also assessed. Assessment of vegetation cover, migratory route of animals if existing and sourcing of construction material particularly borrow earth, aggregate ballast, stone chips and sand has also been undertaken.

4. Team Composition and Acknowledgement

29. The environmental assessment has been carried out by S K Jain, Environmental Expert. He was supported by environmental specialists from EQMS India Pvt Ltd and other organisations consisting of Dr MA Khalid, Climate Change and Bio-Diversity Expert, Dr. Sudhanshu Kumar, Air quality and Noise Modelling Expert, Mr Anil Kumar,GIS and Land Use Analysis Expert, Mr Bhrigu Saikia, Wild Life Expert, Mr T. G. Ekende,Public Consultation and Social Expert, Ms. Subhashree Adhikary, Ecologist, and Mr. Kaleem Ahmad, Data Analyst, and other subject and monitoring experts.

30. The environmental team acknowledges the support extended by the executing agency, PPTA design consultant, state forest and wildlife Authorities concerned, Irrigation Department, Pollution Control Boards, other Govt. departments, and NGOs.

5. EIA Content

31. This EIA report is presented in nine chapters, consistent with the ADB's Safeguard Policy Statement 09. This includes nine chapters following this introduction chapter:

- Chapter 2: Description of Project: This chapter provide in detail the various component of the project

- Chapter 3: Description of Environment (Environmental Profile and Base Line of the project and study area): This provide background information based on primary and secondary information basis the details of Physical, Biological and social and cultural resources of project and study areas.

- Chapter 4: Anticipated Environmental Impacts and Mitigation Measures:

- Chapter 5: Analysis of Alternatives: This covers analysis of various alternatives considered to minimise the overall impacts of proposed development and suggest most appropriate alternatives based of detailed analysis of impact and risk associated with each alternative.

- Chapter 6: Environmental Management Plan and Grievances Redress Mechanism: This chapter provide the details on management aspects with defined roles and responsibilities, and resource requirements for effectively implementation and monitoring of mitigative measures. It also defines the institutional aspects and capacity Building requirements of the project.

- Chapter 7: Information Disclosure, Consultation, and Participation: Covers the details of public consultation carried out with public, NGO, Government bodies at various stage of report preparation. It also covers details of information disclosure and integration of outcome of public consultation in project design.

- Chapter 8: Conclusions and Recommendations: This chapter provide the summary of findings, and concluding remarks on future EIA and EMP requirements

6. Methodology

32. The EIA study was carried out using reconnaissance survey, review of previous studies, field visits, consultation with stakeholders & NGOs, review of existing data and primary data collection.

33. Extensive use of geographic information system is made to analyse the road corridor improvement and bypass areas on the map, analyse the land use, develop the drainage pattern and identify the borrow earth areas. Also it is used to contribute in defining the magnitude of mitigation measures needed to minimise the impacts on land use, landscape, terrestrial ecology and physical cultural resources. Toposheets (scale 1:50,000) procured from Survey of India as available and Google maps were used for the above.

34. The scope of the EIA extends well beyond the vicinity of the proposed alignment. 5 kilometres radius around the alignment is considered as the general impact zone. The immediate 100-meter corridor centred along the proposed corridor was considered as the primary impact zone where most of the adverse impacts are likely to occur. The decision to expand the environmental assessment impact zone to 5-kilometre radius is based on the following considerations: i) to provide a comprehensive environmental baseline information and to ensure that environmental impacts associated with the project are extensively identified and assessed, ii)

to identify appropriate locations for construction camps and other temporary activities (iii) to identify the probable borrow areas and other construction material sources.

35. Alternate analysis was primarily carried out for bypasses since, the proposed development is proposed along existing road alignment and required ROW is mostly available. It was carried out considering physical, biological and socio-economic impacts and technical and financial feasibility.

36. Periodic feedback and interactive approach were followed during the study period. The details including the baseline data presented in the reports pertains to the finalised alignment. The details of various alternatives are discussed under alternatives chapter.

37. The established practices were followed to identify potential impact associated with the proposed project activities. Appropriate tools and techniques were used to identify and predict the magnitude of the impacts. Suitable mitigation measures are suggested based on the intensity of the impacts identified. The Environmental Management and Monitoring plan is also prepared to ensure effective implementation of the mitigation measures proposed.

7. Data Collection

38. The objective of data collection was to provide a database of existing conditions, to be used for predicting the likely changes that are expected and for monitoring such changes. The first step was to undertake a project scoping exercise, identify the parameters to be considered, and outline the activities for collecting data on identified parameters. Sources of data were identified. Relevant available data pertaining to physical, biological, and socio-economic aspects of the environment was collected from various secondary sources supported by primary data collection.

39. Primary data was also collected with focus on sensitive receptors like religious places, schools, hospitals, habitat areas, commercial places, for noise, vibration, water quality, (ground and surface water both), air quality and soil. The air quality data was collected also for PM2.5 as per latest National Ambient Air Quality standards and with focus on urban setting, rural setting, religious places, and at varying distances from the alignment. The primary data was collected between March 2012 and May 2012.

8. Public Consultation

40. Local knowledge about the ecosystem and problems associated with such a linear development including sourcing of construction material and men and road interface were carefully recorded and used in impact assessment and for developing mitigation plans. Consultations were held focusing on air quality, noise and vibration effect, water supply, drainage, aquatic and terrestrial flora and fauna, physical cultural resource of importance, environmental sensitive ecosystems or areas that may be affected by the project. Formal institutional level public consultation and opportunistic informal meetings involving local villagers and those who are likely to be affected due to the proposed projects were organized to determine potential socio-economic impacts. Interactions were also made with various NGOs and concerned government officials. Public consultations were also held with the stakeholders during and after impact assessment. A detailed description of the public consultation has been presented in Chapter 7.

II. PROJECT DESCRIPTION

A. Location and Magnitude of the Project

41. The project proposes improvement of following two exiting road corridors.

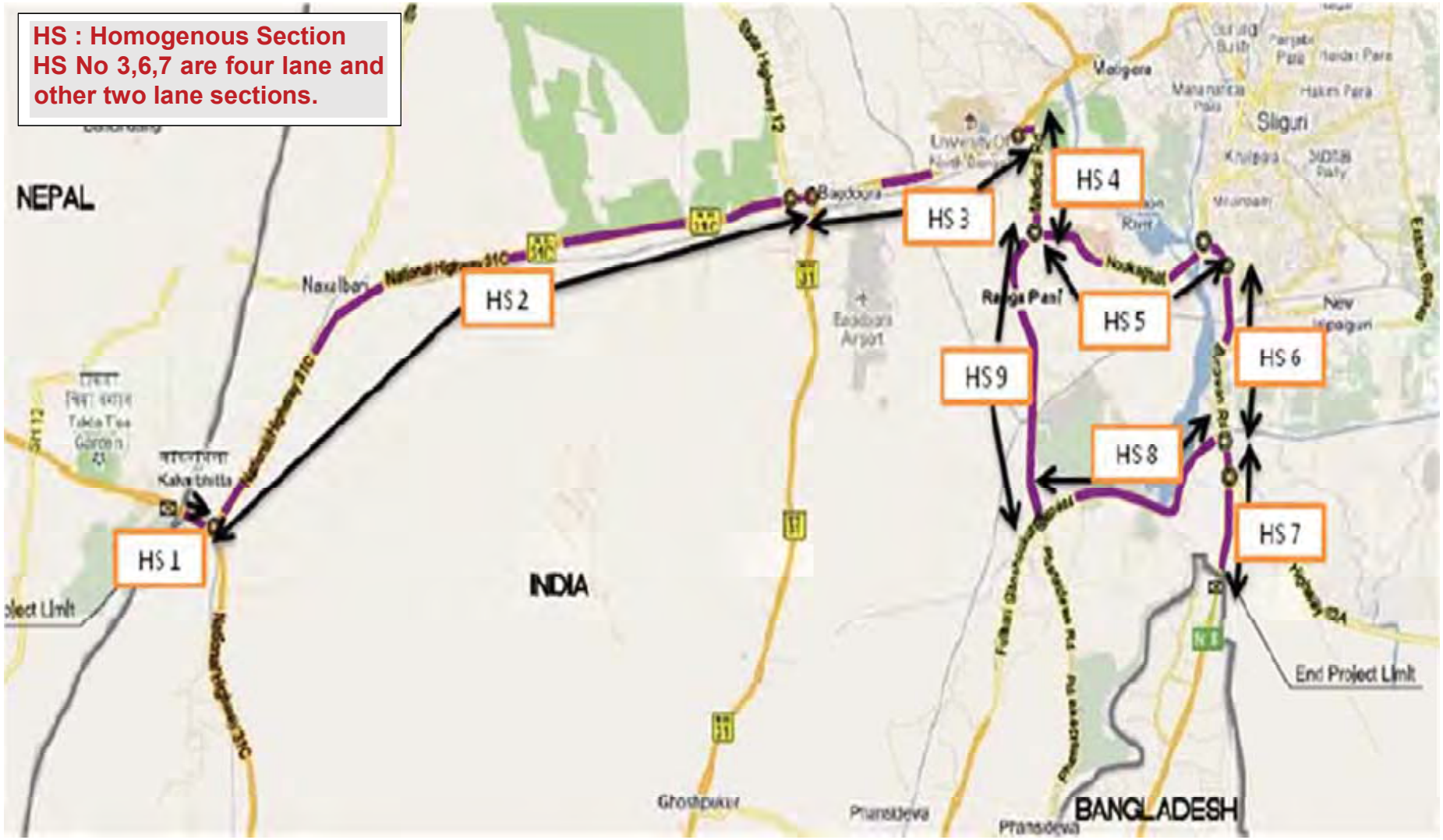
- Road connecting Nepal Border (Kakarbita) to Bangladesh Border (Fulbari Border) which forms part of Asian Highway No AH-2
- Road connecting Bhutan Border (Jaigaon) to Bangladesh border (Chandrabandha Border) which forms part of Asian Highway No AH-48

42. Both the above corridors traverse through north-eastern part of India mostly through rural areas and few urban areas. The total length of Nepal Bangladesh corridor is 48.7 km while Bhutan-Bangladesh corridor is about 115 km including additional corridor of 11.3 Km in AH-2. Both these corridors will be two lane roadways with a number of major at-grade intersections. Four lanes are proposed at two sections in AH-2 with total 6.635 Km length and one section of 17.8 Km length in AH-48 with high projected traffic volumes. Road over bridges and grade separations are proposed at select railroad level crossings, and congested intersections. Land Customs Station (LCS) at Panitanki and Pasakha are also proposed. The road location with road alignments and other project components are shown at **Figure 7** and **Figure 8**.

43. The first 1.2 Km of AH 2 road from Kakarbitta in Nepal border is a state highway and then the project road joins NH 31C at Panitanki and takes north-east direction to reach Naxalbari and proceeds in mostly easterly direction to reach the junction with NH 31 at Bagdogara. This section from Panitanki to Bagdogra is NH31C and has a 2 lane carriageway. The project road continues on NH 31/31 C up to Shivmandir More in easterly direction with a 2 lane blacktopped road. From Shivmandir More, project road turns in a southeast direction along the PWD road taking the Shivmandir More -Medical More- Naukhaghat – Teenbhatti More- Fulbari Junction to reach the Bangladesh border. The existing surfacing is a black topped 2 lane road up to Fulbari junction. The last section, Fulbari Junction to Bangladesh border is about 2 km, which is concrete road.

44. The Project Road (AH48) corridor from Bhutan Border at Phuentsholing to Bangladesh border at Changrabandha comprising of the Phuentsholing – Jaigaon – Hasimara – Dhupguri – Mainaguri - Changrabandha – Burimari (about 115 km) with a proposed Pasakha access road, including one LCS along the Pasakha access road is situated in the North Eastern Part of India. Access to the Site from Siliguri by road is via the NH31 (approximately 58 km). The project road is formed by joining segments of SH12A, NH31D and NH31C. The SH12A segment of the project road starting from Changrabandha at Bangladesh border proceeding in North West direction to reach Maynaguri is under PWRD, Jalpaiguri. The NH31D section of the project road from Maynaguri to Dhupguri is under NHAI and is proposed to be widened to 4-lane configuration as part of the capacity expansion of Ghoshpukur to Falakata corridor. This section is about 19.8km. From Dhupguri, the project road proceeds in North direction to Goyerkata. From Goyerkata, project road proceeds to Birpara in east direction and both sections of the project road are under NH Division 9, PWRD. From Birpara project road proceeds in east direction through NH 31C and then in North direction to Madarihat and then east along NH31C, and then in north-easterly direction to Hasimara along NH31C. Further the project road proceeds north to Jaigaon and Phuentsholing.

Figure 7. : Road Alignment and Lane Configuration of AH-2



Source: DPR Interim Report

Figure 8. Road Alignment and Lane Configuration of AH-48

HS : Homogenous Section
HS No 2 is four lane and other two lane sections.

Source: DPR Interim Report

45. The proposed widening options are finalised with due considerations to engineering aspects like available land, gradient, traffic projections, hydrological aspects, safety considerations, and environmental/social aspects. All efforts are made to improve road within existing ROW.

B. Design Criteria and Salient Features

46. The performance requirement applied to the route and salient features are given in **Table 4**.

Table 4 : Design Criteria and Salient Features

Description	Design Criteria/Features
Cross Section Details for two lane (Typical) (Rural)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 1.5m X 2 Unpaved shoulder : 1.0m X2 Roadway width : 12m ROW[18] : 45 m
Cross Section Details for two lane (Typical) (Village/semi urban)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 2.0m X 2 Unpaved shoulder : 0.5 m X2 Roadway width : 12m ROW : 30 m
Cross Section Details for two lane (Typical) (Urban)	Carriage way : 7m (3.5m X 2) Paved Shoulder : 2.250m X 2 Unpaved shoulder :2.25 m X2 Roadway width : 16m ROW : 30 m
Cross section Details for four lane (Typical)	Carriage way : 14m (7m X 2) Paved Shoulder : 1.5m X 2 Unpaved shoulder : 1.0m X 2 Median : 2 - 4.5m
Design Service Volume (PCU/day) (for Level of Service B as per IRC : 64-1990)	15,000 two Lane with earthen Shoulder 17250 two lane with .1.5 m paved shoulder (Plain Terrain) 40000 four lane with 1.5 m paved shoulder (Plain Terrain)
Design Speed (km/h)	Rural Section : 100-80 Urban Section : 50
Super Elevation	Limited to 7% (Two land Carriageway) Limited to 5% (Four land Divided Carriageway)
Minimum radii of curves (m) in (Plain Terrain)	360m @ 100 km/h design speed 240m @ 80 km/h design speed 150m @ 65 km/h design speed
Vertical Alignment (Max Gradient)	3.3% Plain Terrain 5.0% Rolling
Slide Slopes (hf = height of shoulder edge above the natural ground level) (hc : Height of cut)	hf < 1m : 1:2 1m<hf<3m : 1:1.5 hf>3m :1:1 Above 4m, retaining structures recommended
Pavement Design	As per IRC: 37 – 2001 with the design period of 15 years.

[18] ROW will be restricted to minimum construction width to avoid fresh land acquisition.

Description	Design Criteria/Features
Bridge Design	As per IRC: 78 for foundation and sub structure and IRC SP : 73 for two lane bridge cross section
ROB	3 (level crossings at Panitanki, Naxalbari, Rangapani,) . in AH-2 and 1(Level crossing at Hasimara Bypass) . in AH-48
Elephant Under Pass	3 no in Jaldapara National Park in AH48 at Chainage 85+760, 86+214, 86+953 with span of 5x20m and clear height of 6m. Existing Halang Bridge is also considered as elephant underpass.
Grade Separation	1 in AH-2 at Bagdogra
Intersection Improvement	4 Intersections in AH-2
Land custom stations	1 (Panitanki) in AH-2 And 1 (Pasakha) in AH-48
New Bypass	Panitanki in AH-2 of 1.55 KM,, Hasimara 3.55 KM in AH-48, Pasakha Bypass (6.62 Km)
Bus Bays	28 in AH2 and 44 in AH48
Truck Parking	2 in AH2 and 3 in AH 48
Bridge Reconstruction	1 no. in AH-48
Bridge Widening	All minor bridges 7 in AH 02 and 17 in AH-48

Source: Feasibility Report 2012 and updation through interim DPR report 2013

47. **Existing Traffic**: Both the corridors have mix traffic consisting of fast and slow vehicles. The traffic volume in the Nepal-Bangladesh Corridor is significantly higher, i.e. almost 4 times more than the traffic volume in the Bhutan-Bangladesh Corridor. Cars and Two wheelers (scooters) constitute the majority of the vehicle that ply these routes. In the Nepal-Bangladesh Corridor, cars and scooters form more than 60% of the traffic volume whereas in the Bhutan-Bangladesh Corridor, these vehicle types constitute about 50% of the traffic volume. Truck volumes are higher in the Nepal to Bangladesh Corridor (2,755) compared to the truck volumes in Bhutan-Bangladesh Corridor (1,564). However, in terms of percentage of total daily traffic, the truck percentage in the Bhutan-Bangladesh Corridor (26.1%) is higher compared to the truck percentage in the Nepal-Bangladesh Corridor (13.6%). The percentage of slow vehicles in both corridors is rather small, 9.3% in the Nepal-Bangladesh Corridor, and 15.6% in the Bhutan-Bangladesh Corridor. The Annual Average Daily Traffic (AADT) for individual Segments is given at **Table 5**.

48. **Future Traffic**: Future traffic depends on border traffic and local traffic. Majority of the traffic along this corridor is generated locally in India and supplemented by traffic from the neighbouring countries of Bangladesh, Bhutan and Nepal. The future traffic projections is made based on weighted average growth rate of 4.64% which is arrived at considering the higher traffic of two corridors which is higher in case of Nepal- Bangladesh corridor. The projected traffic of both the corridors is shown at **Table 5**.

Table 5 : Existing and Future Traffic

Section No.	Section	2011 AADT (pcu/day)	2025 AADT (pcu/day)
Nepal to Bangladesh Corridor			
1-1	Local road between Kakarbita and Panitanki	6,200	11,700
1-2	NH 31C between Panitanki and SH-12 More	12,500	23,600

Section No.	Section	2011 AADT (pcu/day)	2025 AADT (pcu/day)
1-3	NH 31C between SH-12 More and Bagdogra	22,700	43,000
1-4	NH 31 between Bagdogra and Shiv Mandir More	34,800	66,500
1-5	Local road between Shiv Mandir More and Medical More	14,500	28,100
1-6	Local road between Medical More and Naukaghat	14,400	17,500
1-7	Local road between Naukaghat and Teen Bhatti More	23,400	34,500
1-8	Local road between Teen Bhatti More and Fulbari Bypass (Truck Terminal)	19,900	27,900
1-9	Local road between Fulbari Bypass (Truck Terminal) and Fulbari Junction	19,700	37,300
1-10	Local road between Fulbari Junction and Bangladesh Border	3,500	6,700
1-11	SH-12 via Rangapani between Medical More and Fulbari Goshpukur bypass junction	10,700	30,000
1-12	Fulbari Goshpukur Bypass between Rangapani and Fulbari (Truck Terminal)	13,100	34,500
Bhutan to Bangladesh Corridor			
2-1	Local road between Pheuntsholing /Jaigaon and Hasimara Old	6,000	11,100
2-2	NH 31C between Hasimara Old and Hasimara Junction	8,100	15,300
2-3	NH 31C between Hasimara Junction and Birpara	8,500	16,100
2-4	NH 31 between Birpara and Telipara	8,900	16,900
2-5	NH 31 between Telipara and Goyerkata	9,600	18,100
2-6	NH 31 between Goyerkata and Dhupguri	9,700	18,300
2-7	NH 31 between Dhupguri and Mainaguri Bypass	15,300	28,900
2-8	SH 12A between Mainaguri Bypass and Indira More (Mainaguri)	6,500	12,200
2-9	SH 12A between Indira More (Mainaguri) and Chandrabandha Bypass	8,300	15,600
2-10	SH 12A between Chandrabandha Bypass and Chandrabandha Junction	5,200	9,700
2-11	SH 12A between Chandrabandha Junction and Truck Terminal Bangladesh Border	1,600	3,000

Source: Feasibility Report 2012

D. Characteristics of Existing Road

49. **Right of way[19] and carriage way width**: The existing carriage way is two lane carriage way with 5.5m to 7m width in poor condition. The width of earthen shoulders varies

[19] As per the feasibility study, the right of way availability assessment was made on estimation basis due to non-availability of field markers at various locations needs to be re-ascertained.

from 0.5 m to 3.0 m. The right of way in general is about 30 to 40m on NH sections. The right of way is available for most of the SH sections as well the road except where four lanes are proposed and for bypass and land custom stations. The available road width is largely about 12 to 25m in many urban sections with considerable encroachments in the form of semi-permanent shops. The minimum formation width is 8m in AH-48 and 7 m in AH-2. The part of the road segment of AH-48 passes through Jaldapara national park area where ROW is confined to existing road formation width only.

50. **Pavement and Carriage way conditions**: The pavements and carriageway in both the road is bad at large number of locations (Figure 9: view of select locations). Mostly cracking exists throughout the road except in few stretches where pavement quality is good. Excessive stripping and potholes can be seen in the roads. Even aggregate base is visible at certain locations. The existing pavement conditions of both the corridors are given at **Table 6**.

Table 6 : Existing Pavement Condition for project corridors

Project Corridor	Aggregate base visible, Top Bituminous layer chipped (Length in km)	Striping, Potholes (length in km)	Good Condition (length in km)
Nepal to Bangladesh	9.0	30.9	8.5
Bhutan to Bangladesh	13.2	48.8	47.5

Source: Feasibility Report 2012

Figure 9. View of existing road conditions at AH-2 and AH-48 locations

Aggregate base layer visible (Bhutan-Bangladesh Corridor at Sta 21+000	Potholes, Cracking, Striping (Nepal-Bangladesh Corridor, Sta 28+000,

Huge Potholes, Striping (Bhutan-Bangladesh Corridor (Dhupguri-Mainaguri) at Sta 89+900,	Good Pavement Condition (Nepal-Bangladesh Corridor (Shiv Mandir-Medical More) at Sta 22+800,

51. Alignment and Geometry: About 70% of horizontal curves in AH-2 and 85% of horizontal curves are of achievable design speed of 80 to 100 Km/h. The substandard curves are mostly in urban sections where a design speed of 50kmph will be applicable and achievable. There are certain acute curves including 900 turn near Hasimara which needs to be improved. The gradient steeper than ruling maximum gradient is not present in the project roads.

52. Cross drainage structure: The Nepal to Bangladesh Corridor has 25 structures constituting of 18 Minor bridges, 4 Major bridges, 1 Road under Bridge (RUB), 1 Road over Bridge (ROB), and 1 Barrage (Mahananda). The Bhutan-Bangladesh Corridor has 47 structures constituting of 36 Minor Bridges, 10 Major Bridges, and 1 Road over Bridge (ROB) (**Table 7**: Summary of Bridge classification)

Table 7 :Summary of Bridge Classification (Nepal-Bangladesh) and (Bhutan – Bangladesh)

S.No.	Bridge Type	Bridge Length (m)							
		>6-10	>10-20	>20-30	>30-40	>40-50	>50-60	>60	Sub total
Nepal – Bangladesh (AH-2)									
1	Minor Bridges(>6-60m)	4	5	2	2	1	4		18
2	Major Bridges (>60m)							4	4
3	RUB						1		1
4	ROB		1						1
5	Barrage							1	1
Total									**25**
Bhutan – Bangladesh (AH-48)									
1	Minor Bridges(> 6-	10	4	9	8	0	5		36
2	Major Bridges(> 60m)							10	10
3	ROB		1						1
Total									**47**

Source: Feasibility Report 2012

53. There are 188 (91 in AH-2 and 97 in AH-48) culverts consisting of pipe, slab or box type culverts along both the project corridors. On an average, one culvert exists per kilometre of the project length. The bridges have poor footpath conditions, deteriorated wearing coat and damaged or missing handrail except the existing Mahananda barrage

(along the existing corridor via Rangapani) which is in good condition (**Figure 10**: View of Bridge and Culverts at certain locations). The detailed inventory of existing bridges and culverts with conditions is given at **Appendix 2.1, 2.2 and 3.1.**

Figure 10. : A View of Select Existing Railway Level Crossing, Bridges and Culverts

Mahananda Barrage along additional corridor via Rangapani (Nepal-Bangladesh, Sta 351+00).	Jaladaka Bridge (Bhutan-Bangladesh Corridor at Sta 77+00, November 20, 2011)
Existing Culvert to be Widened (Nepal-Bangladesh corridor, Sta 24+691)	Partially Clogged Culvert with debris (Bhutan-Bangladesh Corridor, Hasimara-Birpara, Sta 29+950)

54. **Terrain and Land use**: Both the project road alignments traverse through plain terrain. The land use around both the road corridor is largely agricultural. The AH-48 road corridor also passes through Jaldapara National Park area many segments of the project corridors are surrounded by tea gardens, residential and business establishments. About 3km road segment of AH-48 passes through foot of hill at Phuonstilong, though the gradient is very less. The Mainaguri- Chandrabandha section is located in low-lying area and is prone to flood.

55. **Road intersections**: Both the road corridors comprise of no. of major at-grade intersection (**Figure 11**: View of Select Intersections), which are either signalized, non-signalized or round-about. Most of the intersections have three approaches and are congested. AH-2 and AH-48 also passes through railway level crossings. . AH-48 has three railway crossing. Out of this one is ROB and one RUB level type crossing. AH2 has 6 railway crossing. Out this one is RUB and one is ROB type level crossings. AH-48 has 11

major and 56 minor junctions. AH-2 has 9 major and 29 minor junctions. The major intersections would require engineered improvements.

56. **Existing Bus Stops and Truck Lay-bys:** There are many bust stop provided along the road. There are 14 bust stop in the AH-2 and 42 in AH-48. The three truck Lay-bys are provided in AH-48. On AH 2 corridor, there is a truck terminal at Fulbari near the border area which provides of truck parking. Other than this there are no truck lay-bys on AH 2.

Figure 11. View of select existing intersections at AH-2 and AH-48

Intersection at Behar More, Bagdogra (Nepal-Bangladesh at Sta 18+900)

Intersection at Changrabandha Bypass (Bhutan-Bangladesh at Sta 106+720)

Intersection at Medical More (Nepal-Bangladesh at Sta 26+250).

Roundabout at Fulbari Truck Terminal (Nepal-Bangladesh at Sta 35+180)

Existing Railroad crossing at Rangapani (Nepal-Bangladesh, Rangapani corridor at Sta 30+000)

Existing railroad level crossing at Hasimara (Bhutan-Bangladesh at Sta 18+900)

E. Proposed Improvements and Project Activities

57. The proposed roadway improvement will include upgrading the AH-2 and AH-48 roads corridor to National Highway Standards for two lane configuration for most of the road sections and four lane configuration at some sections. The proposed improvement also includes profile improvement, intersection improvement at select locations, rehabilitation and extension of a number of cross drainage structures. The improvement will also include construction of 4.8 km bypass at Pasakha in AH-48. The proposed improvements are detailed in the following sections and are summarised at **Table 8**.

Table 8 : Summary of Proposed Improvements for AH-2 and AH-48

Section	Proposed Improvements				
	CW (2-Lane)	CW (4-Lane)	Shoulders (L/R)		ROB
			- Paved	- Earthen	
Nepal-Bangladesh Corridor (AH-2)					
Kakarbita to SH-12 More	-	-	✓	✓	✓
SH-12 More to Shiv Mandir	-	✓	✓	✓	-
Shiv Mandir to Naukaghat	✓	-	✓	✓	-
Naukaghat More to Fulbari	-	✓	✓	✓	-
Fulbari to Bangladesh	✓	-	✓	✓	-
Fulbari Junction to Bangladesh Border	-	-	✓	✓	-
Corridor Via Rangapani (AH-2)					
Medical More to Intersection of Rangapani Road & Goshpukur Road	✓	-	✓	✓	✓
Intersection of Rangapani Road & Goshpukur Bypass Road to Fulbari Bypass (Truck Terminal)	-	✓	✓	✓	-
Bhutan-Bangladesh Corridor (AH-48)					
Jaigaon / Pheuntsholing to Dhupguri	✓	-	✓	✓	✓
Dhupguri to Mainaguri	-	✓	✓	✓	-
Mainaguri to Chandrabandha	✓	-	✓	✓	-
Bypass					
Panitanki Bypass (AH-48)	✓	-	✓	✓	-
Hasimara Bypass	✓	-	✓	✓	✓
Pasakha Bypass	✓	-	✓	✓	✓

Note: CW: Carriageway, L: Left hand side, R: Right hand side, ROB: Road over Bridge
Source: Feasibility Report 2012 updated with Interim Report DPR 2013

F. Recommended Lane Configurations and Typical Cross-Sections:

58. It is proposed to widen the road to two-lane configuration in most road sections and four lane configuration in certain sections. The recommended lane configuration (Chainage wise) for AH-2 & AH-48 is given in **Table 9** below.

Table 9 : Recommended Lane Configuration for AH-2 and AH-48

Chainage	Section	Lane Configuration/ Improvement proposal	Length (km)
Recommended Lane Configuration for AH-2			
0+000 - 0+640	Mechi Bridge	No improvement	0.640
0+640 – 2+000	Panitanki area and bypass	Four lane required – two lane along the bypass and two lane along existing alignment (no geometric improvement considered along existing alignment to minimize social impact)	1.360
2+000 – 16+900	Panitanki bypass to Near SH 12 More	Two lane configuration (Rural or Village/ semi-Urban cross section provided)	14.900
16+900 - 23+360	Near SH 12 More to Shiv Mandir More	Four lane configuration (with service road for first 2780 m and without service road for remaining length)	6.460
23+360 - 30+450	Shiv Mandir to Naukhaghat More	Two lane configuration (Village/semi-Urban cross section)	7.090
30+450 - 35+100	Naukhaghat More to Fulbari	Four lane configuration (without service road)	4.650
35+100 - 37+100	Fulbari to Bangladesh Border	Two lane configuration (Village/semi-Urban cross section)	2.000
Corridor via Rangapani			
0+000 – 6+000	Medical More to Goshpukur Road Junction	Two lane configuration (Urban or Village/ semi-Urban cross section)	6.000
6+000 – 11+500	Goshpukur Road Junction to Fulbari	Four lanes required because of high truck traffic. However NHAI is developing new 4-lane corridor parallel to this link and therefore only Two lane configuration proposed (Urban or Village/semi-Urban cross section)	5.500
Recommended Lane Configuration for AH-48			
0+000 – 22+600	Changrabandha (Bangladesh border) to NH 31 at Mainaguri	Two lane configuration (Rural or Village/semi-Urban cross section provided)	22.600
22+600 – 36+300	Mainaguri – Dhupguri bypass junction [20] (NHAI section)	Four lane required – This is being implemented by NHAI and not included under this project	13.700
36+300 – 40+300 -65+600 - 89+600	Dhupguri bypass junction - Dhupguri town – Birpara - Hasimara bypass start	Two lane configuration (Rural or Village/semi-Urban or Urban cross section)	53.300 (4.000 + 25.300 + 24.000)

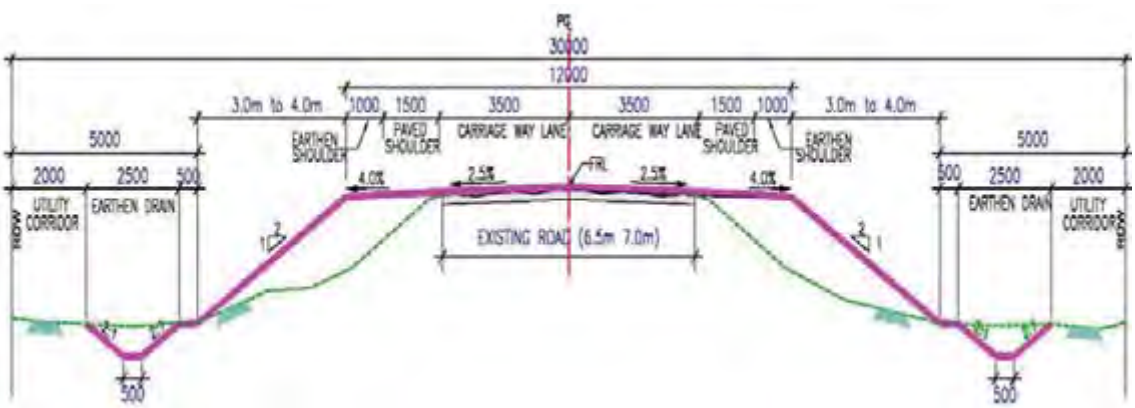
[20] This section falls under NHAI jurisdiction and may developed by them and hence may not be included under this project

Chainage	Section	Lane Configuration/ Improvement proposal	Length (km)
89+600 – 94+400	Hasimara bypass	Two lane configuration (Rural cross section)	4.765
94+400 – 108+800	Hasimara bypass end to Bhutan border along Pasakha Access road	Two lane configuration (Rural or Village/semi-Urban cross section)	14.400
101+500 to Phuentsoling	Pasakha Access road to Phuentsoling along existing alignment	Two lane configuration (Village/semi-Urban and Urban cross section). With Pasakha access road included, it is recommended that this section may be excluded from project	6.600

Source: Interim DPR Report DPR

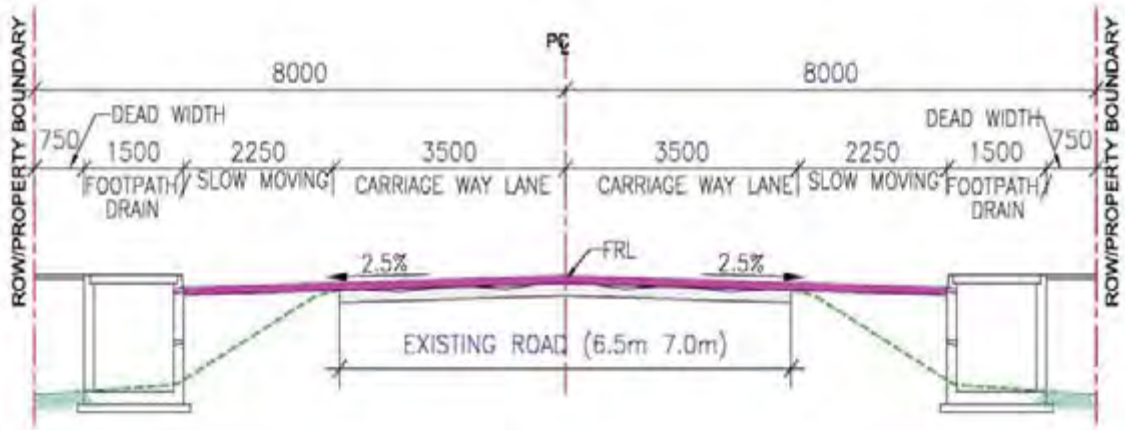
59. Typical roads section and configurations: The typical cross-sections for different scenarios are proposed in line with planned improvements. The certain sections will only require paved shoulder and earthen shoulder improvements. The carriageway will be 7m wide in two lane configuration and 7 X 2m in four lane configuration. The paved shoulder will be 1.5m and earthen shoulder of 1m. The provision of service road on either side of a four lane facility will be provided for about 3.2km length in AH-2. The typical cross sections for different improvement scenarios are shown at **Figure 12** to **15.**

Figure 12. Typical Two Lane Road Cross Section in Rural Area



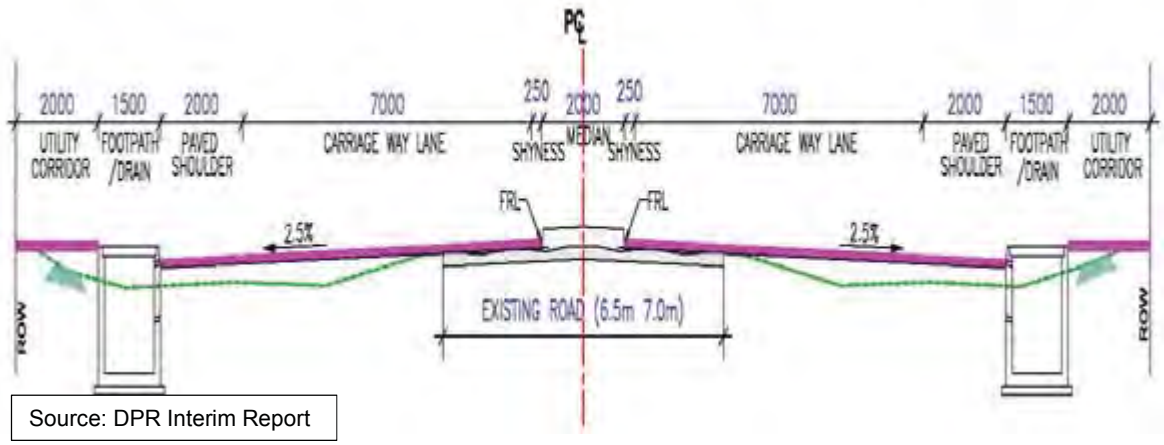
Source: DPR Interim Report

Figure 13. Typical Two Lane Road Cross Section in Urban Area



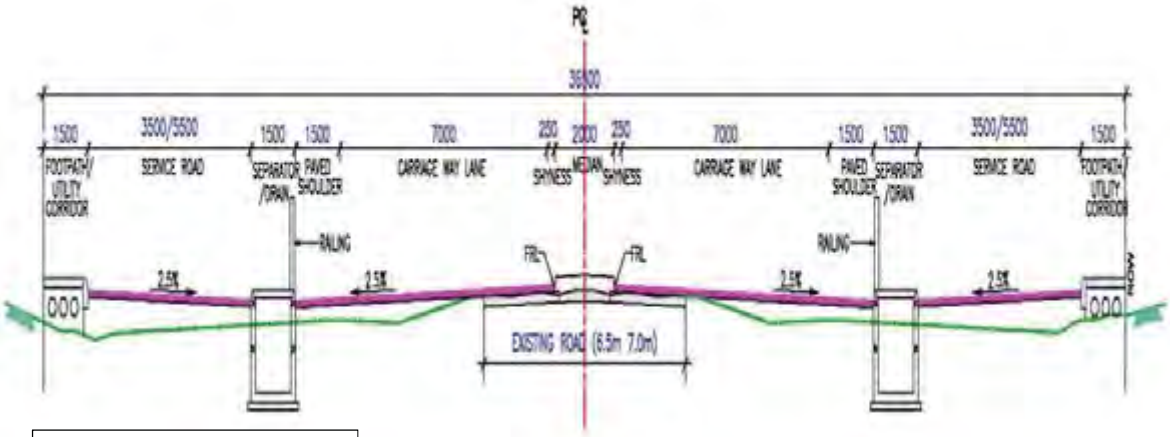
Source: DPR Interim Report

Figure 14. Typical Four Lane Road Cross Section in Rural Area



Source: DPR Interim Report

Figure 15. Typical Four Lane Road Cross Section in Urban Area



Source: DPR Interim Report

G. Geometric Improvements

60. The existing alignment of Nepal Bangladesh corridor requires many of horizontal curves to be improved. However at some locations like the curve on Medical more (Sta 24+200) where land acquisition for ROW is extremely difficult, the existing alignment will be retained.

61. In Bhutan – Bangladesh corridor the horizontal alignment improvements are proposed at four locations (**Table 10**) where horizontal radius of curve will be improved from 112 to 300m to 300 to 800m.

Table 10 : Horizontal Alignment Improvements for Bhutan-Bangladesh Corridor (AH-48)

Chainage	Location	Existing Condition	Proposed Improvements
48+900 to 49+100	Birpara	R = 190 m, 300 m	R = 400 m
51+600 to 51+800	Kali Mandir	R = 160 m	R = 300 m
87+200 to 87+600	Mainaguri	R = 112 m	R = 300 m
109+700 to 110+000	Chandrabandha Junction	R = 120, 200 m	R = 800 m

Note: R - Horizontal radius of curve
Source : Feasibility Report 2012

H. Intersection Improvements

62. To prevent traffic jam, accidents and ensuring smooth movement of increasing traffic, select intersection along both the corridors are proposed to be improved (**Table 11**). The intersection improvements include redesigning, signalisation, or providing grade separation and Road over Bridge (ROB) at railway crossings.

63. In AH-2 Grade Separation is proposed at Bagdogra where heavy traffic from NH-31 intersects NH-31C. Three legged signalised intersections are proposed at Medical More and Fulbari Truck Terminal. The existing roundabout at Fulbari Truck Terminal will also be redesigned to T-intersection with signals. 2 ROB with service roads are proposed at Naxalbari and Rangapani railway level crossings. At other railroad level crossings minor widening of railway, gates and fence is proposed.

64. In AH-48 grade separation is proposed at the intersection of NH-31 with AH-48 at Birpara. The existing intersection at Chandrabandha bypass on SH-12A is proposed to be redesigned..

65. The ROBs are proposed to be provided with intermediate service lanes on either side of the mainline to provide access to the local streets via at grade crossings. To limit additional land acquisition, retaining walls are proposed along the approach roads of each ROB. Typical section of the proposed ROB is shown in **Figure 16.**

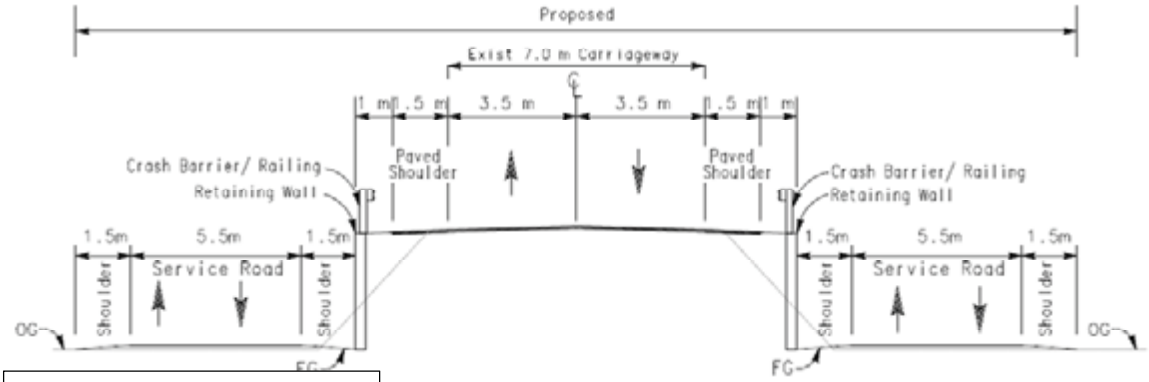
Table 11 : Summary of Intersection Improvements AH-2 and AH-48

Location	Improvement Type
AH-02	
Panitanki (Proposed Bypass Alignment)	Road Over Bridge (ROB
Naxalbari	Road Over Bridge (ROB)
Bagdogra to Shiv Mandir	Interchange with Grade Separation (Flyover)
Medical More	Signalized Intersection

Location	Improvement Type
Fulbari Truck Terminal	Signalized Intersection
Rangapani	ROB Road Over Bridge (ROB
AH-48	
Hasimara (On bypass alignment)	Road Over Bridge (ROB
Birpara	Interchange with Grade Separation
Chandrabandha Bypass	Intersection Redesign

Source: Feasibility Report 2012 and updated with Interim DPR report 2013

Figure 16. : Typical Section for Proposed ROB



Source: Final Feasibility Report

I. Vertical Alignment Improvement

66. About 70% of AH 2 and 46% of AH 48 are having an embankment height of less than 1m (**Table 12**) . If the alignment is passing through expansive clays, the road embankment needs to be raised suitably in addition to meeting the criteria of minimum clearance from HFL of 0.6m for existing subgrade bottom and 1m from new subgrade bottom. Also road embankment may need to be raised to provide adequate clearance above the pipe culverts where needed.

Table 12 : Height of Embankment

Embankment Height (m)	Project Length (%) (AH 48)	Project Length (%) (AH 02)
0 - 1	46	70
1.50	13	9
2 - 3	34	19
3 - 4	4	1
4 - 6	2	1
6 - 12	2	0

Source: Feasibility report 2012 and updated with interim report 2013

67. The Project area received medium to very heavy rainfall. The many major rivers (Mechi, Balason, Mahananda, Torsa, Dudua, Jaladaka, Dharaikari and Jarda) flows through the AH-2 / AH-48 project corridor.

68. Nepal – Bangladesh project road falls within Mahananda river sub-basin. Hence, highest flood level of river Mahananda at 2nd Bridge Hill Cart Road, Siliguri recorded as 117.075m in the year 1958 is considered for designing the vertical alignment improvement in this corridor. The Naxalbari, Naukaghat, Dhupguri and Mainaguri are major flood prone

areas in this corridor. Therefore, the section between Medical More and Naukaghat which is in low lying area and may require raising of the profile.

69. Bhutan –Bangladesh project road falls within Torsa and Jaladakha River Sub Basins. The danger levels for Torsa Gauge station at Hasimara of 116.30 m and for Jaladakha Gauge station at NH -31 crossing of 80.0m considered for designing the vertical alignment improvement in this corridor. This corridor is on high embankment except for the section from Mainaguri to Chandrabandha which is in low lying area and may require raising of profile.

70. As such road may have to be raised where 600 mm, clearance above HFL from bottom of existing subgrade stipulated in IRC SP 73, section 4.2, do, not exist. When raised for reconstruction, the bottom of subgrade will be placed at a minimum, of 1 m height above HFL.

J. Bridge and Culvert Improvement

71. The bridges would be widened to incorporate the proposed roadway improvements. Along the two lane sections, the bridges will be widened on either ends to incorporate the paved shoulders and additional footpath, while the culverts are recommended for extension or reconstruction depending on existing condition. Along the proposed 4-lane sections, the bridges and culverts would be widened to four lanes and at select locations would be widened to incorporate the additional service roads. The bridges adjacent to the proposed ROBs will either be reconstructed or widened accordingly. Also minor repair work is proposed to repair the broken railings and deteriorated footpaths. Improvements may not be needed for bridge over Mechi River on Kakarbita-Panitanki road segment (570 m), since existing Annual Average Daily Traffic (AADT) is significantly lower than the capacity. The existing roadway width on two Teesta Canal Bridges and Mahananda Barrage is 7.5 m in addition to 1.5 m footpath on either side. This width is adequate for a 2-lane highway, plus pedestrian or bi-cycle movements. However, repair work to the footpath and railing for the structures is recommended. There are 7 major bridges, 17 minor bridges, 2 RUB & ROB in AH-2 . Similarly, there are 10 major bridges, 36 minor bridges, 2 RUB & ROB in AH-48

72. Fifty-eight culverts require extension and 14 culverts are recommended for reconstruction. Along the proposed Pasakha Bypass, a new culvert is proposed. The major deficiencies observed in the culverts are blockage of vent ways and missing hand-rails. The **Table 13** and **Table 14** summarises the proposed improvements in bridges and culverts.

Table 13 : Summary of Proposed Improvements for Bridges and Other Structures in AH-2 and AH-48

Type of Structures	AH-02				AH-48			
	Total Structures	Retained	Widening	New/Reconstruction	Total Structures	Retained	Widening/ Deck Replacement	New/Reconstruction
Major Bridges	7	7	-	-	10	10	-	-
Minor Bridges	17	10	7	-	36	17	15+1	2+1
ROB & RUB	2	2	-	-	2	2	-	-
Flyover	0	-	-	1	0	-	-	-
Level Crossings	4	-	-	3	1	-	-	1

Source: Feasibility Report 2012 and updated with Interim DPR report 2013

Table 14 : Summary of Proposed Improvements for Culverts for AH-2 and AH-48

Corridor	Extension	Reconstruction	New	Clear debris	Headwall	Others
Nepal-Bangladesh (AH-2)	59	15	-	6	0	7
Bhutan-Bangladesh (AH-48)	58	14	1	9	2	13

Source: Feasibility Report 2012

K. Road Safety Barriers

73. Where appropriate as per guidelines, provision will be made to construct safety barriers using steel guardrails made of steel beam as per IRC 103 with strong post. Following modified criteria is recommended in addition to provisions of IRC SP 73 as per international standards. For roads where cars travel in excess of 50 km/h following safety features will be adopted :

- Sections with embankment height >2 metre on sharp curve where the side slope is steeper than 1 in 2 if any;
- Where there is a risk that vehicles could fall into a body of water deeper than 1 m or onto a rail track;
- Safety barriers recommended to be installed on bridge approaches at least for 50m on approaching side and 30m on the leaving sides on both ends.
- Safety barriers are recommended in all rail crossings for 50m length on either side.

L. Relevant associated components

1. Land Custom Stations (LCS)

74. As a part of the cross-border improvement, new Land Custom Stations is proposed at Panitanki in AH-2 (**Figure 17**) and along the Pasakha Bypass in AH-48 (**Figure 18**). The required land for LCS at Panitanki has already been procured. However, land for LCS at Pasakha bypass is yet to be acquired.

Figure 17. : Procured Land Site for Proposed LCS at Panitanki (Nepal-Bangladesh corridor Sta 1+000, near existing Sashastra Seema Bal (SSB) camp)

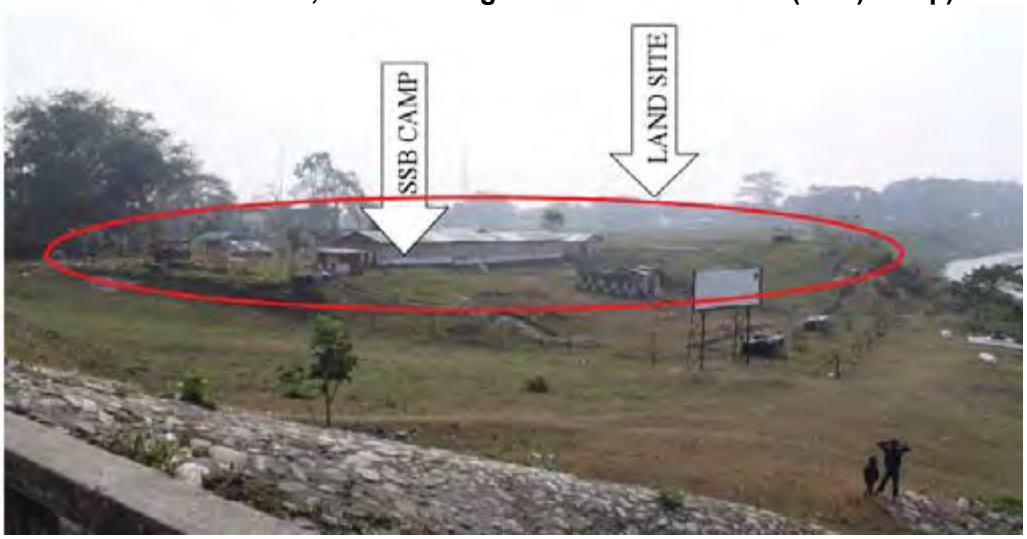


Figure 18. Land Site for Proposed LCS at Pasakha Bypass (Bhutan-Bangladesh corridor, Sta 10+300) Note SW: South-West

75. Each of the LCS would have required facilities. The likely salient features of these terminals are given below:

- The inland clearance depot (ICD) shall be capable to cope with the traffic flow of 2025.
- Separate access land for commercial trucks / containers /bus/car/van and non-mechanized conveyance for entry and exit to the drive port to facilitate speedy clearance without congestion.
- Open yard/area exclusively design as land port inclusive of container parking lot with concrete floor or bricks for accommodating upto 40 to 50 containers. The pavements shall be strong enough to tolerate the load bearing capacity of loaded container of upto 40 ft. TEUs.
- Provision of bituminous pavement parking for 100 to 150 ordinary trucks
- Provision for administrative building and immigration offices
- Covered container freight stations with 1.2m high level platforms for easy unloading from the container directly to the platform.
- Examination and inspection shade for goods (elevated minimum 1m high).
- Provision of warehouse and secured lock past room for cargo under litigations
- Ancillary facilities like electric sub-stations, backup power, water storage, drainage, fire-fighting, banks, money exchange, canteen, business centres, minor vehicle repair service centre.

L. Construction Material and Sources

76. The details of the material to be used for construction and its sources are yet to be finalized by the design team. However, as per the discussion with the EA and other officials, the material like stone aggregate, sand in general are obtained from licence mines of bed material of the river running in the project area. The stone aggregates are also obtained from approved quarries in the nearby areas. The borrow earth requirement of about 2,50,000 CUM borrow earth quantity for embankment and 3,50,000 CUM sub grade,

approximately same[22] for each road will be sourced from nearby fields. Tentatively 9 borrow areas in AH-2 and 25 borrow area in AH-48 are identified by DPR team located at short distance from the road alignment. These locations will be finalised after testing and analysis. The aggregate about 1.21 Mn tones for AH-2 and about 1.27 Mn Tons for AH-48 will be sourced from Pakur Quarry located within the state of West Bengal. .

77. The water is generally sourced from the ground or surface water bodies with due permission from concerned authorities. As per Central Ground Water Authority, the project corridor area does not fall in the water stressed area.

M. Relocation of Utilities and Land Acquisition

78. The various utilities mostly water pipes and telecommunication cables which are largely located in urban areas may require shifting at various locations. However the details of utility to be shifted shall be finalized at DPR stage.

79. The land acquisition involved for widening the road largely for two-lanes to four-lanes, Pasakha bypass and LCS. Total of 12 Ha (9 Ha government land and 3 ha private land) for AH-2 and 55 Ha (35 HA government land and 20 Ha private land) for AH-48 is required for the project.

N. Cost Estimate

80. The estimated cost for both the project corridor is estimated (2012 and feasibility stage estimate) as INR 9,007.0 Million equal to about USD 155.3 Million. The cost for each project corridor is as given below:

- Nepal to Bangladesh Corridor – INR 3,833.1 Million (USD 66.1 Million)
- Bhutan to Bangladesh Corridor – INR 5, 173.9 Million (USD 89.2 Million)

O. Proposed Implementation Schedule

81. The implementation period of 3 years is anticipated for completion of improvement work of both the corridor which is subjected to finance arrangement, land acquisition and necessary clearance from Ministry of Environment and Forests, Government of India.

P. Strip Maps

82. Environmental Strip maps are prepared to provide pictorial view of Environmental features along both the project road corridor. These are given at **Appendix 5.1** and **6.1.**

[22] As per estimate received from DPR team

III. DESCRIPTION OF THE ENVIRONMENT

A. General

83. The main purpose of the environmental baseline study is to assess the original status of the environment in the area before the commencement of the development work/project. This study particularly covers important environmental aspects and provides base reference against which the changes due to the implementation of the project are measured. Selective components of the environment are provided with statistical valid descriptions prior to the onset of the project under consideration.

84. As an outcome of the study, background information on environmental, physical and social setting which are likely to be affected for a proposed developmental project are achieved through the collation of existing data or acquisition of new data through field studies or by other means.

85. West Bengal is the only State in India, which extends from the snowy peaks Himalayan ranges in the North to the Bay of Bengal in the South. The state shows significant diversity in terms of environmental settings and agro climatic zone profile of the area. The state distinctly exhibits diverse ecosystems, geology and physiography.

86. North Bengal comprises of the districts namely Jalpaiguri, Darjeeling, Dinajpur and Cooch Behar that lies at the foothill of the great Himalayas. The area covers moist and dense riverine forests of the Bengal Dooars (Duars) and the stark foothills of the snow-capped Kanchenjunga range. Bhutan and Nepal are two beautiful countries having an easy access from North Bengal. The Proposed project corridors of AH-2 and AH-48 passes through North Bengal. Hence, environmental aspects of these areas are studies more from environmental setting.

B. Baseline Environmental Conditions

87. The natural environment, comprises of physical (air, water, soil, noise and climate), biological, which comprises of ecological units (floral and faunal) that function as natural systems and socio-economic scenario. The natural environment is sensitive to even the minute activities carried out by humans unless it is kept under a certain limited level. Thus, it is imperative to study the existing environmental conditions not only to establish the present physical, biological and socio-economic scenario but also in order to predict future impacts owing to construction and operation of the project. The baselines has been studies based on secondary and primary data collection and analysis. The summary of key environmental features are summarised at **Table 15** for ready reference.

Table 15 : Summary of Environmental Features

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m core zone	Within 5 km buffer zone	Within 100 m core zone	Within 5 km buffer zone
1	Ecological				
	a. Presence of Wildlife Sanctuary/ National Park	None, however movement of wild life is noticed near tea gardens, Naxalbari	None, however movement of wild life is noticed	Jaldapara National Park	Jaldapara National Park and Buxa Tiger Reserve

S. No.	Environmental Features	AH-2		AH-48	
		Within 100 m core zone	**Within 5 km buffer zone**	**Within 100 m core zone**	**Within 5 km buffer zone**
	b. Reserved Forests	Yes	Yes	Yes	Yes
	c. Wetland	None	None	None	None
	d. Migratory route for wild animals	None, in Tree garden near Naxalbari	None	Yes in Jaldapara National park	Yes in Jaldapara National park
	e. Migratory routes for birds	None	None	None	None
	f. Migratory routes for fishes	None	None	None	None
	g. Presence of schedule 1 animal including rivers	None	None	Yes in the Jaldapara National Park	Yes in Jaldapara x
	h. Tree cover	Yes good amount of tree cover along the road	Yes good amount of tree and tea gardens	Yes good amount of tree cover along the road	Yes good amount of tree and tea gardens
	i. Aquatic Sensitivity	None	None	None	None
	j. Birds Nesting	None	None	None	None
2	Archaeological Monuments	None	None	None	None
3	Water Bodies	- Rivers , Manza, Changa, Decomani, Tepu, Hali, Laskar,	Mechi Teesta	Torsha, Halang, Mujnai, Birpara, Dimdima, Jaldhoka,	Raidak
4	Groundwater	In Safe Zone as per Central Ground Water Board	In Safe Zone as per Central Ground Water Board	In Safe Zone as per Central Ground Water Board	In Safe Zone as per Central Ground Water Board
5	Land-use	Agricultural fallow land, Dense vegetation cover	Agricultural fallow land, Dense vegetation cover, Tea gardens	Agricultural fallow land, Dense vegetation cover, Forests	Agricultural fallow land, Dense vegetation cover, Forests, Tea gardens
6	Physically sensitive receptors	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)	Yes (Temples, Schools, Hospitals)
7	Social	Urban Rural Settings	Urban Rural Settings	Urban Rural Settings	Urban Rural Settings

C. Physical Environment

1. Climate Profile

88. The northern region of Bengal, which lies between West Bengal, Bangladesh Nepal and Bhutan, experiences a varied climatic condition throughout the year. In general the weather of this region particularly is reported to vary from sub-humid to pre-humid. The region is close to tropic of cancer which could be a contributory factor to its higher temperature range in the study zone. Inspite of its position in equatorial zone, the Himalayan Mountains in the north, Bay of Bengal in south, and extensive network of rivers, and canals in its surroundings do not allow extreme climatic conditions to prevail in the state. The regional weather station of Northern Indian metrological department observes and records weather in the project region and its surrounding areas. The climatic conditions are collected from IMD and other sources for last many years and available recent years and are provided in following sections. Since AH-2 and AH-48 project roads traverse primarily through Darjeeling, Jalpaiguri[23] and Cooch Behar districts, climatic details have been provided focusing on these two districts.

89. **Temperature :** In the Northern part of the state that includes the mountain region (Himalayas), temperature range from freezing point to 10°C in winter. January is the coldest month and winter starts from the end of November and extends to February. Darjeeling has a normal mean temperature ranging from 5.8°C to 17.0°C where snowfall also occurs occasionally. A temperature dip in the Darjeeling district of the study zone was recorded in the year 1905 to as low as −5 °C which could be attributed to cold winds that blow from Himalayas towards this zone. Whereas average maximum temperature of the region range from 14.8 to 35.9°C. The summer season begins from the month of March and temperature starts rising up to June. May is the hottest month. The summer temperature shows variation from 20°C in Darjeeling district to about 30°C or above in Jalpaiguri district. The mean temperature of 1901 to 2000 is summarized at **Table 16** and monthly annual temperature between 2006 to 2010 is shown at **Figure 19.**

Table 16 : Monthly mean temperature and mean rainfall based upon 1901-2000 data

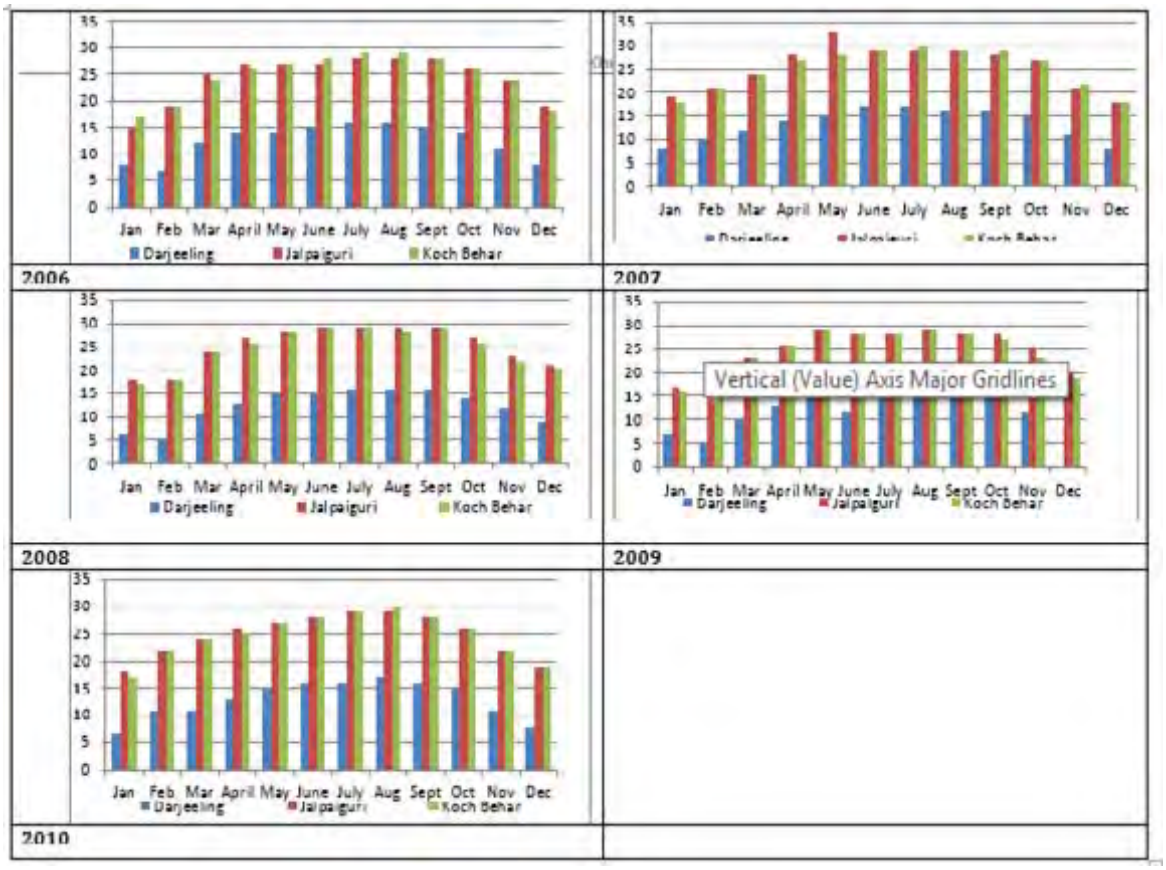
District/Month	Period	Mean Temperature °C	Mean Rainfall in mm
Cooch Behar District			
January	1901-2000	23.7	9.6
February	1901-2000	25.8	11.6
March	1901-2000	29.9	15.8
April	1901-2000	31.7	20.1
May	1901-2000	31.0	22.2
June	1901-2000	31.1	24.1
July	1901-2000	31.3	24.9
August	1901-2000	31.6	25.1
September	1901-2000	31.3	24.3
October	1901-2000	30.5	21.2
November	1901-2000	28.1	15.4
December	1901-2000	25.2	11.2
Darjeeling /Jalpaiguri District			
January	1901-2000	9.4	1.8
February	1901-2000	10.4	2.9
March	1901-2000	14.4	6.3
April	1901-2000	17.4	9.4

[23] Jalpaiguri distric was part of Darjeling district in the past.

District/Month	Period	Mean Temperature °C	Mean Rainfall in mm
May	1901-2000	18.5	11.5
June	1901-2000	19.3	13.6
July	1901-2000	19.4	14.3
August	1901-2000	19.6	14.2
September	1901-2000	19.2	13.3
October	1901-2000	18.0	10.3
November	1901-2000	14.7	6.3
December	**1901-2000**	**11.5**	**3.3**

Source: Indian Metrological Department

Figure 19. : Climate Map of Project Road Districts



90. **Rainfall & Humidity:** In the rainy months of the monsoon season, the air is generally very dump and the relative humidity ranges between 80 and 90 per cent over a greater part of the State. The annual rainfall is generally >900 mm at the foothill region on the north which reaches to 4000 mm along the south facing slopes of the Himalayas in Darjeeling . The maximum average annual rainfall in the state during 2009-2010 is about 1,100 mm with Darjeeling showing higher rainfall followed by Jalpaiguri and Koch Behar. A gradual increase is noticed from June to July which is followed by a decreasing trend with the offset of the monsoon season. The annual humidity of the project area is observed to be above 50% throughout the year during 1961-1990. The humidity range for Darjeeling district is higher comparatively than Koch Behar and Jalpaiguri which remains above 80% from May to Oct. This could be mainly due to presence of mountains, hills, falls and forest cover within and around the vicinity of the study zone. The annual rain fall in project road districts 0f the

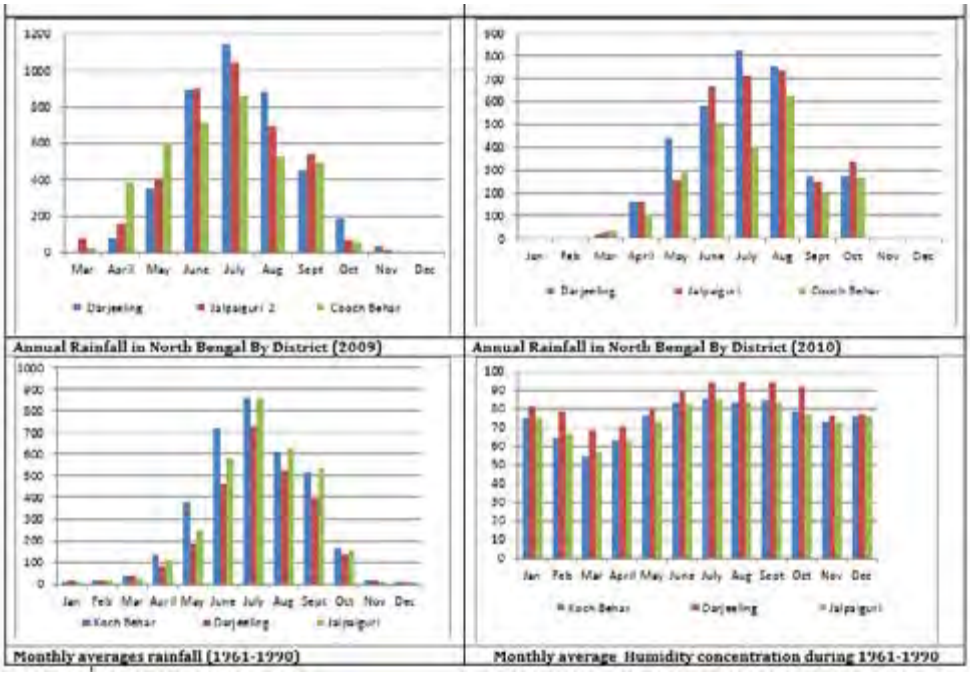
year 2010 and mean humidity between 1991 to 2010 is given at **Table 17.** Graphic representation is given at **Figure 20.**

Table 17 : Annual Rainfall in West Bengal by District as seen in 2010

District	Annual Rainfall in West Bengal by District during year 2010 (in mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Darjeeling				72	355	896	1142	876	456	188	33	
Jalpaiguri		2	74	159	396	900	1044	688	539	70	10	
Cooch Behar			30	385	600	711	863	525	496	61	2	

(Source: Bureau of Applied Economics and Statistics, W.B.)

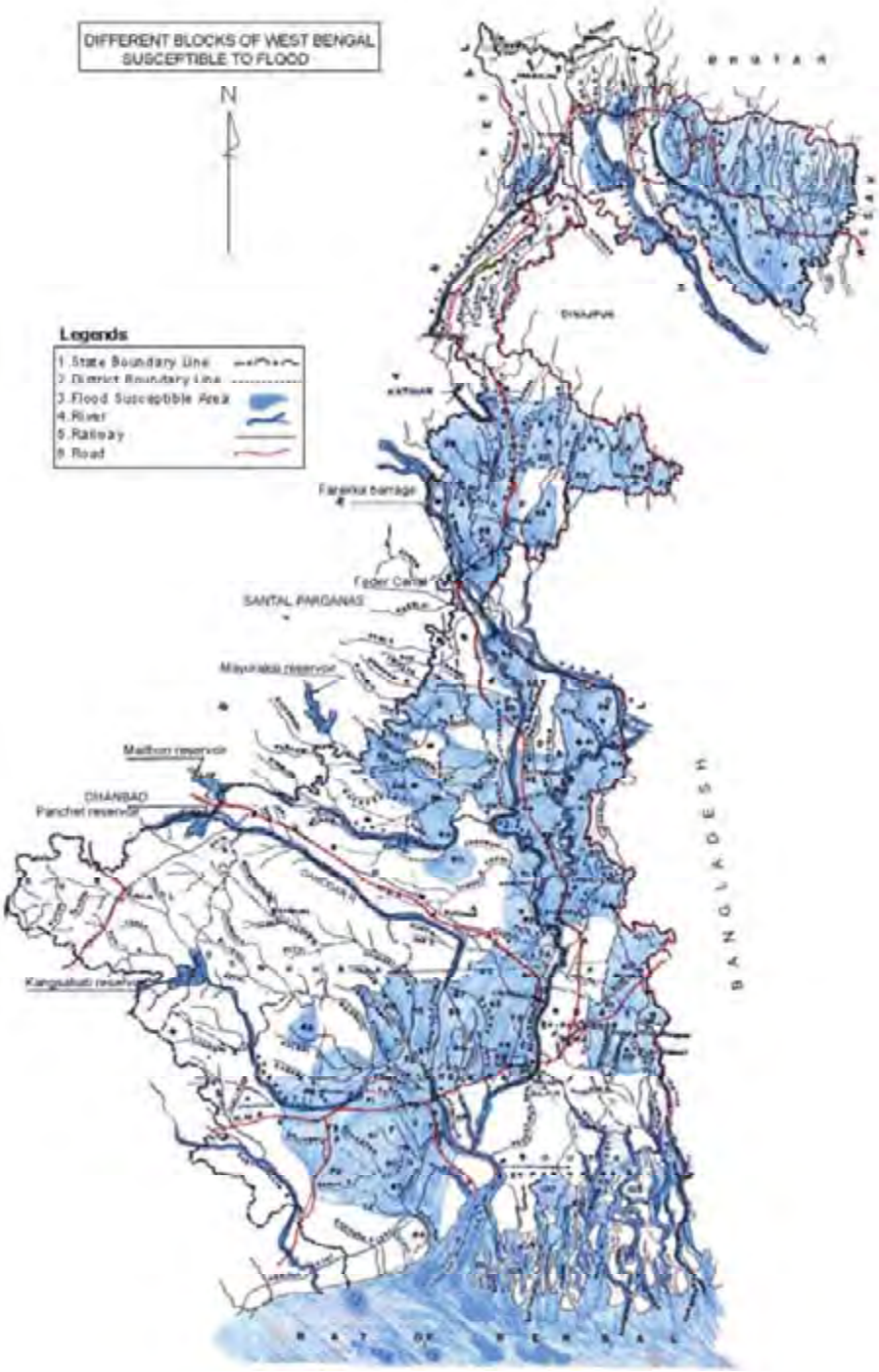
Figure 20. : Annual Rainfall and Humidity Levels in Project Road Districts



Source: IMD Data

91. **Flood :** State of West Bengal has a flood prone area of 2.65 million hectares. The major rivers flowing through the project corridor are Mechi, Balason, Mahananda, Torsa, Jaldhoka, Dharaikari and Jardha. These rivers emanate from the Himalayas, gathering both surface runoffs and subsurface flows as they traverse North Bengal before merging with the Ganga or entering Bangladesh. During the lean period these rivers are fed by molten water from the Himalayas. The advent of Monsoon from June to August initiates a tremendous increase in their discharge volume, causing most rivers to swell overflowing their banks. Naxalbari, Naukaghat, Dhupguri and Mainaguri are major flood prone areas along the project corridor. Flood susceptible areas for the State of West Bengal are shown in **Figure 21**.

Figure 21. : Flood Susceptible Area for State of West Bengal

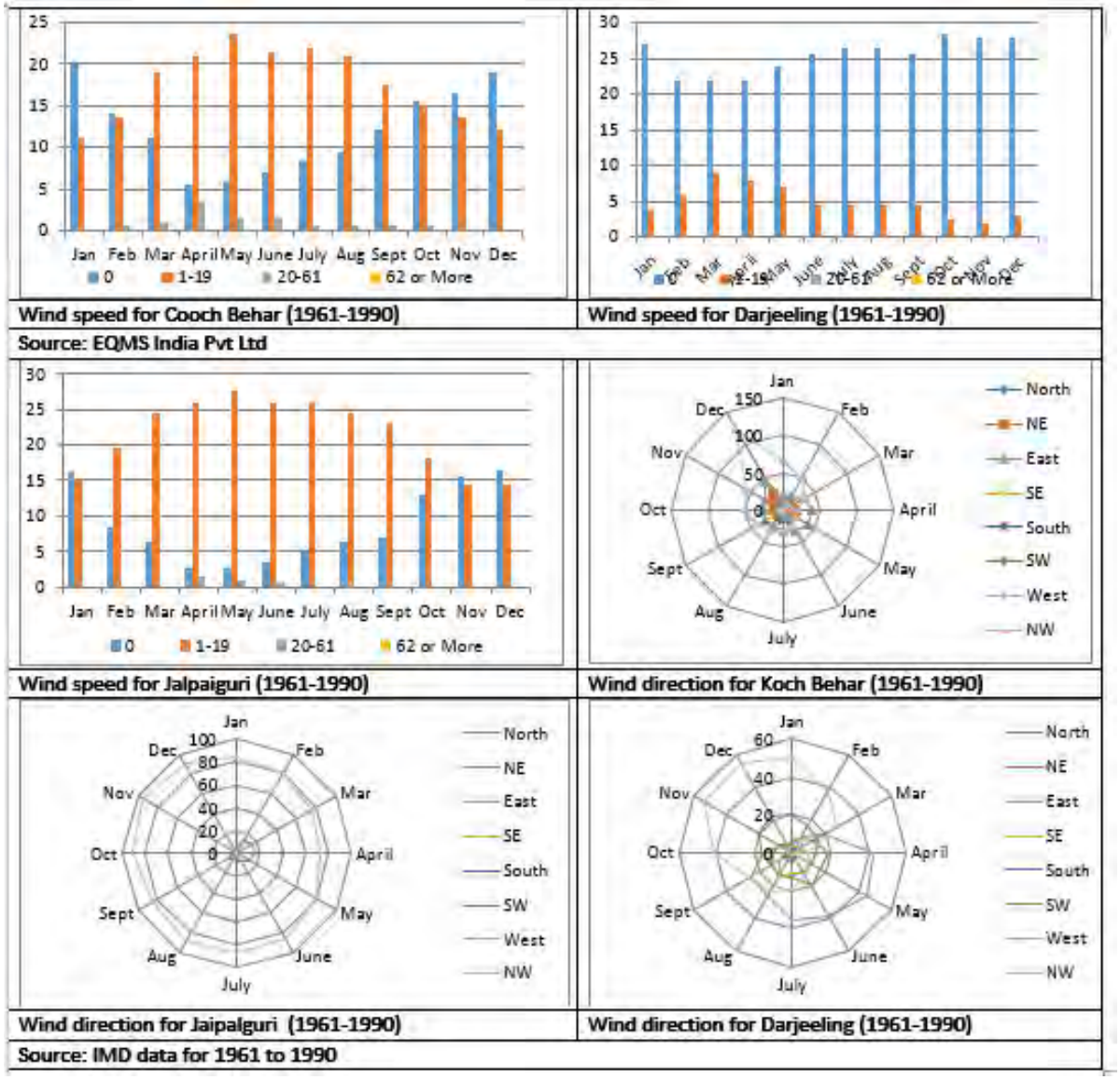


(Source: Irrigation & Waterways Dept. Govt. Of West Bengal, www.wbiwd.gov.in)

92. **Wind Speed and direction:** As per the Climatological data available for the duration 1961-1980 the monthly mean speed varies from 1-19 km/Hr to 23 km/Hr in Koch Behar, 0-7 Km/Hr in Darjeeling, 11-25 Km/Hr in Jalpaiguri. High wind speeds are recorded from March to September in Koch Behar and Jalpaiguri districts whereas the wind speed remains low for Darjeeling district almost throughout the year. The annual pattern for wind speed and wind direction has been represented in the **Figure 22**. It can be seen from the graphs that the

predominant wind direction for Cooch Behar was East, North-East and South-East. Whereas the predominant wind directions for Darjeeling are South-West, and for Jalpaiguri are East.

Figure 22. : Wind Speed and Direction of Project District Roads.



Wind speed for Cooch Behar (1961-1990) | Wind speed for Darjeeling (1961-1990)

Source: EQMS India Pvt Ltd

Wind speed for Jalpaiguri (1961-1990) | Wind direction for Koch Behar (1961-1990)

Wind direction for Jaipalguri (1961-1990) | Wind direction for Darjeeling (1961-1990)

Source: IMD data for 1961 to 1990

93. **Topography:** The Entire project area has plain topography. The topographic analysis was carried out through contour analysis and Digital elevation Model approaches. The Contour Map and DEM[24] maps of the both the project corridor is shown at **Figure 23** to **26**. The elevation difference between the entire AH-2 corridor project area is 110MSL to 160 MSL and in AH-48 is 72MSL to 220MSL.

[24] A digital elevation model is a digital model or 3D representation of a terrain's surface — commonly for a planet (including Earth), moon, or asteroid — created from terrain elevation data. For the relief study of the area SRTM DEM is used which has a resolution of 90 meters The Shuttle Radar Topography Mission (SRTM) is a joint project between NASA and NGA (National Geospatial Intelligence Agency). After downloading the DEMs the farther processing is done using the ARC GIS 9.3 version. For Contour mapping following steps has been used 3 D Analyst -Surface analysis – Contour option.10 Meters contour interval is taken for 2 km Radius area.

Figure 23. : Contour map for the proposed alignment AH-2

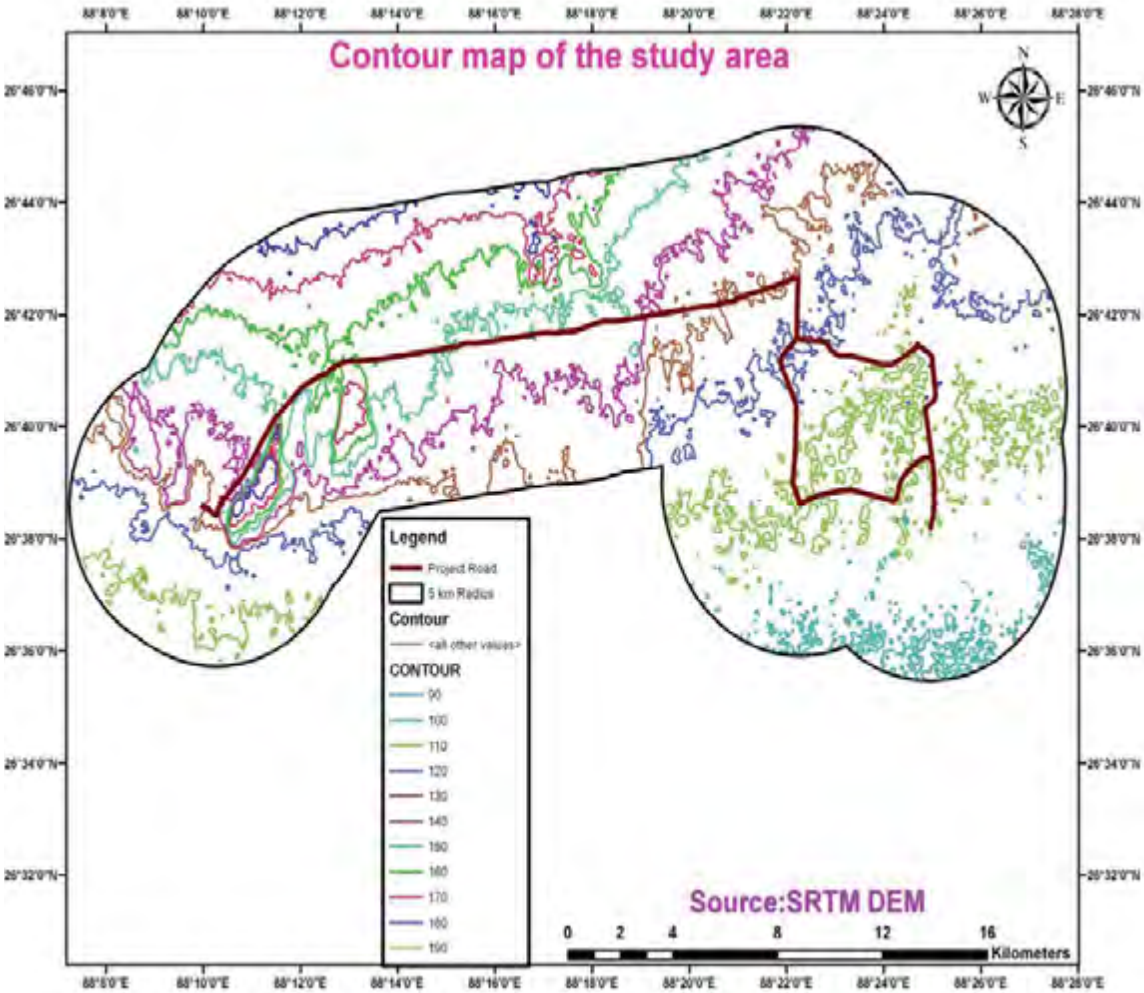


Figure 24. : Digital elevation map proposed for Alignment AH-2

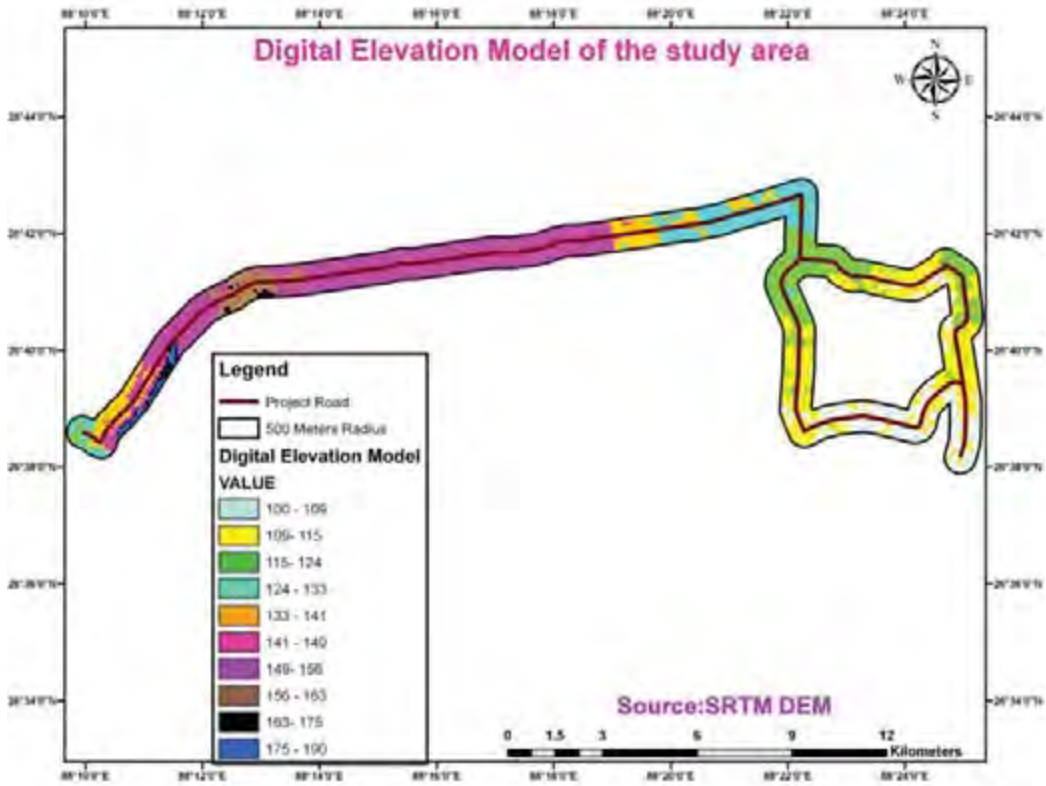


Figure 25. : Dgital elevation model for Proposed alignment AH-48

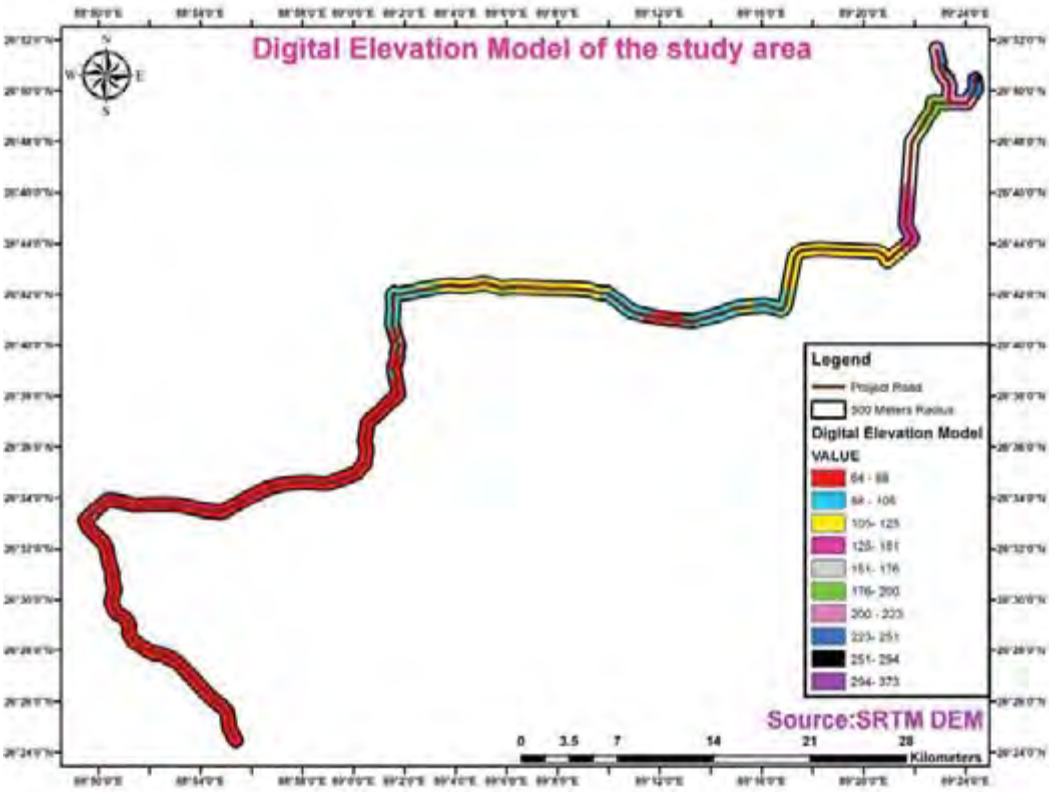
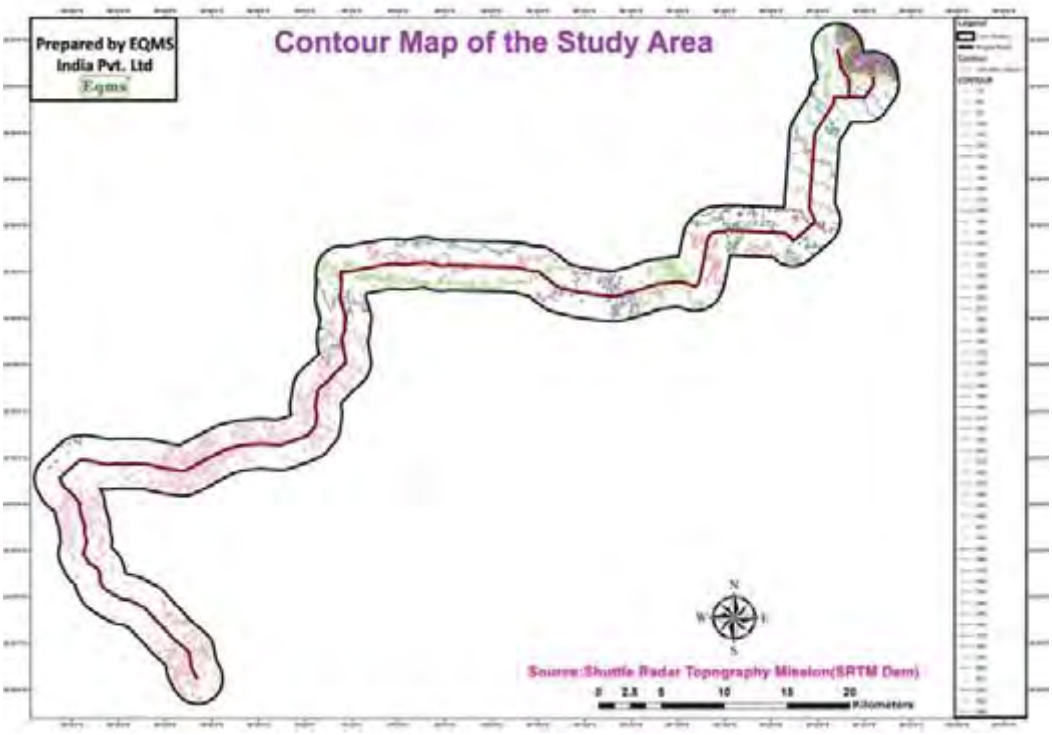


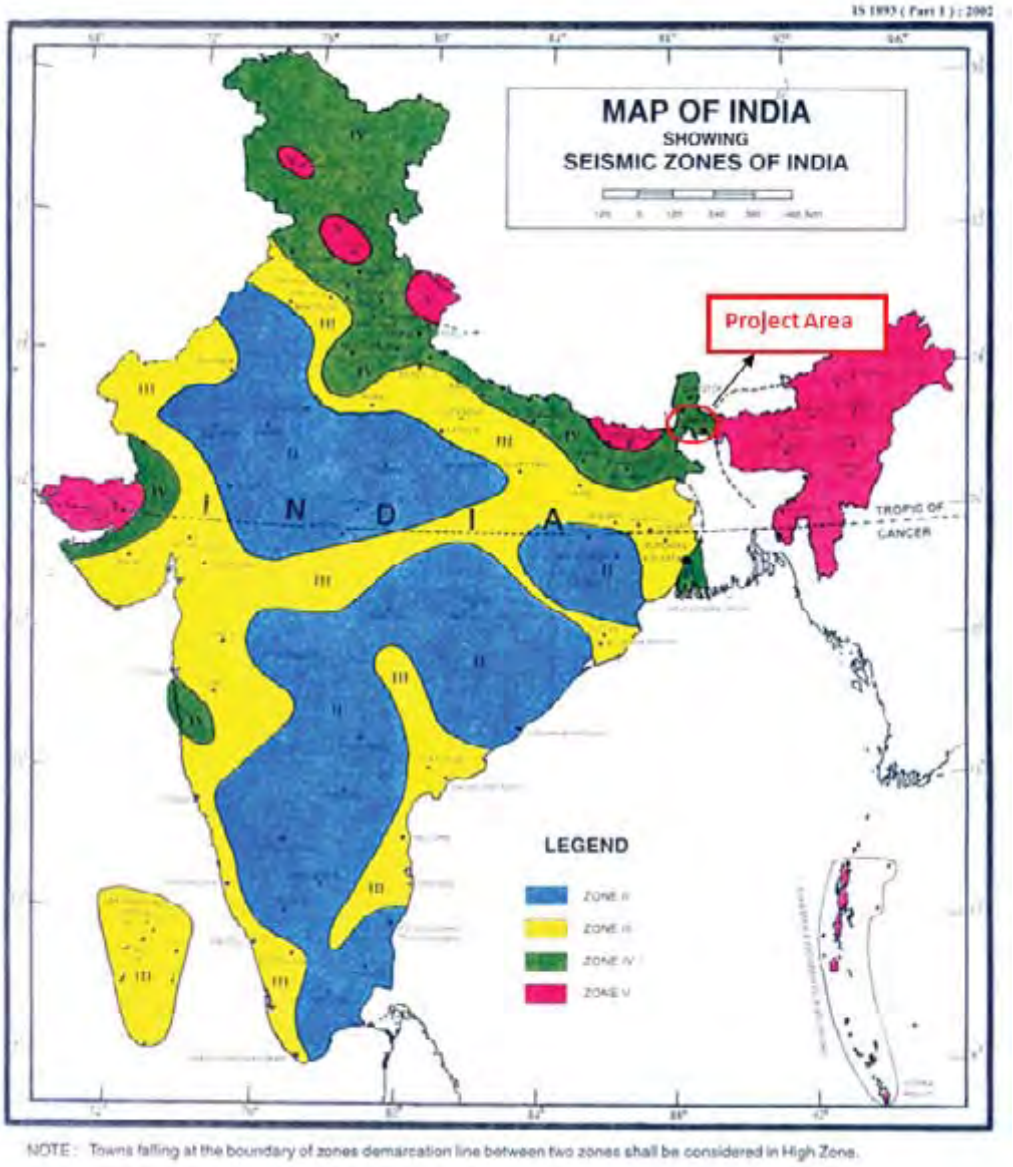
Figure 26. : Contour Map for the proposed alignment AH-48



94. **Geology:** The State of West Bengal consists of 19 districts and 340 blocks and ranges from Himalayan region in north to Bay of Bengal in south. The total coverage area of the state is 88,752 Sq km and the entire area falls under major river basins. Out of this total area, 73,858 sq.km. is occupied by the unconsolidated sedimentary deposits of the Quaternary period. Hard rocks ranging in age from the Precambrian to the Tertiary periods, which are decidedly older than the sedimentary formations forms the remaining area.

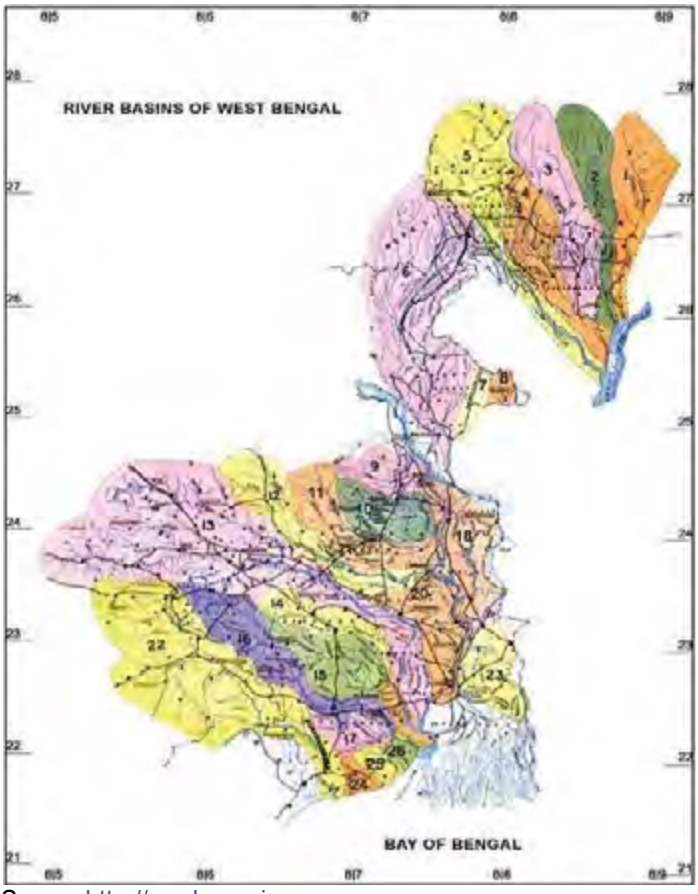
95. **Seismicity :** As per the Seismic Zonal Map of India, all the 3 Districts Darjeeling, Jalpaiguri and Cooch Behar to which road is traversing are located in Zone IV as shown in below **Figure 27**. This zone is categorized as high damaged risk zone.

Figure 27. : Seismic Zone of India



96. **Hydrology and Drainage :** Hydrology: West Bengal is a land of rivers. Some of these are the tributaries and the others are the distributaries. By such connectivity, the rivers of West Bengal can be said to constitute three major river systems, namely, the Ganges, the Brahmaputra and the Subarnarekha. The river basin of west Bengal is shown at **Figure 28**. The road corridor AH_2 and AH-48 primarily falls under Torsha, Jaldhaka, Teesta river basin.

Figure 28. : River Basins of West Bengal



*Source:*http://cgwb.gov.in

Name of sub Basin

1. Sankosh River Basin
2. Raidak River Sub Basin
3. Torsha River Sub Basin
4. Jaldhaka River Sub Basin
5. Teesta River Sub Basin
6. Mahananda River Sub Basin
7. Punarbhaba River Sub Basin
8. Atrai River Sub Basin
9. Pagla Bansloi Sub Basin
10. Brahmani-Dwarka Sub Basin
11. Mayurakshi River Sub Basin
12. Ajoy River Sub Basin
13. Damodar River Sub Basin
14. Darakeswar River Sub Basin
15. Silabati River Sub Basin
16. Kangsabati River Sub Basin
17. Kaliaghai River Sub Basin
18. Jalangi River Sub Basin
19. Churni River Sub Basin
20. Bhagirathi-HooghlySub Basin
21. Rupnarayan River Sub Basin
22. Subarnarekha River Basin
23. 24 Parganas & Calcutta Part Drainage Basin
24. Pichabhange Drainage Basin
25. Rasulpur Drainage Basin
26. Haldi Drainage Basin

97. **Drainage Pattern:** A drainage basin is the topographic region from which a stream receives runoff, through flow, and groundwater flow. The drainage pattern of the study area is Dendritic[25] . Drainage Pattern of both the project area is shown at **Figure 29** and **30**.

[25] Dendritic drainage systems (from Greek δενδρίτης, dendrites, "of or pertaining to a tree") are the most common form of drainage system. In a dendritic system, there are many contributing streams (analogous to the twigs of a tree), which are then joined together into the tributaries of the main river (the branches and the trunk of the tree, respectively). They develop where the river channel follows the slope of the terrain. Dendritic systems form in V-shaped valleys; as a result, the rock types must be impervious and non-porous

Figure 29. Drainage Pattern Map of AH-2

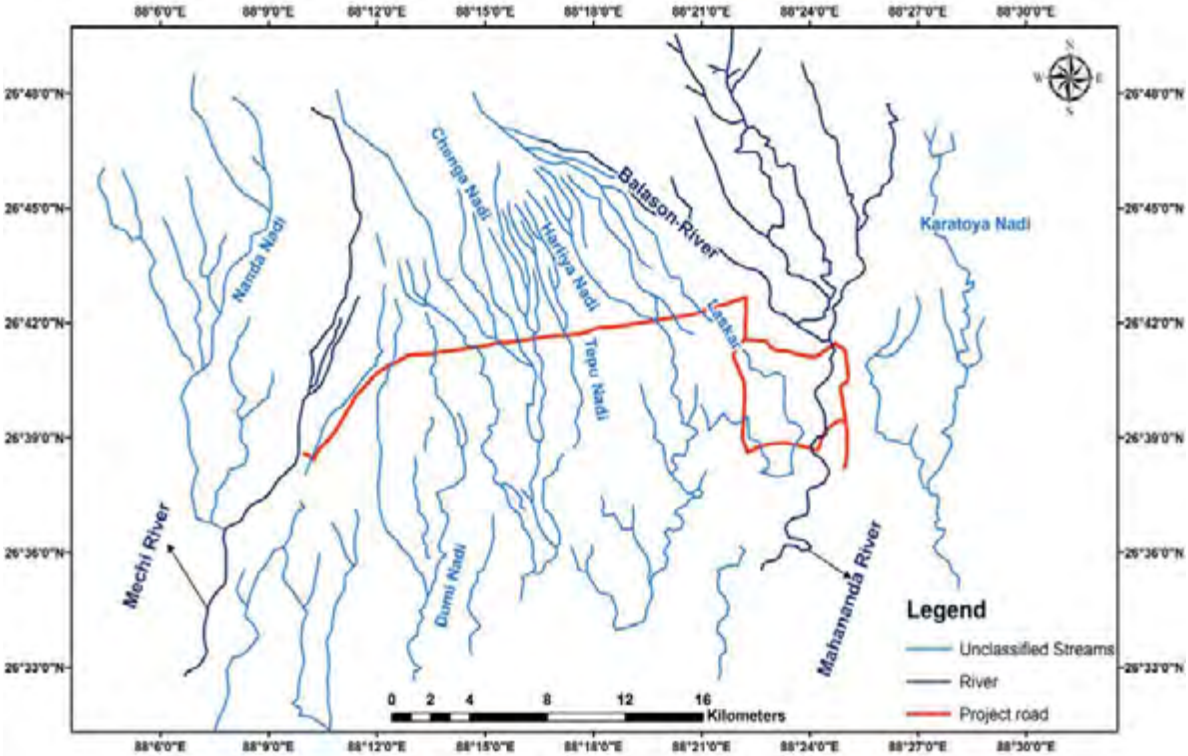
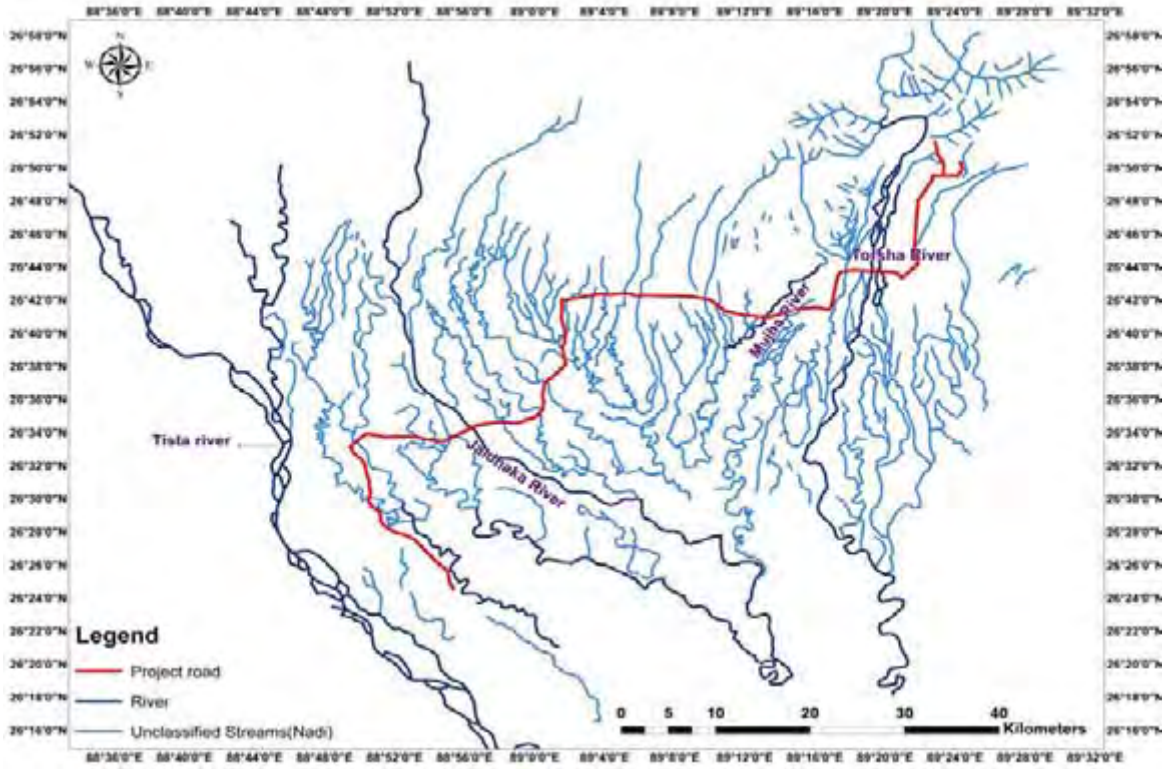


Figure 30. : Drainage Pattern Map of AH-48



98. **Water Resources:** Surface water: Major River flows in the AH-2 project region are **river** Mechi, Manza and many other rivers, which flows from North to South-east. Similarly the major river in the AH-48 region are river Teesta, Jaldhaka, Mujha and Torsha, which flows from North to South-east. The both road area is drained by large no of rivers. Most of these are perennial in nature. The list of river crossing the road is given at **Table 18**.

Table 18 : River Falling in AH-2 and AH-48

River	Chainage	River Type
AH-2		
Kamchi Nala	6.3 km	-
Pond	7.2	-
Manza River	10.4 km	Perennial
Canal	12.6 km	-
Changa River	11.3 km	Perennial
Decomani River	12.3 km	Perennial
Lalpha River	13.2 km	Perennial
Tepu River	14.6 km	Perennial
Canal	15.3 Km	-
Halai River	19.00 km	Perennial
Bwabalanb River	19.4 km	Perennial
Laskar River	21.00 km	Perennial
Tista Main Canal	34.00 Km	-
AH-48		
Torsha River	87.70 to 88.10 km	Perennial
Halang River	85.40 km	Perennial
Mujnai river	73.8 km	Perennial
Daldati River	72.9 km	Perennial
Ekti River	72.00 km	Perennial
Karjee River	69.9 km	Perennial
Birpara zora River	67.7 km	Perennial
Birpara River	65.9 km	Perennial
Dimdima River	61.5 km	Perennial
Kalua River	57.9 km	Perennial
Mechka River	47.1 Km	Perennial
Gilandi River	43.8 km	Perennial
Bimani River	41.7 km	Perennial
Kumlai River	40.3 km	Perennial
Jhumer River	36.3 Km	Perennial
Jaldhoka River	33.1 to 33.3 km	Perennial
Churabandar River	29.00 km	Perennial
Jhajangi River	28.00 km	Perennial
Halhali River	26.2 km	Perennial
Jordha River	21.3 km	Perennial

99. **Ground Water:** On the basis of physiographic features and geologic set-up, the state of West Bengal is broadly classified into three distinct groundwater-bearing zones as following (Refer **Table 19** for Details):

- Himalayan and Sub-Himalayan zones of Darjeeling and parts of the Jalpaiguri and Cooch Behar districts lying in the north,
- Crystalline or compact rocky uplands of Purulia and the western fringes of Bankura, Birbhum, Burdhaman and Medinipur districts including marginal lateritic tracts, and
- The low lying alluvial plains of the northern, central and southern parts of the state encompassed within the districts of Jalpaiguri, Cooch Behar, West Dinajpur, Malda, Murshidabad, Nadia, Hugli, Howrah, the eastern parts of Burdhaman, Bankura and Medinipur, and 24-Parganas.

100. As per WBWA, the entire project area falls under safe zone. Means no permission is required for extraction of water upto 100KLD per day.

Table 19 : Ground Water Situation In Districts Of West Bengal

Formation	District	Findings	Remarks/ Recommendations
Consolidated/ Semi consolidated/ Hard Crystalline rocks	Purulia, Bankura, Medinipur, Burdhaman, Birbhum	Ground water occurs in : i. Weathered residuum within 10mbgl. ii. Fractures within 65mbgl having discharge within 20 m^3/hr.	In this water scarce area, topographic lows, zone of intersection of regionally extended joints & fractures (to be identified by resistivity survey) are the suitable locales for ground water development through dug and dugcum-bore wells.
Gondwana Sandstone	Purulia, Burdhaman, Birbhum	Ground water occurs in the fractured zone within 100mbgl generally discharging 10 m^3/hr with maximum discharge of 22m^3/hr.	Bore wells within 100m depth is found suitable. Location of the well site should be pinpointed after detailed geophysical survey.
Unconsolidated /Recent Alluvium	Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur, Dakshin Dinajpur, Malda, Murshidabad, Nadia, North 24 Parganas, Hugli, Howrah, Medinipur, Burdhaman, Bankura, Birbhum	Ground water occurs both under unconfined & confined condition within the explored depth of maximum 600mbgl. Aquifers are fairly thick& regionally extensive with large yield prospect of about 150m3/hr. In Birbhum and Bankura districts aquifers beyond 136 mbgl upto the drilled depth of 350mbgl in the Tertiary formation are found under auto flow condition.	Ground water can be utilised through heavy-duty tube wells within 120mbgl & shallow tube wells within 60mbgl. In arsenic infested area development of shallow aquifers should be avoided.

Formation	District	Findings	Remarks/ Recommendations
		The occurrence of Arsenic in ground water in the depth span of 20-80 m bgl restricted mainly in the eastern part of Bhagirathi river has posed a serious problem. In view of the situation exploration work has been undertaken in the arsenic infested areas & arsenic free deeper aquifers could be identified beneath a thick clay bed in Nadia district.	

101. **Soils:** Soils of the Project road region are categorized as Tarai and Teesta alluvial soils. The texture of the soil in the study zone is reported to range mostly from sandy to sandy loam. They are porous and grey to black in colour. As a consequence of leaching of bases due to heavy rains in this region soil reaction is strongly to moderately acidic (PH 4.0 to 6.0). Organic matter content in this soil is medium to high and is not well decomposed (raw humus type). Available phosphorus is medium and potassium is low to medium in the soil. Phosphate fixation capacity is high. Some nutrients like calcium and magnesium are deficient. Deficiency of some micronutrients is also found in certain areas. In strongly acid soils aluminium toxicity to plants is common. Apart from high acidity and micronutrient deficiency there are other problems like water erosion and deposition of sands on cultivated lands due to frequent flash floods from rivers originating from hills.

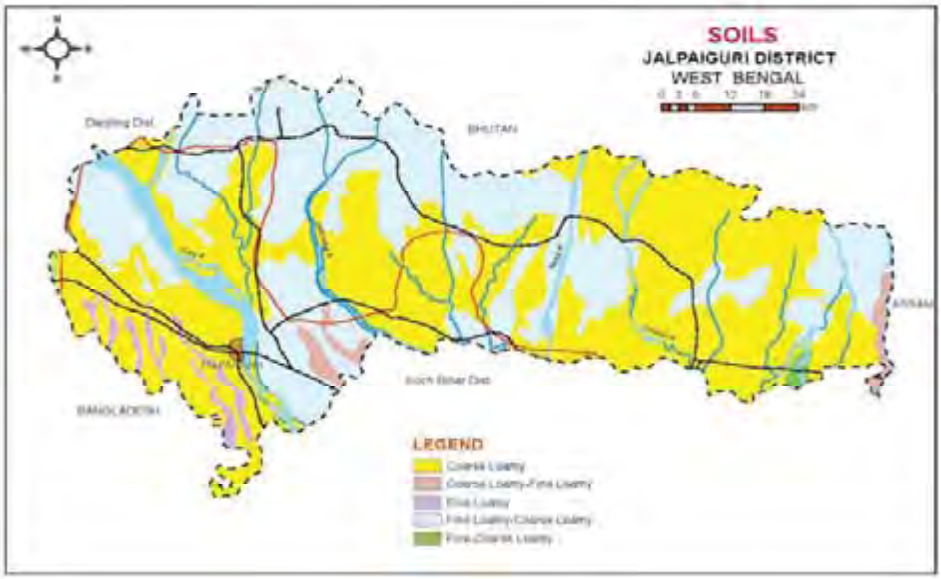
102. Unconsolidated/ Older Alluvium: Bhabhar zone in parts of Darjeeling & Jalpaiguri district Aquifer Condition:-In the sub-mountain zone of Himalaya, the sediments consist of assorted materials varying from boulders to sand of various grades. The water table in Bhabar zone is commonly as deep as 20 to 30 m along the foothill region, which is the recharge zone, but becomes shallow (<1.5 m bgl) in the down slope direction towards the spring line and are characterized by high seasonal fluctuation to the tune of 10-12 m. Yields of tube wells tapping this aquifer vary in general from 20 to 80 m 3 /hr with a maximum drawdown of 20 m. The yield of the springs in the contact zone of Bhabar and Terai varies from 0.5 to 2 lps. Recent ground water exploration in Bhabar zone has identified the existence of potential granular zones within depth of 150 m bgl and tube well tapping these granular zones is capable of yielding up to 68m 3/hr of ground water. Transmissivity of the aquifers varies from 130- 700 m^2/ day.

103. Unconsolidated / Recent Alluvium: Aquifer Condition: - Ground water occurs both under unconfined & confined condition within the maximum explored depth of 600 m bgl. Aquifers are fairly thick & regionally extensive with large yield prospect of about 150 m 3 /hr.

104. **Jalpaiguri:** The soil in this region ranges from alluvial soil to sandy and clayey soil. The soil can be broadly classified under two heads –a) the terai soils covering almost the entire district and b) the brown forest soil covering the northern foot hills of the district. However, the soil is predominantly sandy and hence porous with low water holding capacity. The alluvial soil is fertile enough for crops like paddy, jute and tea to be grown. This kind of soil is brought down by hilly rivers like Teesta, Torsa and Mahananda. The rivers often

overflow their banks depositing layers of fertile soil on the banks on either side. In the upper region to the north of the Duars, the soil is mainly hard, black and clayey. This soil is suitable for growing tea which is a major cash crop of this region. In the lower plain land the soil consists of a mixture of both clay and sand. The soil Map of Jalpaiguri district is shown at **Figure 31** and **Table 20.**

Figure 31. Soil map of Jalpaiguri



Source: NBSS & LUP Regional Centre, Kolkata

Table 20 : Soil types of Jalpaiguri

Major Soils (common names like red sandy loam deep soils (etc.,)*	Area ('000 ha)	Percent (%) of total Geographical area
1. Shallow to moderately coarse loam soils	268.028	43.04
2. Deep to very deep clay loamy soils	121.486	19.05
3. Deep to very deep clayey soils	195.461	31.38

Source: www.crida.in/cp-2012/.../WestBengal%206-Darjeeling-31.12.2011.pdf

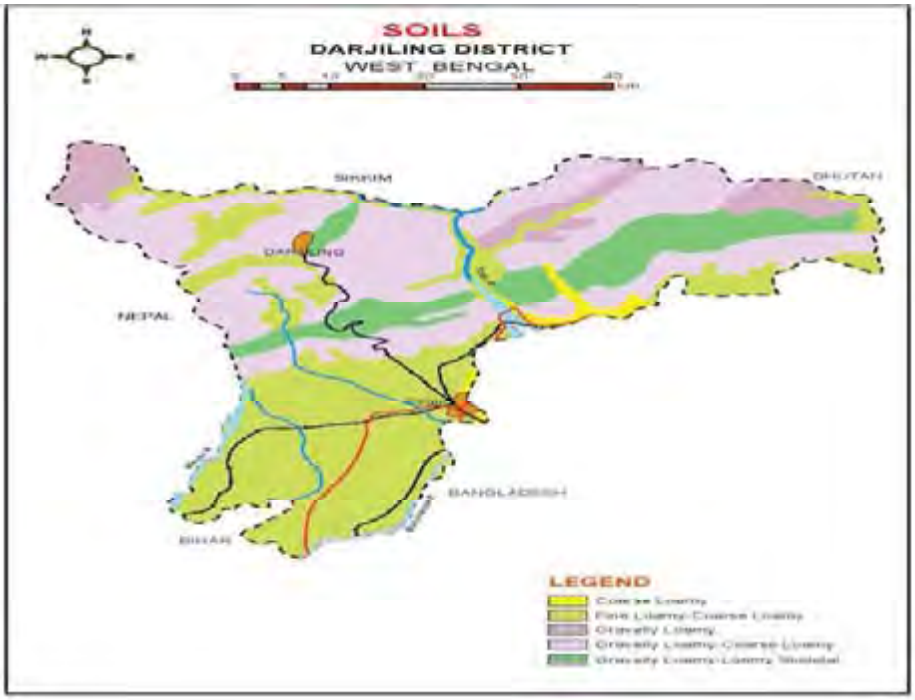
105. **Darjeeling:** The soils of Darjeeling Hill area have developed depending upon the underlying geological structure. But, in general the soils have been developed by both fluvial action and lithological disintegration. The soils that have developed in the Kalimpong area are predominantly reddish in colour. Occasional dark soils are found due to extensive existence of phyletic and schists. Soils in the highlands stretching from the west to the east of the district along most of the inter-fluvial areas are mainly mixed sandy loam and loamy, while those on the southern slopes of Mirik and Kurseong are mainly clayey loam and reddish in colour. Sandy soils are mainly found in the east of the river Teesta.

106. All the soils are definitely acidic in nature with the tendency to increase slightly in depth in most cases indicating the lacking of bases from surface and accumulation in the lower horizons. The weathering of lateritic type is the substantial mechanism in the transformation of the substratum. The variable thickness of the regolith and soils depend on the rate of weathering and gradient of the longitudinal slope profiles and intensity / gravity of mass movements. The basic soil types are yellow soils, red brown soils and brown forest soils. Red and yellow soils have developed on gneiss while brown on schists and shales.

Coarse pale yellow to red brown soils are found on the Siwaliks while clayey dark soils are developed on Daling series.

107. The character of the bedrock is reflected only in the grain size composition of the soil. On the Darjeeling gneiss, very coarse-grained (50% -80%) particles are found. In Damuda and Daling series percentage of sandy and coarse particles in the soils are high. On the Siwaliks, silty – clay fraction is higher. The chemical content of the soil over Darjeeling gneiss is characterized by a high proportion of potassium derived from feldspar and muscovite mica. This soil is poor in lime, magnesium, iron oxides, phosphorous and nitrogen. Therefore lime is used in the tea plantation areas. The soil Map of Jalpaiguri district is shown at **Figure 32**.

Figure 32. : Soil map of Darjeeling District



Source: NBSS & LUP Regional Centre, Kolkata

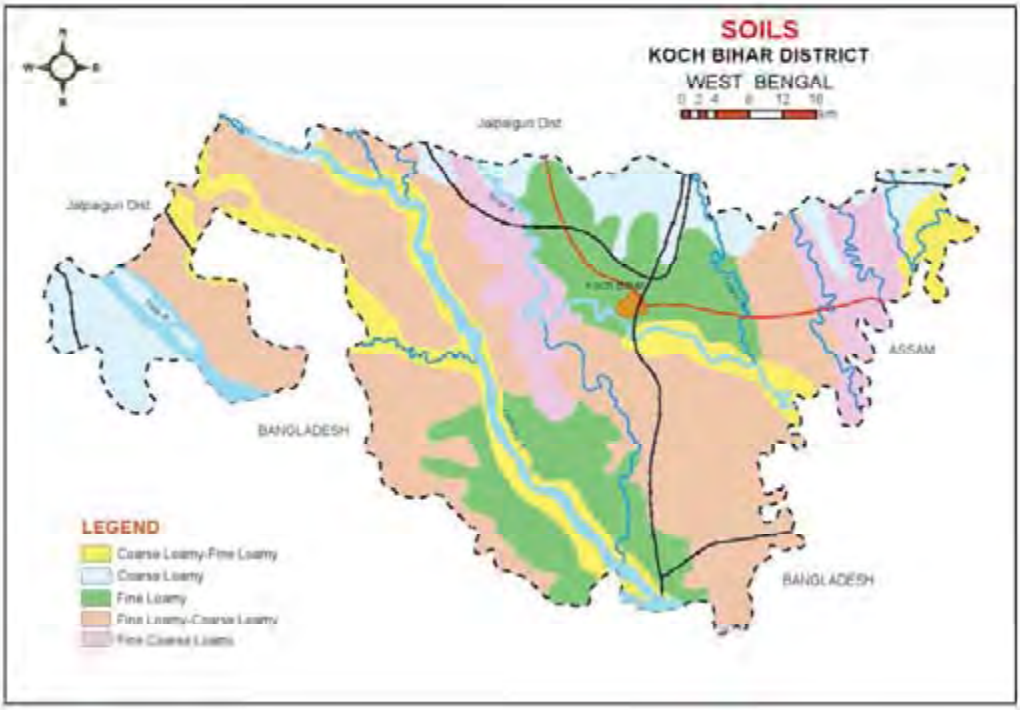
Table 21 : Soil types of Darjeeling District

Major Soils (common names like red sandy loam deep soils (etc.,)*	Area ('000 ha)	Percent (%) of total geographical area
Medium deep to very deep fine loamy soils (hill-brown forest soils)	110.48	35.0
Sandy loam soils (Medium lands to foot hills)	109.31	34.7
Shallow to medium deep Loamy soils(plains)	95.10	30.0

108. **Koch Behar:** A gentle slope from North West to South East is characteristic of this **district**. The geological formation is the alluvium of recent times deposited by Teesta and Mahananda rivers. The soil is alluvial of very recent formation. It is mostly sandy and loose. The surface soil is loam and hardly any good clay is found. The soil moisture regime is mostly Ustic, while soil temperature regime is Hyper-thermic. The length of moisture

availability (LGP) ranges between 270-300 days in a year. The principal crops are Paddy, Jute, Tobacco and Vegetables. The soil Map of Jalpaiguri district is shown at **Figure 33**.

Figure 33. : Soil map of Koch Behar



Source: NBSS & LUP Regional Centre, Kolkata

Table 22 : Soil types of Koch Behar District

Major Soils (common names like red sandy loam deep soils (etc.,)*	Area ('000 ha)	Percent (%) of total
1. Sandy	49.1	1.4
2. Coarse loamy	1061.3	31.3
3. Deep to very deep Fine loamy	1812.0	53.4
4. Fine	260.3	7.7
5. Miscellaneous	204.3	6.2

Source: www.crida.in/cp-2012/.../WestBengal%206-Darjeeling-31.12.2011.pdf

D. Land-Use

1. Land use of West Bengal

109. According to the land use classification of the state, 66 percent of land is being used for agriculture purposes, 3.6 % under current fallow and 13.5% for forest covers 13.5 %. **Table 23** provides district wise land use classification of the state.

Table 23: District wise Land Use Statistics of West Bengal (2007-08) (in hectares)

S.No	District	Reporting Area	Forest Area	Area Under Non Agricultural Use	Current Fallow	Net Area	Others
1	Burdhaman	698,762	3.0%	29.5%	1.1%	64.7%	1.7%
2	Birbhum	451,118	3.5%	21.5%	2.7%	70.6%	1.7%
3	Bankura	687,998	21.6%	21.5%	5.4%	50.2%	1.2%
4	Medinipur (East)	396,594	0.2%	24.4%	0.7%	73.8%	0.9%
5	Medinipur (West)	928,581	18.5%	17.0%	2.0%	60.2%	2.3%
6	Howrah	138,676	0.0%	36.9%	2.9%	58.2%	1.9%
7	Hooghly	313,379	0.2%	28.4%	0.1%	70.2%	1.1%
8	24-Parganas (North)	386,524	0.0%	31.5%	0.5%	67.1%	0.9%
9	24-Parganas (South)	948,710	44.9%	14.6%	0.9%	39.2%	0.4%
10	Nadia	390,655	0.3%	22.6%	1.5%	74.0%	1.5%
11	Murshidabad	532,499	0.1%	24.0%	0.1%	74.9%	0.9%
12	Uttar Dinajpur	312,466	0.2%	10.2%	0.1%	88.6%	1.0%
13	Dakshin Dinajpur	221,909	0.4%	14.2%	1.0%	83.2%	1.1%
14	Malda	370,862	0.5%	23.7%	17.7%	56.7%	1.4%
15	**Jalpaiguri**	**622,700**	**28.7%**	**13.6%**	**2.4%**	**53.7%**	**1.5%**
16	**Darjeeling**	**325,469**	**38.3%**	**11.4%**	**3.7%**	**43.2%**	**3.3%**
17	**Cooch Behar**	**331,565**	**1.3%**	**20.1%**	**0.4%**	**74.8%**	**3.3%**
18	Purulia	625,646	12.0%	16.0%	18.4%	50.0%	3.6%
19	**West Bengal**	**8,684,113**	**13.5%**	**20.3%**	**3.6%**	**61.0%**	**1.6%**

Source: Economic Review, 2008-09

2. Land use of Study Area

110. A systematic digital image interpretation approach was used to delineate the land use classes. The present study was focused on demarcating boundaries of different land use/land cover units from an analysis of different types of colour registrations of land use/land cover units from satellite imagery in 500m and 5 Km area. GIS software (ARC GIS 9.3) was used for the study. The digital image processing is done in Image processing software ERDAS 9.1. Multi-spectral supervised classification using the maximum likelihood algorithm followed by smoothing and editing of pixels was performed in that platform. The Satellite data which is used to make Land use and land cover of the area is LISS III (23.5 meters) and Landsat 4-5 thematic mapper (30 meters resolution).

111. The land Use in both the road corridors falls under agriculture fellow land classification followed by agriculture. The land use of LCS at Nepal Border is fellow land with some patches of vegetation. While the land use of LCS at Bhutan border is vegetation with some patches of fellow land. The details of Land use classification of both the corridors is given at **Table 24 (AH-02) and Table 25 (AH-48)**. (**Figure 34 and 35**)

Table 24 : Land Use Classification Details of AH-2 road corridor

Class(500 meters Radius)	Area (Sq km)	Class(5 km)	Area (sqkm)
Agricultural land	10.18	Agricultural Land	41.9
Agri fallow land	25.03	Agricultural Fallow land	222.55
Vegetation	5.01	Open land	4.89
Dry river bed	1.24	Water body	10.87
Waterbody	0.97	Settlement	57.63
Settlement	3.05	Dry river bed	11.03
Total	**45.48**	Vegetation	75.07
		Total	**423.94**

Figure 34. : Land use Analysis of AH-02 in 500 m

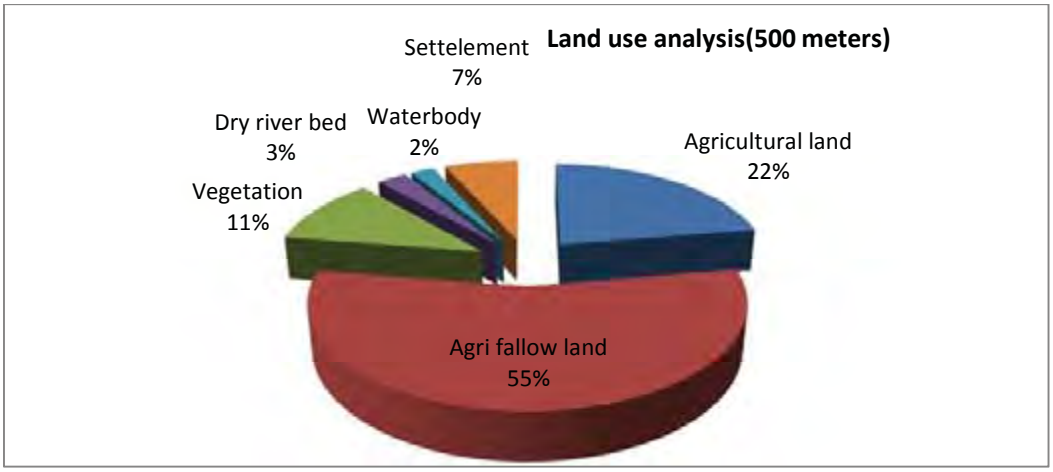


Figure 35. : Land use Analysis of AH-02 in 5 km

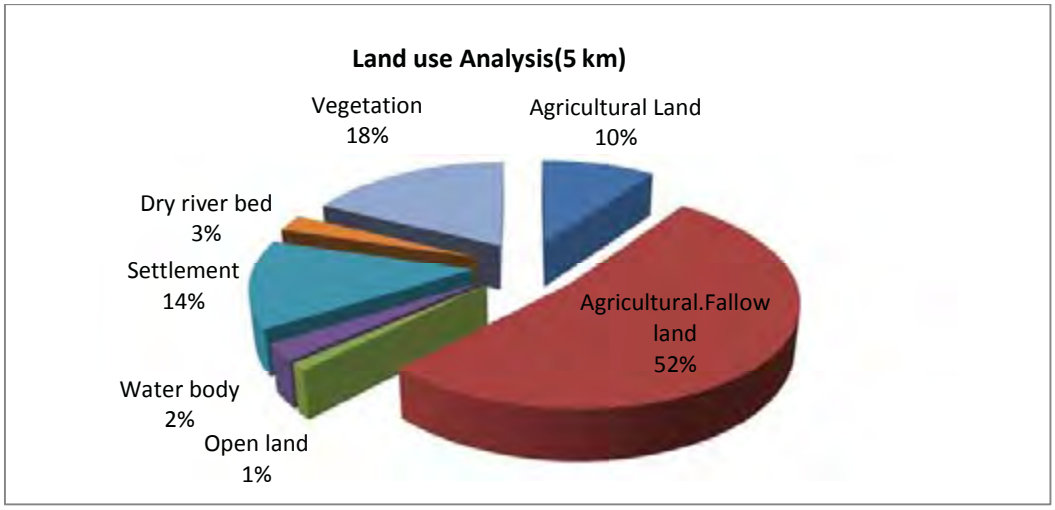


Figure 36. : Land use of AH-02 in 500m radius

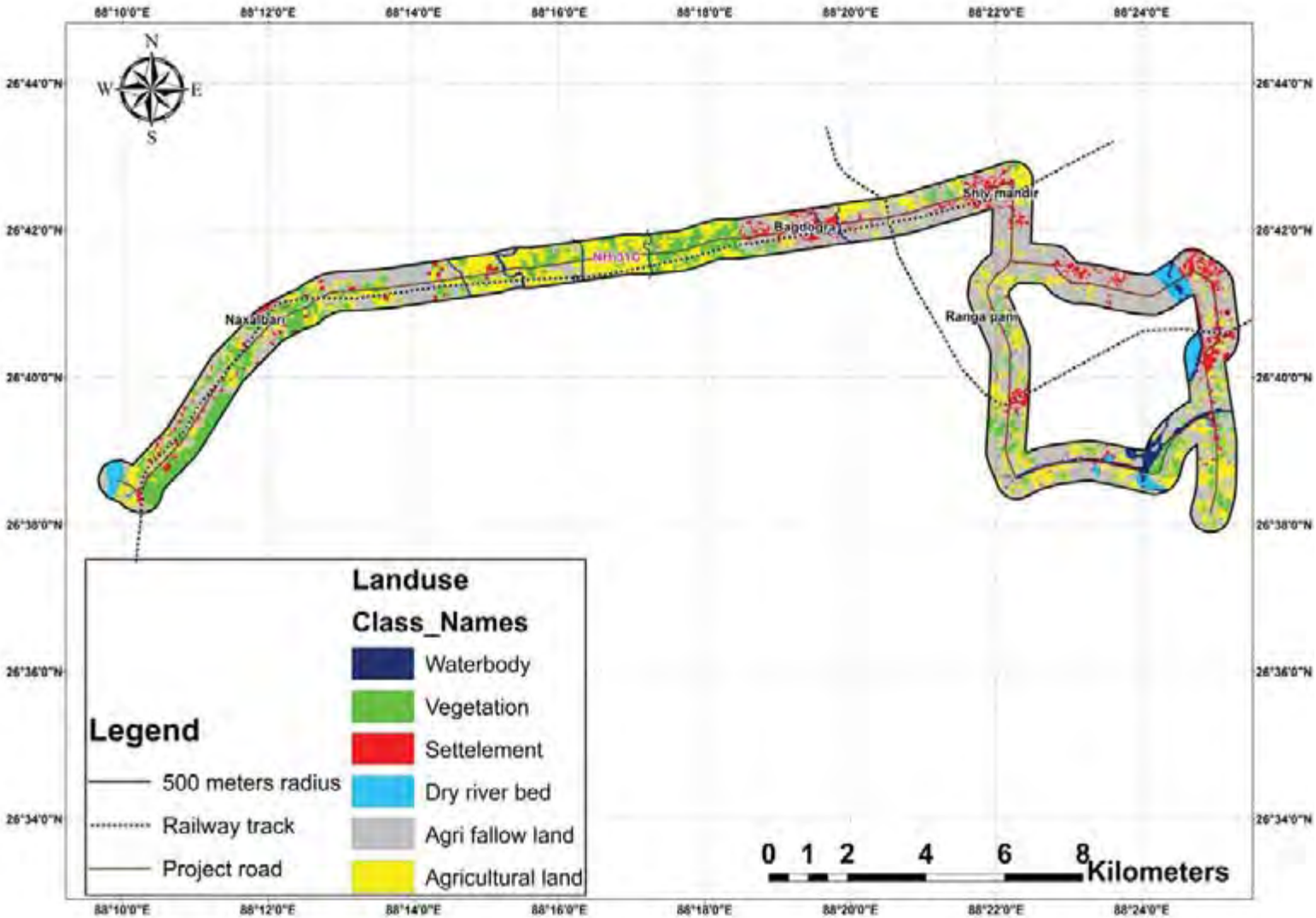


Figure 37. Land use of AH-02 in 5 km radius

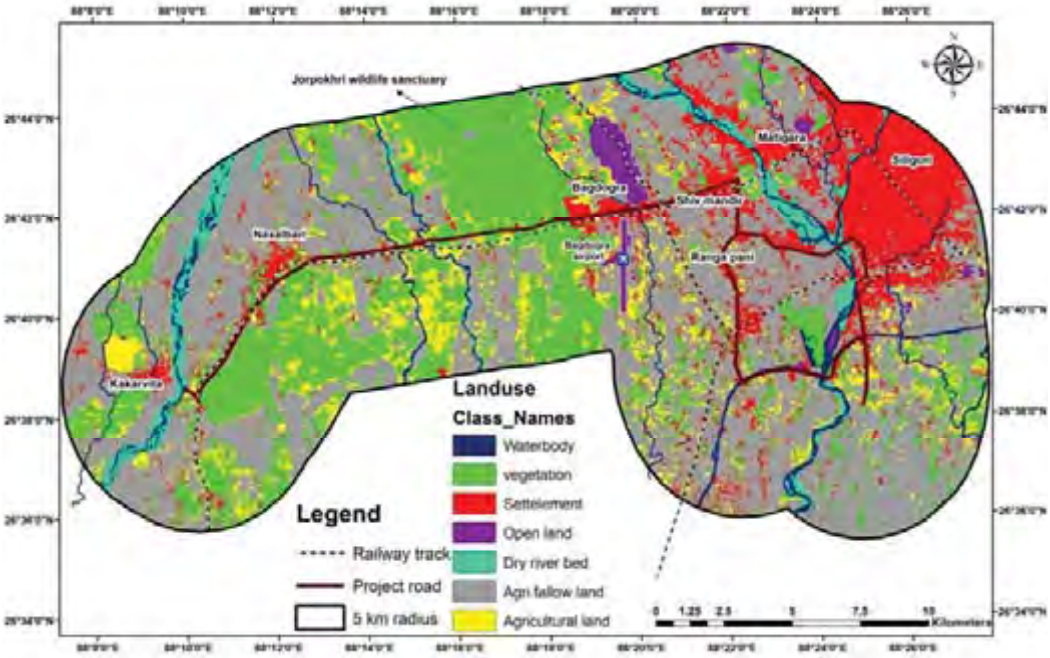


Table 25 : Land Use Classification of AH-48

Class (500 meters)	Area (sqkm)	Class (5 km)	Area (sqkm)
A.L	38.54	Agricultural land	199.96
A.F.L	37.12	Agri. Fallow land	511.85
Settlement	7.75	Settlement	22.52
Water body	1.77	Water body	24.80
Vegetation	17.63	Vegetation	225.97
Total	**102.81**	Open Land	15.73
		Dry River Bed	58.57
		Total	**1, 059.4**

Figure 38. Land use Analysis of AH-48 in 500 m radius

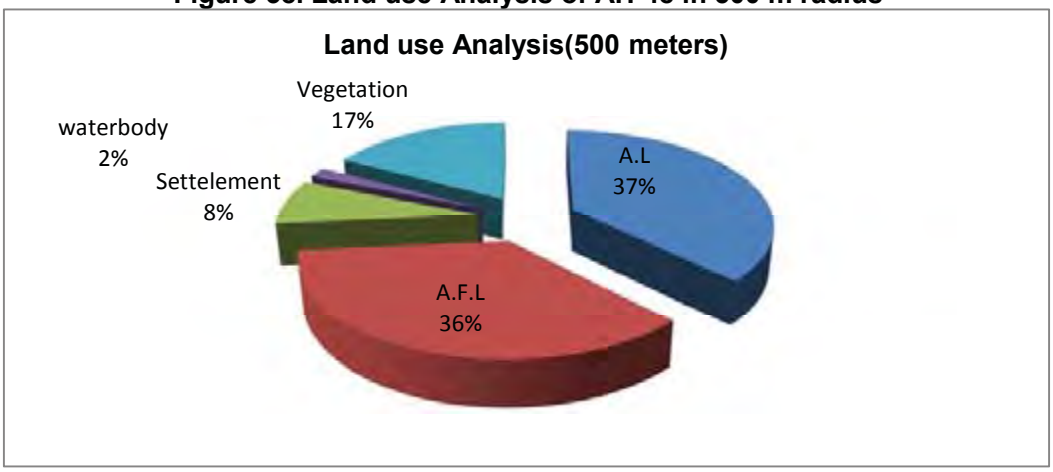


Figure 39. Land use Analysis of AH-48 in 5 km radius

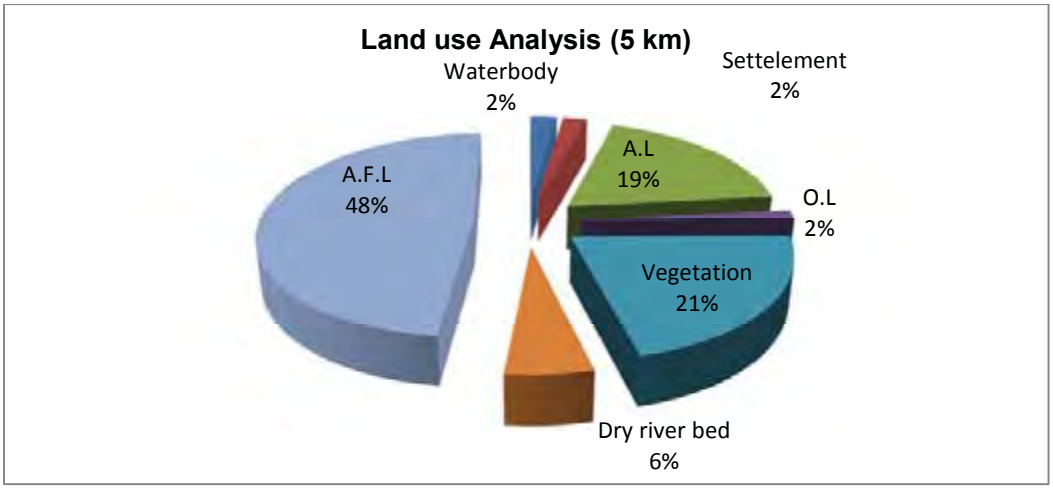


Figure 40. Land use of AH-48 in 500m radius

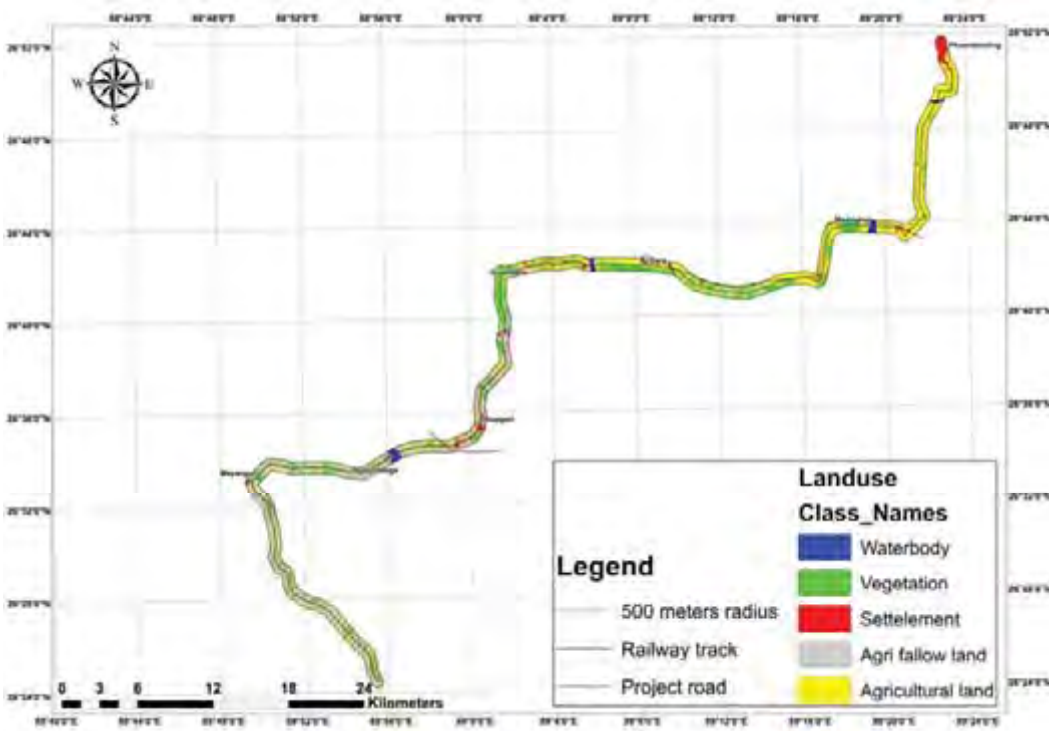
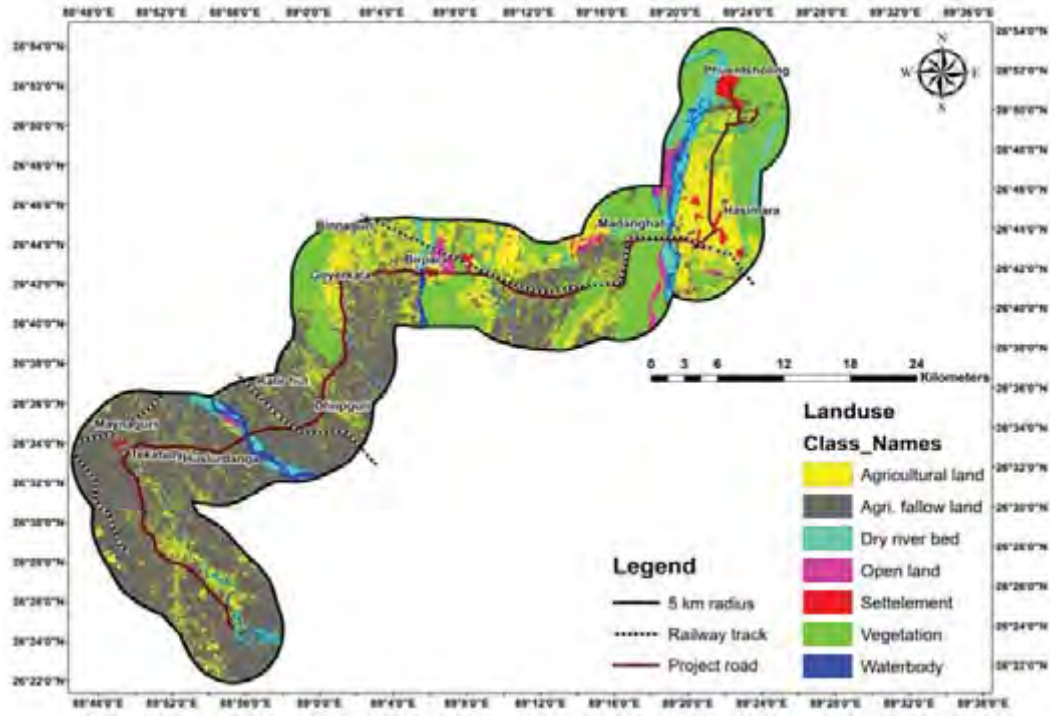


Figure 41. Land use of AH-48 in 5 km radius



112. **Environmental Quality :** Environmental Quality analysis provide the good reference level to likely predicted level due to the proposed project activity and thus facilitate evolving mitigative measures to reduce the impact to the acceptable level. In absence of availability of secondary data, primary data were generated for assessing the baseline environmental quality. The monitoring were carried out at various location in both the corridors for air, noise, soil surface and ground water. The monitoring locations are shown at the **Figure 42** and results are presented with discussions in the following sections.

Figure 42. :Environmental Quality Monitoring, Sampling locations (AH-02)

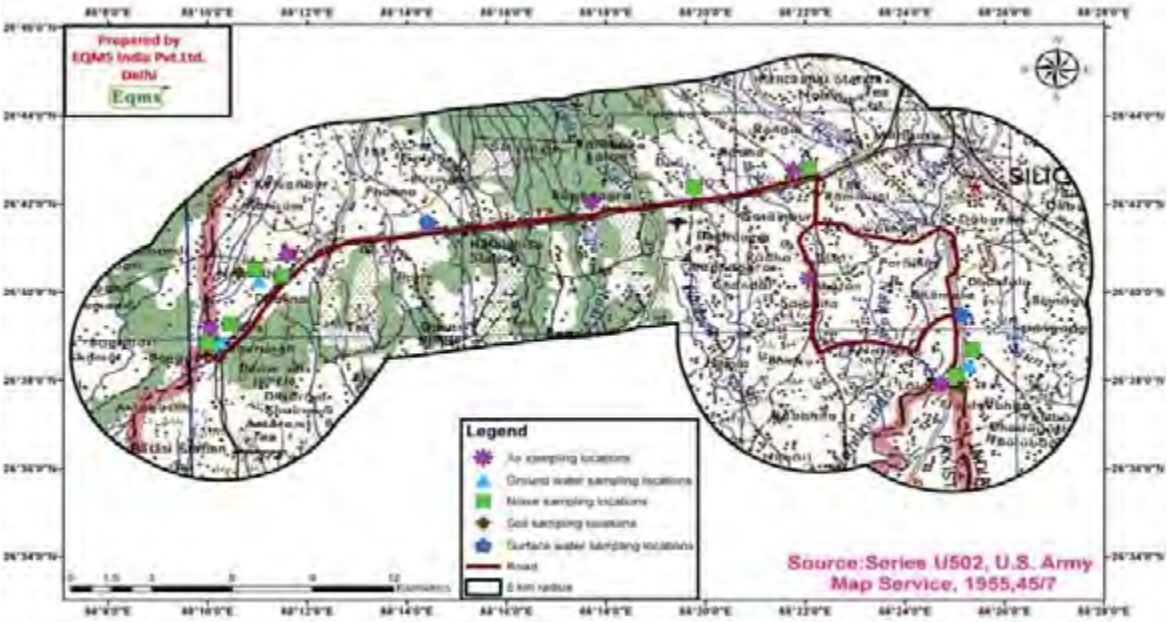
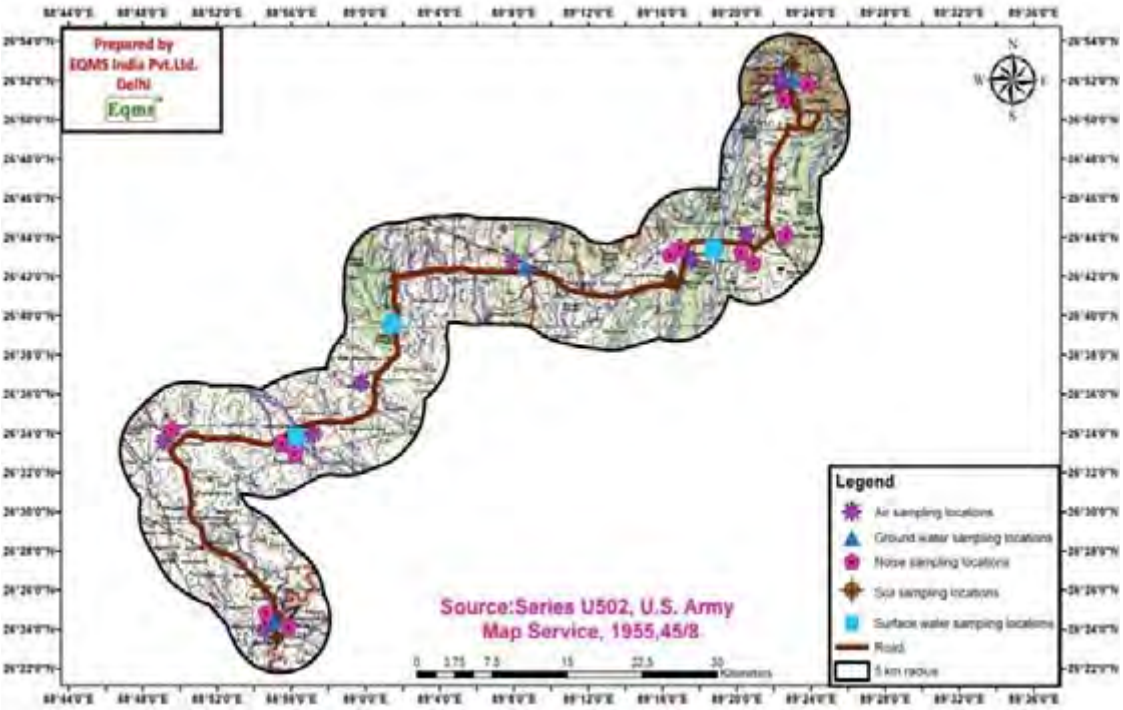


Figure 43. : Environmental Quality Monitoring, Sampling locations (AH-48)



113. **Air quality :** Ambient Air quality and background concentrations of criteria pollutions have been obtained for the study zone through monitoring of these pollutants according to the methodology prescribed CPCB standards. These criteria pollutants or classical pollutants include oxides of sulphur (SO2), nitrogen dioxide, (NO2), particulates matter of size 2.5 and 10 (PM2.5 AND PM10). Organic pollutant like carbon monoxide have also been monitored since it is considered and reported to be an important class of air pollutant and is also known to be an important pollutant emitted largely from automobiles/vehicles and other sources. These pollutants have been measured and monitored at residential, commercial and at sensitive zones. The locations at AH-2 corridor include Kakarbita, Naxalbari School, Bagdogra, Medical, Fulbari Village , Rangapani, while the monitoring locations at AH-48 corridor include namely Chandrabandha, Mainaguri, Jaldhaka Park, Magurmari, Birpara, Pacchim Kherbari, Jaldapara Forest, Jaigaon.

114. The air quality for the measured criteria pollutants are monitored 24-hourly except for carbon monoxide. The monitoring of this specific pollutant has been done 8-hourly as per the available guidelines. The minimum and maximum concentrations of S02, N02, CO are within the prescribed standards at all the chosen sampling sites of AH-2 and AH-48 corridors. The average concentrations of SO, NO2, CO range from 4.7-10.5 µg /m3 , 16.3-20. 7 µg /m3, 0.26 mg /m3 respectively for the AH-2 corridor. Whereas the average concentrations of SO2, NO2, CO ranges from 5.3-11.7 µg /m3, 15.3-25.2 µg /m3, 0.20-0.44 mg /m3 respectively for the AH-48 corridor.

115. The average concentrations of PM 2.5, PM 10 µg/m3 at few locations are observed close to notified National ambient air quality standards. At Jaigaon, which is along AH-48 corridor the concentrations of PM10 is reported to be above prescribed standards of CPCB/National Ambient air quality standards. This could be due to entrainment of road dust into the air and due to heavy traffic load and congestion particularly along this road which may have been responsible in contributing PM10. The concentration of particulate PM10 at Rangapani and Naxalbari along AH-2 road corridor though have been observed to be within

the prescribed National ambient air standards still are on a high range as they have been reported to be above 80 µg/m3. The ambient air quality results are given at **Table 26** and **27**.

Table 26 : Ambient Air Quality Levels for AH-2

Location	Category	Pollutants in µg/m^3				
		SO_2	NOx	PM_{10}	$PM_{2.5}$	CO
Kakarbhitta	Commercial/ urban	6.8	16.3	66.8	27.2	450
		7.5	19.5	70.2	30.5	340
Naxalbari School	School/urban	10.5	22.6	93.3	40.2	235
		8.5	20.7	85.2	42.6	310
Bagdogra	Village	6.5	15.6	76.4	38.4	390
		9.2	17.1	72.5	33.8	370
Medical (Thikni kata)	Village	8.3	20.8	84.3	36.4	250
		6.4	15.8	80.6	32.7	265
Fulbari Village	Village	4.7	17.3	57.5	28.1	360
		5.3	14.7	60.4	33.2	305
Rangapani (alternative Road)	Village	8.1	18.2	81.8	41.3	280
		7.4	16.3	76.9	37.0	300
NAAQ Standards, µg/m^3 (for Industrial, Residential, Rural and Other areas) for 24 hrs		80	80	100	60	2000

Source : Primary Data Collection

Table 27 : Ambient Air Quality Levels for AH-48

Location	Category	Pollutants in µg/m^3				
		SO_2	NOx	PM10	PM 2.5	CO
Changrabandha	Village	5.3	15.6	61.3	29.2	235
		6.6	14.8	70.2	33.5	270
Maynaguri	Near (Road)	10.3	21.7	89.7	38.6	325
		8.5	19.3	92.2	40.8	360
Jaldhaka Park	Village	6.8	18.6	66.2	27.6	240
		8.2	16.2	78.6	30.7	200
Magurmari	Village	7.8	17.6	75.6	38.8	250
		6.6	15.3	92.5	32.5	210
Birpara	Village	8.0	16.5	88.4	30.2	265
		7.5	18.0	82.1	36.6	290
Pacchim Kherbari	Near (School)	7.9	19.5	75.8	33.0	280
		6.5	17.1	82.4	37.5	265
Jaldapara Forest/sanctuary area	Forest Area	8.4	20.4	80.3	36.5	205
		8.0	18.1	92.5	40.2	235
Jaigaon	Commercial	11.8	25.2	105.1	47.2	440
		9.2	22.2	117.5	43.3	410
NAAQ Standards, µg/m^3 (for Industrial, Residential, Rural and Other areas) for 24 hrs		80	80	100	60	2000

*** Two Samples at each location basis**

116. **Noise**: The environmental assessment of noise from the industrial activity, construction activity and vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, and annoyance and general community responses.

117. A preliminary reconnaissance survey was undertaken to identify the major noise generating sources in the area which has been identified based on the activities in the village area and traffic. The noise monitoring has been conducted for determination of ambient noise levels in the study area. The noise level at each location were recorded for 24 hrs. Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hrs. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations within study area. The hourly noise levels monitored during day time and night time are presented in **Table 28** and **29** and Represented graphically at **Figure 44** and **45.**

Table 28 : Noise Levels [dB(A)] in the Study Area along alignment AH-2

Location	Category	Day Time			Ambient noise quality standards	Night Time			Ambient noise quality standards	Remarks
		L Max	L Min	Leq		L Max	L Min	Leq		
Panitanki More	Road	75.4	54.8	69.4	**65**	75.4	54.8	69.4	**55**	Noise levels are higher than the prescribed CPCB standards during day and night time due to heavy traffic movement in the highway zone
Kakabhitta	Commercial	65.4	36.6	58.3	**65**	65.4	36.6	58.3	**55**	Noise levels are higher than the prescribed standards at night due to high vehicular density and increased traffic movement
Naxalbari	Commercial	73.6	58.3	67.3	**50**	73.6	58.3	67.3	**55**	Noise levels are higher than the prescribed CPCB standards during day and night time due to heavy traffic movement in the highway zone especially of commercial traffic during the night, increased traffic density due to adjoining areas also add up to the raised noise levels
Naxalbari School	School	66.2	32.7	60.4	**50**	66.2	32.7	60.4	**40**	Noise levels are higher than the prescribed standards due to high vehicular density and increased traffic movement
Medical More	Road	77.8	60.5	73	**50**	77.8	60.5	73	**55**	Noise levels are higher than the prescribed CPCB standards during day and night time due to heavy traffic movement in the highway zone
Medical (Thikni kata) Near Rangapani Village	Village	62.5	30.5	55.1	**55**	62.5	30.5	55.1	**45**	Noise levels are higher than prescribed CPCB limits due to traffic from other adjoining regions or due to the traffic intersecting at this point, road networks merge at this point which add up to the traffic volume.
Fulbari	Village	68.1	58.2	63.5	**55**	68.1	58.2	63.5	**45**	Noise levels are higher than the prescribed CPCB standards during day and night time due to heavy traffic movement in the highway zone
Fulbari Village	Road	58.7	30.8	52.1	**65**	58.7	30.8	52.1	**55**	Noise levels are within the prescribed CPCB standards

Table 29 : Noise Levels [dB(A)] in the Study Area along AH-48 road alignment

		Day Time Limits in db (A)			Ambient noise quality standards	Night Time Limits in db (A)			Ambient noise quality standards	Remarks
Location	**Category of Area/ Zone**	**L Max**	**L Min**	**Leq**		**L Max**	**L Min**	**Leq**		
Jaigaon near roadside	Commercial	70.8	60.2	66.5	**65**	70.8	60.2	66.5	**65**	Noise level is higher than the prescribed standards CPCB standard during day and night time due to heavy traffic movement in the highway region
Jaigaon near temple	Silent	52.7	33.6	45.7	**50**	52.7	33.6	45.7	**50**	Noise levels are within prescribed limits
Jaldapara village	Residential	68.5	53.1	64.3	**55**	68.5	53.1	64.3	**55**	Noise levels are higher than the prescribed standards
Jaldapara National Park	Silent	46.2	36.7	40.9	**50**	46.2	36.7	0.9	**50**	Noise levels are within the prescribed standards
Pacchim Kherbari Village	Residential	70.8	58.3	66	**55**	70.8	58.3	66	**55**	Noise level is higher than the prescribed standards due to traffic movement
Pacchim Kherbari school	Residential	48.7	28.2	42.8	**55**	48.7	28.2	42.8	**55**	Noise levels are within prescribed limits
Jaldhaka Park	Residential	71.2	50.6	66.1	**55**	71.2	50.6	66.1	**55**	Noise levels are high due to continuous traffic movement/flow and high traffic density
Jaldhaka Park village	Residential	46.3	27.8	41.3	**55**	46.3	27.8	41.3	**55**	Noise levels are within prescribed limits
Changrabandha near village	Residential	65.7	45.4	60.1	**55**	65.7	45.4	60.1	**55**	Noise levels are high due to traffic congestion, addition of traffic from border regions
Maynaguri village	Residential	49.6	31.2	43.4	**55**	49.6	31.2	43.4	**55**	Noise levels are within prescribed limits
Hasimara village	Residential	45.4	28.6	40.2	**55**	45.4	28.6	40.2	**55**	Noise levels are within prescribed limits

Figure 44. : Ambient Noise quality Monitored result with National Ambient Noise Quality standard of AH-2

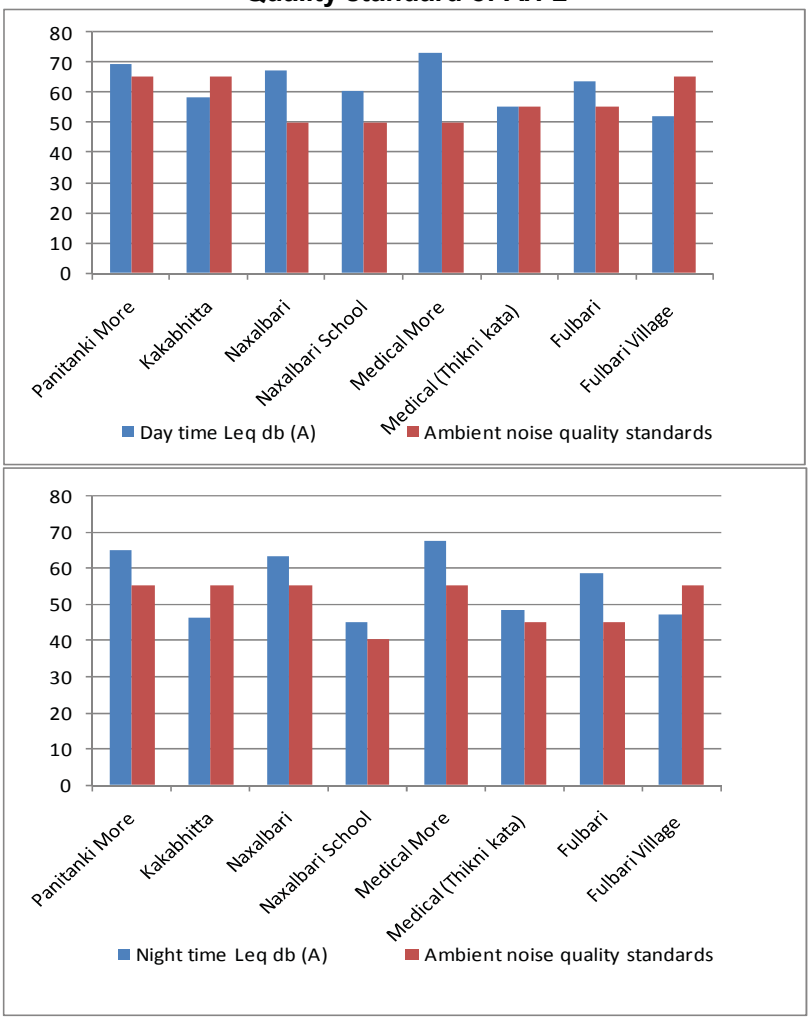
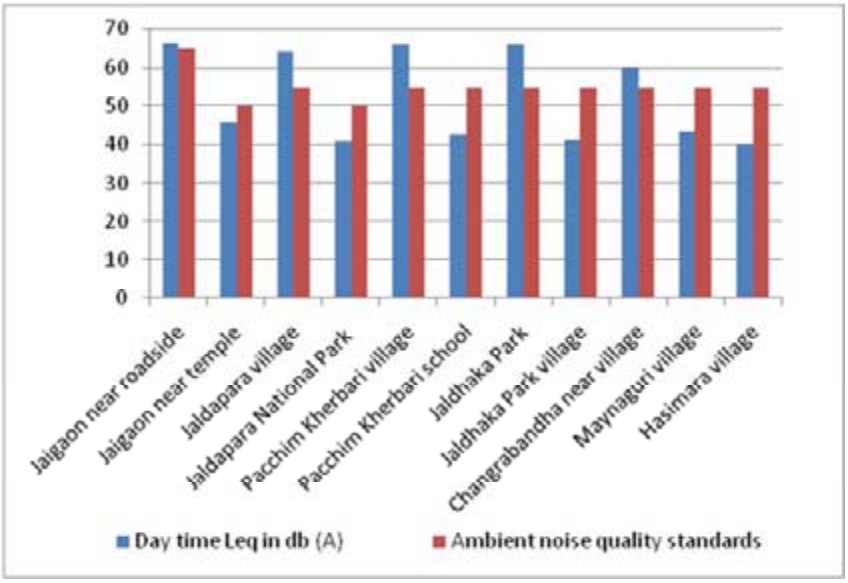
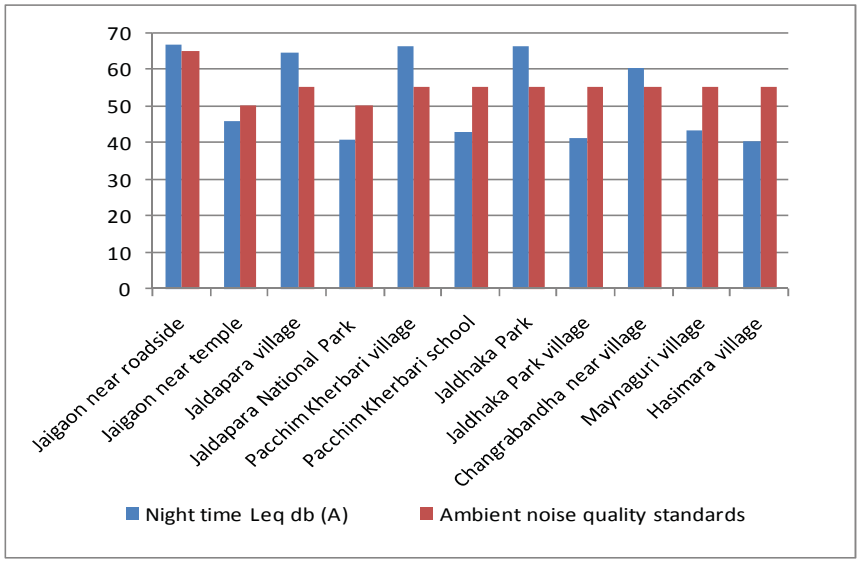


Figure 45. : Ambient Noise quality Monitored result with National Ambient Noise Quality standard of AH-48





118. It can be observed from the Table that the noise levels are within prescribed National Ambient noise levels at some locations along AH-2 road alignment whereas noise levels have been recorded to have exceeded at some other chosen monitoring sites. These locations include Panitanki More, Naxalbari near roadside, Medical (Thikni kata) Near Rangapani due to heavy traffic movement of commercial and private vehicles. The conditions are similar at AH-48 Corridor where noise levels have been observed within limits apart from locations like Jaigaon (near roadside), Jaldapara village Pacchim Kherbari village, Jaldhaka Park, Chandrabandha near village. The higher noise levels at these locations are mainly due to higher traffic density and continuous movement along the corridor which is a national highway. The noise levels have been observed to be higher at border Jaigaon and Chandrabandha due to addition of traffic volume from adjoining areas and connecting roads.

119. **Water quality :** There are many river crossed by the both the project corridors. The water quality of these rivers and ground water analysed to assess the quality of water and its suitability for drinking and construction activities. Five surface water samples were collected from five major rivers and six ground water samples were collected and analysed. The test results are given at **Table 30** to **33.**

120. Surface water quality meets the standard king water requiring conventional treatment before use. The ground water quality meets the drinking water standard.

Table 30 : Surface water quality along proposed AH 2 alignment

Sr. No.	Parameters	Teesta Canal	Manza River	Surface Water Quality Standards (as per IS: 2296)				
	Physical Parameters			**A**	**B**	**C**	**D**	**E**
1	pH	7.4	7.9	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
2	Temperature, 0C	18	18	-	-	-	-	-
3	Dissolved Oxygen, mg/l	7.5	7.7	6 (min.)	5 (min.)	4 (min.)	4 (min.)	-
4	Total Suspended Solids, mg/l	5	8	-	-	-	-	-
5	Conductivity, µmho/cm	180	172	-	-	-	1000	2250
	Chemical Parameters							
6	Total Alkalinity, mg/l	70	62	-	-	-	-	-
7	Total Dissolved Solids, mg/l	134	131	500	-	1500	-	2100
8	Total Hardness as CaCO3, mg/l	64	60	300	-	-	-	-

Sr. No.	Parameters	Teesta Canal	Manza River	Surface Water Quality Standards (as per IS: 2296)				
9	Calcium Hardness as CaCO3, mg/l	30	35	-	-	-	-	-
10	Magnesium Hardness as CaCO3, mg/l	34	25	-	-	-	-	-
11	Chloride as Cl, mg/l	5.8	8.8	250	-	600	-	600
12	Phosphate as PO4, mg/l	Nil	Nil	-	-	-	-	-
13	Nitrate as NO3, mg/l	0.05	0.06	20	-	50	-	-
14	Sulphate as SO4, mg/l	18	12.2	400	-	400	-	100
15	Sodium as Na, mg/l	10	9	-	-	-	-	-
16	Potassium as K, mg/l	5	7	-	-	-	-	-
17	Chemical Oxygen Demand, mg/l	<4	<4	-	-	-	-	-
18	Biological Oxygen Demand, mg/l	<2	<2	2	3	3	-	-
19	Copper as Cu, mg/l	BDL (0.01)	BDL (0.01)	1.5	-	1.5	-	-
20	Mercury as Hg, mg/l	BDL (0.001)	BDL (0.001)	0.001	-	-	-	-
21	Cadmium as Cd, mg/l	BDL (0.01)	BDL (0.01)	0.01	-	0.01	-	-
22	Selenium as Se, mg/l	BDL (0.001)	BDL (0.001)	0.01	-	0.05	-	-
23	Arsenic as As, mg/l	BDL (0.001)	BDL (0.001)	0.05	0.2	0.2	-	-
24	Lead as Pb, mg/l	BDL (0.01)	BDL (0.01)	0.01	-	0.01	-	-
25	Zinc as Zn, mg/l	BDL (0.01)	BDL (0.01)	15	-	15	-	-
26	Chromium as Cr+6, mg/l	BDL (0.01)	BDL (0.01)	0.05	0.05	0.05	-	-
27	Iron as Fe, mg/l	BDL (0.01)	BDL (0.01)	0.3	-	50	-	-
Bacteriological Parameters								
28	Total Coliform, MPN/100 ml	1386	1712	50	500	5000	-	-
29	Faecal Coliform, MPN/100 ml	668	724	-	-	-	-	-

Source: Primary Sampling and Testing

121. Class A – Drinking water without conventional treatment but after disinfection. Class B –Water for outdoor bathing. Class C – Drinking water with conventional treatment followed by disinfection. Class D – Water for fish culture and wild life propagation. Class E – Water for irrigation, industrial cooling and controlled waste disposal. (Unobj = Unobjectionable)

Table 31 : Surface water quality along proposed AH - 48 road alignment

Sr. No.	Parameters	Torsa River	Jaldhaka River	Angravasa River	Surface Water Quality Standards (as per IS: 2296)				
Physical Parameters					A	B	C	D	E
1	pH	8.2	8.1	8.3	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
2	Temperature, 0C	19	18	19	-	-	-	-	-
3	Dissolved Oxygen, mg/l	7.8	7.6	7.5	6 (min.)	5 (min.)	4 (min.)	4 (min.)	-
4	Total Suspended Solids, mg/l	6	<4	7	-	-	-	-	-
5	Conductivity, µmho/cm	158	160	166	-	-	-	1000	2250
Chemical Parameters									
6	Total Alkalinity, mg/l	60	48	52	-	-	-	-	-
7	Total Dissolved Solids, mg/l	105	104	122	500	-	1500	-	2100
8	Total Hardness as CaCO3, mg/l	60	50	55	300	-	-	-	-
9	Calcium Hardness as CaCO3, mg/l	36	20	32	-	-	-	-	-

Sr. No.	Parameters	Torsa River	Jaldhaka River	Angravasa River	Surface Water Quality Standards (as per IS: 2296)				
10	Magnesium Hardness as CaCO3, mg/l	24	30	23	-	-	-	-	-
11	Chloride as Cl, mg/l	3.8	10	6.7	250	-	600	-	600
12	Phosphate as PO4, mg/l	Nil	Nil	Nil	-	-	-	-	-
13	Nitrate as NO3, mg/l	0.4	0.01	0.3	20	-	50	-	-
14	Sulphate as SO4, mg/l	8.8	12	7.1	400	-	400	-	100
15	Sodium as Na, mg/l	5	8	7	-	-	-	-	-
16	Potassium as K, mg/l	2	4	3	-	-	-	-	-
17	Chemical Oxygen Demand, mg/l	<4	<4	<4	-	-	-	-	-
18	Biological Oxygen Demand, mg/l	<2	<2	<2	2	3	3	-	-
19	Copper as Cu, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	1.5	-	1.5	-	-
20	Mercury as Hg, mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.001	-	-	-	-
21	Cadmium as Cd, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01	-	0.01	-	-
22	Selenium as Se, mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.01	-	0.05	-	-
23	Arsenic as As, mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.05	0.2	0.2	-	-
24	Lead as Pb, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01	-	0.01	-	-
25	Zinc as Zn, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	15	-	15	-	-
26	Chromium as Cr+6, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05	0.05	0.05	-	-
27	Iron as Fe, mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.3	-	50	-	-
	Bacteriological Parameters								
28	Total Coliform, MPN/100 ml	1157	2065	1898	50	500	500	-	-
29	Faecal Coliform, MPN/100 ml	540	892	820	-	-	-	-	-

Table 32 : Ground water quality along proposed AH 2 alignment

S. No.	Ground Water Parameters	Location			Indian Standards (IS: 10500)
		Kakarbita	Naxalbari	Fulbari	
1	Colour, (Hazen units)	Less than 5	>5	Less than 5	5
2	Odour	Agreeable	Agreeable	Agreeable	Unobjectionable
3	Turbidity (NTU),	0.1	0.3	0.1	5
4	Taste	Acceptable	Acceptable	Acceptable	Agreeable
5	pH	6.78	6.47	6.24	6.5-8.5
6	Total Hardness (as CaCo3 mg/l	67	86	43	300
7	Chlorides (as Cl) mg/l	20	25	15	250
8	Calcium (as Ca) mg/l	6	12	8	75
9	Magnesium (as Mg) mg/l	13	14	6	-
10	Dissolved solids mg/l	122	182	86	500
11	Fluoride (as F) mg/l	0.1	0.1	0.1	1
12	Iron (as Fe) mg/l	0.1	0.1	0.1	0.3
13	Residual, free chlorine mg/l	<0.1	<0.1	<0.1	-
14	Copper (as Cu) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
15	Manganese (as Mn) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.1
16	Sulphate (as SO_4) mg/l	12	13	7	200
17	Nitrate (as NO_3) mg/l	2.1	2.3	1.6	45
18	Phenolic Compounds (as C6H5OH) mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.001
19	Mercury (as Hg) mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.001

S. No.	Ground Water Parameters	Location			Indian Standards (IS: 10500)
		Kakarbita	Naxalbari	Fulbari	
20	Cadmium (as Cd) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01
21	Selenium (as Se) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01
22	Arsenic (as As) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
23	Cyanide (as Cn) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
24	Lead (as Pb) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
25	Zinc (as Zn) mg/l	BDL (0.1)	BDL (0.1)	BDL (0.1)	5
26	Anionic detergents (as MBAS) mg/l	BDL (0.1)	BDL (0.1)	BDL (0.1)	0.2
27	Chromium (as Cr) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
28	Poly nuclear aromatic hydrocarbons (as PAH) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0
29	Mineral Oil (mg/l)	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01
30	Pesticides (mg/l)	Absent	Absent	Absent	0
31	Alkalinity (mg/l)	25	30	20	200
32	Aluminium (mg/l)	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.03
33	Boron (mg/l)	BDL (0.1)	BDL (0.1)	BDL (0.1)	1

Table 33 : Ground Water Quality along the Proposed Alignment (AH-48)

S. No.	Ground Water Parameters	Location			Indian Standards (IS: 10500)
		Jaigaon	Birpara	Chandrabandha	
1	Colour, (Hazen units)	Less than 5	Less than 5	Less than 5	5
2	Odour	Agreeable	Agreeable	Agreeable	Unobjectionable
3	Turbidity (NTU),	0.2	0.2	0.1	5
4	Taste	Acceptable	Acceptable	Acceptable	Agreeable
5	pH	6.08	6.21	6.75	6.5-8.5
6	Total Hardness (as CaCo3 mg/l	38	53	48	300
7	Chlorides (as Cl) mg/l	15	18	15	250
8	Calcium (as Ca) mg/l	4	6	4	75
9	Magnesium (as Mg) mg/l	7	9	9	-
10	Dissolved solids mg/l	76	86	96	500
11	Fluoride (as F) mg/l	0.1	<0.1	0.1	1
12	Iron (as Fe) mg/l	0.1	0.1	0.1	0.3
13	Residual, free chlorine mg/l	0.1	<0.1	<0.1	-
14	Copper (as Cu) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.05
15	Manganese (as Mn) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.1
16	Sulfate (as SO_4) mg/l	8	10	11	200
17	Nitrate (as NO_3) mg/l	1.5	1.7	1.8	45
18	Phenolic Compounds (as C6H5OH) mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.001
19	Mercury (as Hg) mg/l	BDL (0.001)	BDL (0.001)	BDL (0.001)	0.001
20	Cadmium (as Cd) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01
21	Selenium (as Se) mg/l	BDL (0.01)	BDL (0.01)	BDL (0.01)	0.01

122. **Soil Quality :** Soil fertility is an aspect of the soil-plant relationship. Fertility status of the soils is primarily and importantly dependent upon both the macro and micronutrient reserve of that soil. Continued removal of nutrients by crops, with little or no replacement will increase the nutrient stress in plants and ultimately lowers the productivity. The fertility status of the soils mainly depends on the nature of vegetation, climate, and topography, texture of soil and decomposition rate of organic matter. Optimum productivity of any cropping systems depends on adequate supply of plant nutrients. The fertility of the soil depends on the concentration of N, P, K, organic and inorganic materials and water.

Nitrogen is required for growth of plant and is a constituent of chlorophyll, plant protein, and nucleic acids. Phosphorus is most often limiting nutrients remains present in plant cell nuclei and act as energy storage. It helps in transfer of energy. Potassium is found in its mineral form and affect plant cell division, carbohydrate formation, translocation of sugar, various enzyme actions and resistance to certain plant disease, over 60 enzymes are known to require potassium for activation. It is essential to determine the potential of soil in the area to identify the current impacts of urbanization and industrialization on soil quality and also predict impacts, which may arise due to the project operations. Accordingly, a study of assessment of the baseline soil quality has been carried out.

123. For studying soil profile of the region, two sampling locations were selected along proposed alignment AH-2 and three locations along proposed AH-48. The samples have been collected from three different depths from 5 to 15cm and representative samples prepared by thoroughly mixing. The homogenized samples were analysed for physical and chemical characteristics. The soil quality results for AH-2 and AH-48 are presented at **Table 34** and **Table 35**.

Table 34 : Soil test results Proposed alignment AH-2

S. No.	Soil Parameters	Location	
		Fulbari	**Naxalbari**
1	Bulk density (g/cc)	1.41	1.38
2	Organic Matter %	5.2	4.6
3	Water Holding Capacity %	22.8	27.6
4	pH(20% slurry)	8.2	8.3
5	Colour	Gray	Brown
6	Texture	Sandy loam	Sandy loam
7	Porosity % v/v	6	6
8	Carbonate mg/kg	164	202
9	Bicarbonate mg/kg	Nil	Nil
10	Chlorides mg/kg	148	151
11	Conductivity (20% slurry)	95.3	92.8
12	Potassium mg/kg	32	38
13	Phosphorous mg/kg	220	245
14	Nitrogen mg/kg	250	236

Table 35 : Soil test results Proposed alignment AH-48

S. No.	Soil Parameters	Location		
		Jaigaon	**Madarihat**	**Chandrabandha**
1	Bulk density (g/cc)	1.34	1.33	1.34
2	Organic Matter %	4.9	2.1	3.9
3	Water Holding Capacity %	22.7	21.9	16.2
4	pH(20% slurry)	7.9	7.7	7.4
5	Colour	Dark Grass	Gray	Brown
6	Texture	Sandy loam	Sandy loam	Sandy loam
7	Porosity % v/v	5	7	8
8	Carbonate mg/kg	158	164	224
9	Bicarbonate mg/kg	Nil	Nil	Nil
10	Chlorides mg/kg	144	172	156
11	Conductivity (20% slurry)	92.8	96.8	92.4

S. No.	Soil Parameters	Location		
		Jaigaon	Madarihat	Chandrabandha
12	Potassium mg/kg	36	39	31
13	Phosphorous mg/kg	255	270	269
14	Nitrogen mg/kg	201	209	211

124. **Soil reaction classes and critical limits for Macro and Micro nutrients in soil :** According to Soil Survey Manual (IARI, 1970), the soils are grouped under different soil reaction classes viz extremely acidic (pH<4.5), very strongly acidic (pH 4.5 – 5.0), strongly acidic (pH 5.1 – 5.5), moderately acidic (pH 5.6-6.0), slightly acidic (pH 6.1-6.5), neutral (pH 6.6- 7.3), slightly alkaline (pH 7.4-7.8), moderately alkaline (pH 7.9-8.4), strongly alkaline (pH 8.5-9.0).The soils are rated as low (below 0.50 %), medium (0.50-0.75 %) and high (above 0.75 %) in case of organic carbon, low (<280 kg ha-1), medium (280 to 560 kg ha-1) and high (>560 kg ha-1) in case of available nitrogen, low (< 10 kg ha-1), medium (10 to 25 kg ha-1) and high (> 25 kg ha-1) for available phosphorus, low (< 108 kg ha-1), medium (108 to 280 kg ha-1) and high (> 280 kg ha-1) for available potassium and low (<10 mg kg-1), medium (10-20 mg kg-1) and high (> 20 mg kg-1) for available sulphur (Singh et. al. 2004, Mehta et. al.1988). Critical limits of Fe, Mn, Zn, Cu and B, which separate deficient from non-deficient soils followed in India are 4.5, 2.0, 0.5, 0.2 and 0.5 mg kg-1 respectively. (Follet and Lindsay, 1970 and Berger and Truog, 1940).

3. Interpretation of Soil Characteristics

125. Interpretation of Soil Characteristic has been dwelled in following sub-sections.

126. **Soil Texture:** The soils of study area are alluvial soil. Thus the soil texture ranges from clay to Sandy loam as per triangular classification of soil texture.

127. **Soil Reaction:** Soil pH is an important soil property, which affects the availability of several plant nutrients. It is a measure of acidity and alkalinity and reflects the status of base saturation.

128. AH 2: The soil pH ranges from 8.2-8.3, thereby indicating the soil is moderately alkaline.

129. AH 48: The soil pH ranges from 7.4 to 7.9, thereby indicating the soil is slightly alkaline

130. **Macronutrients :** Nutrients like nitrogen (N), phosphorus (P) and potassium (K) are considered as primary nutrients and sulphur (S) as secondary nutrient. These nutrients help in proper growth, development and yield differentiation of plants and are generally required by plants in large quantity.

131. **Available Nitrogen :** Nitrogen is an integral component of many compounds including chlorophyll and enzyme essential for plant growth. It is an essential constituent for amino acids which is building blocks for plant tissue, cell nuclei and protoplasm. It encourage aboveground vegetative growth and deep green colour to leaves. Deficiency of nitrogen decreases rate and extent of protein synthesis and result into stunted growth and develop chlorosis.

132. AH: 2: Available nitrogen content in the surface soils ranges between 236-250 mg/kg thereby indicating that soils are high in available nitrogen content.

133. AH-48: Available nitrogen content in the surface soils ranges between 201-211 mg/kg thereby indicating that soils are high in available nitrogen content.

134. **Available Phosphorus** : Phosphorus is important component of adenosine di-phosphate (ADP) and adenosine tri-phosphate (ATP), which involves in energy transformation in plant. It is essential component of deoxyribonucleic acid (DNA), the seat of genetic inheritance in plant and animal. Phosphorous take part in important functions like photosynthesis, nitrogen fixation, crop maturation, root development, strengthening straw in cereal crops etc. The availability of phosphorous is restricted under acidic and alkaline soil reaction mainly due to P-fixation. In acidic condition it gets fixed with aluminium and iron and in alkaline condition with calcium.

135. AH-2: Available phosphorus content ranges between 220 and 245 mg/kg thereby indicating that soils are high in available phosphorus.

136. AH-48: Available phosphorus content ranges between 255-270 mg/kg thereby indicating that soils are low to medium in available phosphorus.

137. **Available Potassium** : Potassium is an activator of various enzymes responsible for plant processes like energy metabolism, starch synthesis, nitrate reduction and sugar degradation. It is extremely mobile in plant and help to regulate opening and closing of stomata in the leaves and uptake of water by root cells. It is important in grain formation and tuber development and encourages crop resistance for certain fungal and bacterial diseases.

138. AH-2: Available potassium content in these soils ranges between 31 and 36 mg/kg thereby indicating that the soils are low to medium in potassium content.

139. AH-48: Available potassium content in these soils ranges between 32-39 mg/kg thereby indicating that the soils are low to medium in potassium content

D. Biological Environment

1. Biodiversity Scenario of India

140. Biodiversity or Biological diversity is a term coined to describe the immense variety and richness of life on this planet. Biodiversity includes not only the many species that exists, but also the diversity of population that makes up a species, the genetic diversity among individual's life form and the many different habitats and ecosystems around the globe. The benefits arising from the conservation of components of biological diversity can be considered in three groups: ecosystem services, biological resources and social benefits.

141. India is very rich in terms of biological diversity due to its unique bio-geographical location, diversified climatic conditions and enormous eco-diversity and geo-diversity. India's immense biological diversity encompasses ecosystems, populations, species and their genetic make-up. This diversity can be attributed to the vast variety in physiography and climatic situations resulting in a diversity of ecological habitats ranging from tropical, sub-tropical, temperature, alpine to desert. According to world biogeographic classification, India represents two of the major realms (the Palaearctic and Indo-Malayan) and three biomes (Tropical Humid Forests, Tropical Dry/Deciduous Forests and Warm Deserts/Semi-Deserts). India is one of the 17 mega diverse countries of the world. With only 2.4% of the world's land area, 16.7% of the world's human population and 18% livestock, it contributes about 8% of the known global biodiversity. India is home to world's largest wild tigers population and has got unique assemblage of globally important endangered species like Asiatic lion, Asian

Elephant, One-horned Rhinoceros, Gangetic River Dolphin, Snow Leopard, Kashmir Stag, Dugong, Gharial, Great Indian Bustard, Lion Tailed Macaque etc (Ministry of Environment and Forests).

142. India has a network of 668 Protected Areas (PAs), extending over 1,61,221.57 sq. kms. (4.90 % of total geographic area of the country), comprising 102 National Parks, 515 Wildlife Sanctuaries, 47 Conservation Reserves and 4 Community Reserves. UNESCO has designated 5 Protected Areas as World Heritage Sites. There are 4 categories of the Protected Areas viz, National Parks, Sanctuaries, Conservation Reserves and Community Reserves. (Ministry of Environment and Forests).

143. In terms of plant diversity, India ranks tenth in the world and fourth in Asia. With over 45,500 plant species, India represents nearly 11% of the world's known floral diversity. As elsewhere in the world, many organisms especially in lower groups such as bacteria, fungi, algae, lichens and bryophytes are yet to be described and remote geographical areas are to be comprehensively explored. The richness of Indian plant species as compared to the world is shown in **Table 36.**

Table 36 : Number of species in major groups of plants and microorganisms

Plant groups	No. of species described		% of India to the world
	India	World	
Virus/Bacteria	850	8,050	10.6
Algae	7175	40,000	17.9
Fungi	14,500	72,000	20.1
Lichens	2223	13,500	16.4
Bryophytes	2500	14500	17.2
Pteridophytes	1,200	10,000	12.0
Gymnosperms	67	650	10.3
Angiosperms	17,527	2,50,000	7.0

Source: BSI, 2009

144. Although India has only 2% of world's total land surface, it holds nearly 7.50% of the species of animals that the world has, which accounts for 92,037 species so far known which are displayed in the table below (Zoological survey of India) (**Table 37**)

Table 37 : Estimated Faunal Diversity of India

Taxonomic group	No. of species		% in India
	World	India	
PROTISTA (Protozoa)	31,250	2,577	8.24
Arthropoda	999,059	71,480	7.15
Chordata	46,499	5,163	10.65
Pisces	21,734	2,641	12.15
Amphibia	5,185	312	6.02
Reptilia	5,819	462	7.94
Aves	9,026	1,232	13.66
Mammalia	4,629	397	8.58
Total (Animalia)	**1,195,759**	**89,460**	**7.48**
Grand Total (Protista+Animalia)	**1,227,009**	**92,037**	**7.50**

Source: Animal Discovery 2011, Compiled by: Director, ZSI (Updated January, 2012)

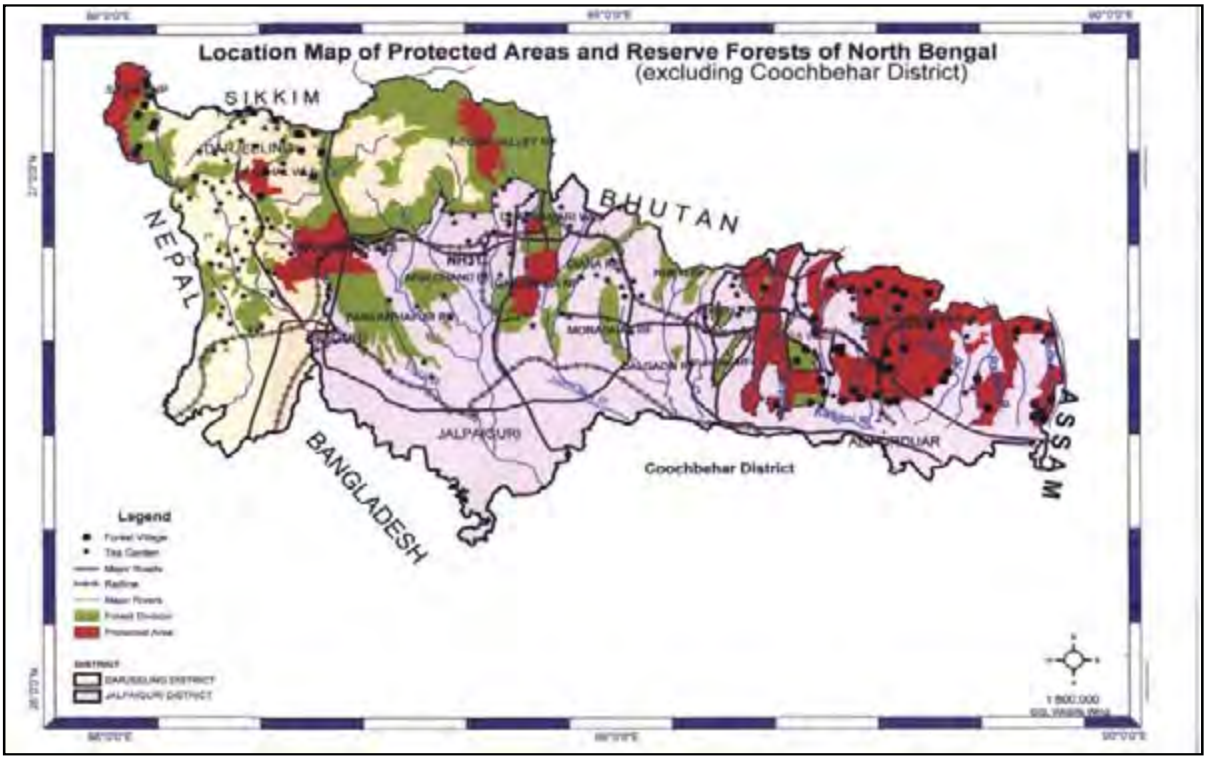
2. Biodiversity of West Bengal and Project Area

145. The climate and physiography of the state supports a huge diversity of life forms covering just 2.7% of the Indian landmass, it is home to 12.27% of Indian biodiversity known till date. The state has more than 7000 species of described flora including bacteria, algae, fungi, bryophytes, pteridophytes and angiosperms and more than 10,000 species of described fauna.

146. The forests of West Bengal are classified into seven categories viz., Tropical Semi-Evergreen Forest, Tropical Moist Deciduous Forest, Tropical Dry Deciduous Forest, Littoral and Swampy Forest, Sub -Tropical Hill Forest, Eastern Himalayan Wet Temperate Forest and Alpine Forest. The state has a recorded forest land of 11,879 sq. km., of which 7,054 sq. km. is Reserved Forest, 3,772 sq. km. is Protected Forest and 1,053 sq. km. is Unclassified State Forest, thus constituting 13.38% of the geographical area of the state. Under the conservation and protection regime the State has one Biosphere Reserve, two Tiger Reserves, five National Parks and 15 Wildlife Sanctuaries (West Bengal State Action Plan on Climate Change report, Government of India, 2010).

147. North Bengal is extremely rich in forests which has 1 National Park, 1 Tiger Reserve and 3 sanctuaries and is one of the important elephant habitat housing nearly 400 resident elephants which is 1.5% of the total elephant population in India. This region is also habitat of large mammals like Rhinoceros, Tiger, Gaur and many other smaller vertebrates. There are 16 mammals listed in Red Data Book of IUCN; 18 mammals occurring here are listed in the CITES **Appendix 9.1**. The forests here host 50-60% of species richness of the state. Notified Protected Areas cover 1225 sq. km i.e., 55% of the forests in Northern Bengal. (**Figure 46**) (WWF, India)

Figure 46. : Location map of protected areas and Reserve Forests of North Bengal excluding Cooch Behar



148. Forests and Floral species: North Bengal districts studied were Darjeeling and Jalpaiguri and Cooch Behar. (**Table 38**).

Table 38 : District wise Area under Forests by Legal Status in West Bengal (Area in Sq.Km.)

Sl. No.	District	Reserved Forests	Protected Forests	Unclassed State Forests & others	Total Area
1	Darjeeling	1,115	-	89	1,204
2	Jalpaiguri	1,483	217	90	1,790
3	Cooch Behar	-	42	15	57

Source: State Forest Report West Bengal 2010-2011

149. Out of total forest area of West Bengal 11,879 sq km. above three districts constitute nearly 26% of the forest of West Bengal. (**Table 39**).

Table 39 : Major Forest Types of West Bengal

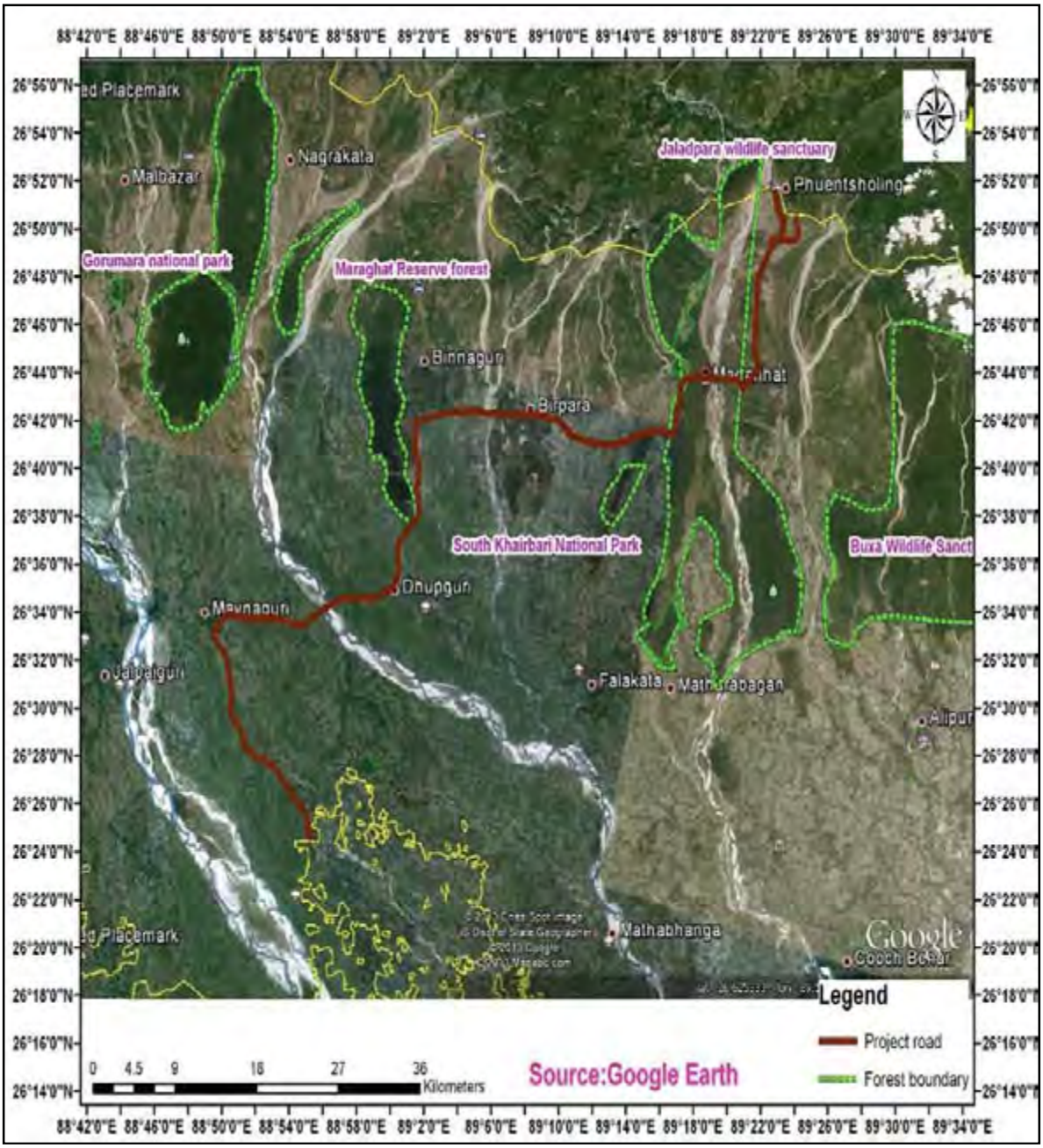
Group Name:	Location	Sites	Area	Species
Group 1B: Northern Tropical Wet Evergreen Forests	Plains of North Bengal up to 150 m. altitude.	Bagdogra range of Kurseong divison, Khutimari areas of Jalpaiguri division, Damanpur, Cheko, Gadadhar, Rajabhatkhawa, Rydak of Buxa Tiger Reserve	167 sq.km.	Sal, Nageshwar, Jam, Kainjal, Lator, Malagiri, Lali & Canes
Group 2B: Northern Sub-Tropical Semi -Evergreen Forests	North Bengal	Sumbong, Peshok, Buxaduar	25 sq.km.	Champ, Panisaj, Gokul, Angare
Group 3C: North India Moist Deciduous Forests	North Bengal	Almost entire duars and terai area	1757 sq.km.	The most important forests of the State are in this sub-montane belt consisting of Sal with Champ, Chilauni, Chikrassi, Gamar, Lali, Lasune, Panisaj, Paccasaj interspresed with riverian forests of Khair, Sissoo, Simul, Toon etc., representing succession from riverian to climax sal.

Source: State Forest Report West Bengal 2010-2011

150. The project area is falling two districts of North Bengal viz., Project area: AH-2 which is passing through Darjeeling districts and Project area AH-48 which is passing through Jalpaiguri district in North Bengal. Forest boundary and Project Road for AH-2 alignment and Forest boundary and Project Road for AH-48 alignment are shown in **Figure 47** and **Figure 48.**

Figure 47. : Map showing Forest boundary and Project Road: AH-2

Figure 48. : Map showing Forest boundary and Project Road: AH-48



3. Terrestrial ecology

151. **Methods and Methodology for assessment of floral diversity:** The study was carried out during the month of March and May 2012. A detailed investigation was made to

analyse overall vegetation profile and floral resource characteristics within 10 m from the centre of the proposed road in a 1 km. Milometer of the vehicle is used for measuring purpose. The land use and vegetation type was collected by visual observation as well as secondary data. Forest Working Plans of the Forest Divisions under which the project area were present as well as various published and unpublished reports were used as the secondary source of data. Personnel Interviews were conducted with local people for extracting information for base line as well as impacts and mitigation measures.

152. Surveys were conducted for phyto-sociological attributed through quadrate methods and floral assessments were done for frequency, density abundance and relative values. These gave diversity indices for local flora and important value index (IVI) for importance of species in the plant communities. These have been mentioned in the table. Attempts were made to identify medicinal and economically important plants of the area using standard methods.

153. **Tree species with high index values**: Baseline data was collected for assessment for tree species abundance and diversity in project area AH- 2 and AH-48. Following is the detailed listing of tree species with high IVI values along various sections of study areas. (**Table 40** and **Table 41**).

Table 40 : Tree species with high IVI value along various sections of study area AH-2

Site Name : 1st section (from kakarbitha/panitanki)				
1	Left Side	Luha siris	Albizzia lucidor	26.60
		Belkar	Trewia nudiflora	24.87
2	Right side	Bot	Ficus benghalensis	23.36
		Gameri	Gaemelina arborea	22.37
Site Name : 2nd section				
1	Left Side	Bot	Ficus benghalensis	25.69
		Kathal	Artocarpus heterophyllus	21.01
2	Right side	Belker	Trewia nodiflora	28.40
		Bot	Ficus benghalensis	24.75
-	**Site Name : 3rd section (upto Changrabahda)**			
1	Left Side	Makal ban	Bambusa nutans	50.59
		Belker	Trewia nodiflora	24.66
2	Right side	Makal bans	Bambusa nutans	40.91
		Belker	Trewia nodiflora	37.89
-	**Site Name : 4thsection (ending at Phulbari)**			
1	Left Side	Makal ban	Bambusa nutans	40.56
		Kadam	Anthocephalus cadamba	22.57
2	Right side	Makal bans	Bambusa nutans	30.70
		Supari	Areca catechu	20.29
-	**Site Name : Medical more to truck terminus**			
1	Left Side	Luha siris	Albizzia lucidor	106.98
		Ahat	Ficus religiosa	22.27
2	Right side	Jika	Linnea grandis	23.90
		Luha siris	Albizzia lucidor	23.59

Table 41 : Tree species with high IVI value along various sections of study area AH-48

Site Name : Alternate II (UP)				
S.N		Local name	Scientific name	IVI
1	Left Side	Supari	Areca catechu	69.67
		Kathal	Artocarpus heterophyllus	50.47

2	Right side	Kathal	Artocarpus heterophyllus	50.57
		Aam	Mangifera indica	49.87
-	**Site Name : Alternate II (Down)**			
1	Left side	Parli	-	110.17
		Gahara	-	108.10
2	Right side	Gahara	-	110.26
		Parli	-	108.24
-	**Site Name : 1st section starting from Jaigoan**			
1	Left side	Gura neem	Melia azedirachta	59.76
		Koroi	Albizzia lebbek	55.53
2	Right side	Supari	Areca catechu	41.62
		Aam	Mangifera indica	40.45
-	**Site Name : 2nd section**			
1	Left Side	Koroi	Albizzia lebbek	71.88
		Gura neem	Melia azedirachta	63.70
2	Right side	Supari	Areca catechu	48.07
		Koroi	Albizzia lebbek	46.34
-	**Site Name : 3rd section**			
1	Left Side	Semul	Bombax ceiba	35.987
		Belker	Trewia nodiflora	33.75
2	Right side	Semul	Bombax ceiba	58.35
		Belkar	Trewia nudiflora	42.98
-	**Site Name : 4th section**			
1	Left Side	Kola	Musa sps.	46.53
		Barua bans	Bambusa arundinacea	21.04
2	Right side	Kola	Musa sps.	62.77
		Belkar	Trewia nudiflora	17.36
-	**Site Name : 5th section**			
1	Left Side	Makal ban	Bambusa nutans	76.15
		Bot	Ficus benghalensis	22.30
2	Right side	Makal bans	Bambusa nutans	47.65
		Bot	Ficus benghalensis	23.07
-	**Site Name : 6th section**			
1	Left Side	Barua bans	Bambusa arundinacea	57.08
		Acacia	Acacia auriculiformis	16.54
2	Right side	Acacia	Acacia auriculiformis	33.90
		Ajar	Largerstoemia speciosa	17.79
-	**Site Name : 7th section**			
1	Left Side	Acacia	Acacia auriculiformis	61.48
		Bot	Ficus benghalensis	24.47
2	Right side	Kola	Musa sps.	57.34
		Acacia	Acacia auriculiformis	28.62
-	**Site Name : 8th section**			
1	Left Side	Bijli bans	Bambusa pallida	48.67
		Bot	Ficus benghalensis	28.17
2	Right side	Acacia	Acacia auriculiformis	65.32
		Bot	Fius benghalensis	44.47
-	**Site Name : 9th section**			
1	Left Side	Kola	Musa sps.	69.34
		Bot	Ficus benghalensis	30.49
2	Right side	Kola	Musa sps.	42.82

		Bijli bans	Bambusa pallida	23.47
-	**Site Name : 10th section**			
1	Left Side	Kola	Musa sps.	35.31
		Makal ban	Bambusa nutans	31.19
2	Right side	Makal bans	Bambusa nutans	38.59
		Barua bans	Bambusa arundinacea	24.99
-	**Site Name : 11th section (upto changrabahda)**			
1	Left Side	Kola	Musa sps.	60.11
		Aam	Mangifera indica	
2	Right side	Makal bans	Bambusa nutans	32.47
		Kola	Musa sps.	25.98

154. **Floral surveys**: The floral survey along AH-2 and AH-48 road corridors gave detailed list of species along with their usage which are described in **Table 42**. A summary of total tree species encountered on left and right side of the road are given in **Table 43**.

Mossaic forest along the AH-2

Forest Plantation along the road

Table 42 : Floral species within (Right of Way) Project Road AH-2

Chainage (10 Km Band)	No of trees on left side of the road within 10m from canter of the road	No of Trees on right side of the road within 10 M from canter of the road
0-10 Km	492	452
11-20 Km	564	585
21-30 Km	935	621
31-38 Km	811	692
Truck terminus to Medical more 0-11 Km	123	2451

Table 43 : List of Flora species observed along road alignment AH-2

S.N.	Scientific Name of the Floral species	Local Name of the Floral species	Status & Use
1	Mangifera Indica	Aam	Fruit, Timber
2	Acacia auriculiformis	Acacia	Medicinal, Timber
3	Ficus religiosa	Ahat	Religious
4	Ailanthus sp.	Ailanthus	Timber, fire wood
5	Lagerstroemia speciosa	Ajar	Timber
6	Cassia fistula	Amaltas/ Sunaru	Ornamental, Timber
7	Calotropis procera	Akan	Medicinal

S.N.	Scientific Name of the Floral species	Local Name of the Floral species	Status & Use
8	Annona squamosa	Atafal	Fruit
9	Mimusops elengi	Bakul	Medicinal
10	Bambusa arundinacea	Barua Bans	Misc. use
11	Oroxylum indicum	Batgila	Medicinal, Timber
12	Aegle marmelos	Bel	Medicinal
13	Trewia nodiflora	Belker	Timber
14	Salix tetrasperma	Bher	Timber
15	Callistemon sp.	Bottle brush	Ornamental
16	Ficus benghalensis	Bot	Religious
17	Dillenia indica	Chalta	Medicinal, Fruit
18	Caryota urens	Chaur	Ornamental
19	Polyanthia longifolia	Dabdaru	Timber, ornamental
20	Ficus lepidosa	Dumur	Fodder
21	Eucalyptus maculata	Eucalyptus	Timber
22	Ficus sp.	Ficus	Religious
23	Gamelina arborea	Gameri	Timber, Medicinal
24	Delonix regia	Gulmohor	Ornamental
25	Melia azedirachta	Gura Neem	Timber
26	Ficus sp.	Jagya Dumur	Religious
27	Syzygium cumini	Jamun	Fruit, Timber
28	Linnea grandis	Jika	Fire wood
29	Anthocephalus cadamba	Kadam	Timber, Fire wood
30	Bamboosa hamiltonii	Kako Bans	Misc.use
31	Artocarpus heterophyllus	Kathal	Fruits, Timber
32	Pithecellobium angulatum	Khori	Fire wood
33	Albizzia lebbek	Koroi	Timber, Fire wood
34	Ziziphus jujuba	Kul	Fruits
35	Litchi chinensis	Lichi	Fruits
36	Albizzia lucidor	Luha siris	Timber
37	Erythrina indica	Madar	No particular use
38	Bambusa nutans	Makal bans	Misc. use
39	Cocos nucifera	Narikol	Fruits
40	Azadirecta indica	Neem	Medicinal, Timber
41	Butea monosperma	Palas	Medicinal, Timber
42	Psidium guajava	Piyara	Fruits
43	Chukrassia tabularis	Poma	Timber
44	Hevea brasilliensis	Rubber	Ornamental
45	Tectona grandis	Sagun	Timber
46	Moringa oleifera	Sajna	Vegetable
47	Alstonia scholaris	Satiana	Medicinal, Timber
48	Bombex cebia	Semul	Medicinal, Timber
49	Samanea saman	Siris/Beladuba	Timber
50	Dalbergia sisoo	Sissoo	Timber
51	Areca catechu	Supari	Fruit
52	Tamarindus indica	Tetul	Fruits, Timber

Tea Garden Home for small mammals

NBU –Home for small mammals, birds, butterflies and herpetofauna along the AH-2

Rural area faunal habitat

155. **AH-48**: Among the plant species observed along the proposed alignment AH-48 that crosses through Jaldapara national sanctuary, the most abundant floral species along are

Silk cotton (Bombax ceiba), Bael (Aegle marmelos), Ber (Ziziphus jujube) et. (**Table 44** and **Table 45**).

Table 44 : Floral species within Right of Way Project Road AH-48

Chainage (10 Km Band)	No of trees on left side of the road within 10m from canter of the road	No of Trees on right side of the road within 10 M from canter of the road
0-10 Km	1141	2,209
11-20 Km	2,309	1,132
21-30 Km	2,308	1,136
31-40 Km	1,283	874
41-50 Km	893	1,991
51- 60 Km	1,456	970
61- 70 Km	4,067	2,906
71- 80 Km	2,106	1,568
81- 90 Km	478	348
91-100 Km	180	325
101-110 Km	228	249
Alternate I (0- 7 Km)	5,642	5,698
Alternate II (0- 7 Km)	344	284

Table 45 : List of Floral species observed along road alignment AH-48

S. No.	Scientific Name of the species	Local Name of the species	Status & Use
1	Mangifera Indica	Aam	Fruit, Timber
2	Acacia auriculiformis	Acacia	Medicinal, Timber
3	Ficus religiosa	Ahat	Religious
4	Lagerstroemia speciosa	Ajar	Timber
5	Cassia fistula	Amaltas/ Sunaru	Ornamental, Timber
6	Phyllanthus emblica	Amla	Fruit
7	Ananas comosus	Anaras	Fruit
8	Terminalia arjuna	Arjun	Medicinal, Timber
9	Annona squamosa	Atafal	Fruit
10	Mimusops elengi	Bakul	Medicinal
11	Bambusa arundinacea	Barua Bans	Misc. use
12	Oroxylum indicum	Batgila	Medicinal, Timber
13	Aegle marmelos	Bel	Medicinal
14	Trewia nodiflora	Belker	Timber
15	Salix tetrasperma	Bher	Timber
16	Terminalia belerica	Bhera	Medicinal, Timber
17	Bamboosa pallida	Bijli Bans	Misc.use
18	Ficus benghalensis	Bot	Religious
19	Dillenia indica	Chalta	Medicinal, Fruit
20	Caryota urens	Chaur	Ornamental
21	Polyanthia longifolia	Dabdaru	Timber, ornamental
22	Ficus lepidosa	Dumur	Fodder
23	Eucalyptus maculata	Eucalyptus	Timber
24	Ficus sp.	Ficus	Religious
25	Gamelina arborea	Gameri	Timber, Medicinal

S. No.	Scientific Name of the species	Local Name of the species	Status & Use
26	Delonix regia	Gulmohor	Ornamental
27	Melia azedirachta	Gura Neem	Timber
28	Hibiscus rosa sinensis	Jaba phul	Ornamental
29	Ficus sp.	Jagya Dumur	Religious
30	Eleocarpus floribundus	Jalpai	Fruit
31	Citrus aurantifolia	Jambura	Fruit
32	Syzygium cumini	Jamun	Fruit, Timber
33	Linnea grandis	Jika	Fire wood
34	Anthocephalus cadamba	Kadam	Timber, Fire wood
35	Bamboosa hamiltonii	Kako Bans	Misc.use
36	Brugiera gymnorrhiza	Kakra	Fire wood
37	Averrhoa carambola	Kamranga	Fruit
38	Bauhinia purpurea	Kanchan	Ornamental
39	Artocarpus heterophyllus	Kathal	Fruits, Timber
40	Phoenix dactylifera	Khajur	Fruits
41	Pithecellobium angulatum	Khori	Fire wood
42	Albizzia lebbek	Koroi	Timber, Fire wood
43	Ziziphus jujuba	Kul	Fruits
44	Litchi chinensis	Lichi	Fruits
45	Albizzia lucidor	Luha siris	Timber
46	Erythrina indica	Madar	No particular use
47	Bambusa nutans	Makal bans	Misc. use
48	Cocos nucifera	Narikol	Fruits
49	Azadirecta indica	Neem	Medicinal, Timber
50	Butea monosperma	Palas	Medicinal, Timber
51	Carica papaya	Papaya	Fruits
52	Codiaeum variegatum	Pata Bahar	Ornamental
53	Psidium guajava	Piyara	Fruits
54	Chukrassia tabularis	Poma	Timber
55	Hevea brasilliensis	Rubber	Ornamental
56	Tectona grandis	Sagun	Timber
57	Moringa oleifera	Sajna	Vegetable
58	Alstonia scholaris	Satiana	Medicinal, Timber
59	Bombex cebia	Semul	Medicinal, Timber
60	Samanea saman	Siris/Beladuba	Timber
61	Dalbergia sisoo	Sissoo	Timber
62	Areca catechu	Supari	Fruit
63	Borassus flabelliformis	Tal	Fruits
64	Tamarindus indica	Tatul	Fruits, Timber
65	Thuja elastica	Thuja	Ornamental

156. **Threatened, rare and endangered and medicinal plants:** An assessment of Rare, threatened, endangered (RET) and medicinal plants were carried out in the Project area AH-2 and AH-48 which are shown in **Table 46** and **47**. Most of the species are observed to be endemic whereas very few are exotic like Acacia, Gulmohar, Khori and Eucalyptus, Bottlebrush etc. Among these only Delonix regia (Gulmohar) has been observed as vulnerable category as per IUCN.

Table 46 : Species recorded in the study area along with their status and use along proposed alignment AH-2

S. N.	Scientific Name of the species	Local Name of the species	Status (Endemic/Exotic)	Use	IUCN Status
1	Mangifera Indica	Aam	Endemic	Fruit, Timber	-
2	Acacia auriculiformis	Acacia	Exotic	Medicinal, Timber	Least Concern
3	Ficus religiosa	Ahat	Endemic	Religious	-
4	Ailanthus sp.	Ailanthus	Endemic	Timber, fire wood	-
5	Lagerstroemia speciosa	Ajar	Endemic	Timber	-
6	Cassia fistula	Amaltas/ Sunaru	Endemic	Ornamental, Timber	-
7	Calotropis procera	Akan	Endemic	Medicinal	-
8	Annona squamosa	Atafal	Endemic	Fruit	-
9	Mimusops elengi	Bakul	Endemic	Medicinal	-
10	Bambusa arundinacea	Barua Bans	Endemic	Misc. use	-
11	Oroxylum indicum	Batgila	Endemic	Medicinal, Timber	-
12	Aegle marmelos	Bel	Endemic	Medicinal	-
13	Trewia nodiflora	Belker	Endemic	Timber	-
14	Salix tetrasperma	Bher	Endemic	Timber	-
15	Callistomen sp.	Bottle brush	Exotic	Ornamental	-
16	Ficus benghalensis	Bot	Endemic	Religious	-
17	Dillenia indica	Chalta	Endemic	Medicinal, Fruit	-
18	Caryota urens	Chaur	Endemic	Ornamental	-
19	Polyalthia longifolia	Dabdaru	Endemic	Timber, ornamental	-
20	Ficus lepidosa	Dumur		Fodder	-
21	Eucalyptus maculata	Eucalyptus	Exotic	Timber	-
22	Ficus sp.	Ficus	Endemic	Religious	-
23	Gamelina arborea	Gameri	Endemic	Timber, Medicinal	-
24	Delonix regia	Gulmohor	Endemic	Ornamental	Vulnerable B1+2c
25	Melia azedirachta	Gura Neem	Endemic	Timber	-
26	Ficus sp.	Jagya Dumur	Endemic	Religious	-
27	Syzygium cumini	Jamun	Endemic	Fruit, Timber	-
28	Linnea grandis	Jika		Fire wood	-
29	Anthocephalus cadamba	Kadam	Endemic	Timber, Fire wood	-
30	Bamboosa hamiltonii	Kako Bans	Endemic	Misc.use	-
31	Artocarpus heterophyllus	Kathal	Endemic	Fruits, Timber	-
32	Pithecellobium angulatum	Khori	Exotic	Fire wood	-
33	Ricinus comunis	-	Exotic	-	-
34	Albizzia lebbek	Koroi	Endemic	Timber, Fire wood	-

S. N.	Scientific Name of the species	Local Name of the species	Status (Endemic/Exotic)	Use	IUCN Status
35	Ziziphus jujuba	Kul	Endemic	Fruits	Least Concern
36	Litchi chinensis	Lichi	Endemic	Fruits	-
37	Albizzia lucidor	Luha siris	Endemic	Timber	-
38	Erythrina indica	Madar	Endemic	No particular use	Least Concern
39	Bambusa nutans	Makal bans	Endemic	Misc. use	-
40	Cocos nucifera	Narikol	Endemic	Fruits	-
41	Azadirecta indica	Neem	Endemic	Medicinal, Timber	-
42	Butea monosperma	Palas	Endemic	Medicinal, Timber	-
43	Psidium guajava	Piyara	Exotic	Fruits	-
44	Chukrassia tabularis	Poma	Endemic	Timber	-
45	Hevea brasilliensis	Rubber	Endemic	Ornamental	-
46	Tectona grandis	Sagun	Endemic	Timber	-
47	Moringa oleifera	Sajna	Endemic	Vegetable	-
48	Alstonia scholaris	Satiana	Endemic	Medicinal, Timber	-
49	Bombex cebia	Semul	Endemic	Medicinal, Timber	-
50	Samanea saman	Siris/Beladuba	Endemic	Timber	-
51	Dalbergia sisoo	Sissoo	Endemic	Timber	-
52	Areca catechu	Supari	Endemic	Fruit	-
53	Tamarindus indica	Tetul	Endemic	Fruits, Timber	-

Table 47 : Species recorded in the study area along with their status and use along proposed AH- 48

S.N	Scientific Name of the species	Local Name of the species	Status (Endemic /Exotic)	Use	IUCN Status
1.	*Mangifera Indica*	Aam	Endemic	Fruit, Timber	-
2.	*Acacia auriculiformis*	Acacia	Exotic	Medicinal, Timber	Least Concern
3.	*Ficus religiosa*	Ahat	Endemic	Religious	-
4.	*Lagerstroemia speciosa*	Ajar	Endemic	Timber	-
5.	*Cassia fistula*	Amaltas/ Sunaru	Endemic	Ornamental, Timber	-
6.	*Phyllanthus emblica*	Amla	Endemic	Fruit	-
7.	*Ananas comosus*	Anaras	Endemic	Fruit	-
8.	*Terminalia arjuna*	Arjun	Endemic	Medicinal, Timber	-
9.	*Annona squamosa*	Atafal	Endemic	Fruit	-
10.	*Mimusops elengi*	Bakul	Endemic	Medicinal	-
11.	*Bambusa arundinacea*	Barua Bans	Endemic	Misc. use	-
12.	*Oroxylum indicum*	Batgila	Endemic	Medicinal, Timber	-

S.N	Scientific Name of the species	Local Name of the species	Status (Endemic /Exotic)	Use	IUCN Status
13.	*Aegle marmelos*	Bel	Endemic	Medicinal	-
14.	*Trewia nodiflora*	Belker	Endemic	Timber	-
15.	*Salix tetrasperma*	Bher	Endemic	Timber	-
16.	*Terminalia belerica*	Bhera	Endemic	Medicinal, Timber	-
17.	*Bamboosa pallida*	Bijli Bans	Endemic	Misc.use	-
18.	*Ficus benghalensis*	Bot	Endemic	Religious	-
19.	*Dillenia indica*	Chalta	Endemic	Medicinal, Fruit	-
20.	*Caryota urens*	Chaur	Endemic	Ornamental	-
21.	*Polyanthia longifolia*	Dabdaru	Endemic	Timber, ornamental	-
22.	*Ficus lepidosa*	Dumur	Endemic	Fodder	-
23.	*Eucalyptus maculata*	Eucalyptus	Exotic	Timber	-
24.	*Ficus sp.*	Ficus	Endemic	Religious	-
25.	*Gamelina arborea*	Gameri	Endemic	Timber, Medicinal	-
26.	*Delonix regia*	Gulmohor	Exotic	Ornamental	0 Vulnerable B1+2c
27.	*Melia azedirachta*	Gura Neem	Endemic	Timber	-
28.	*Hibiscus rosa sinensis*	Jaba phul	Endemic	Ornamental	-
29.	*Ficus sp.*	Jagya Dumur	Endemic	Religious	-
30.	*Elaceocarpus floribundus*	Jalpai	Endemic	Fruit	-
31.	*Citrus aurantifolia*	Jambura	Endemic	Fruit	-
32.	*Syzygium cumini*	Jamun	Endemic	Fruit, Timber	-
33.	*Linnea grandis*	Jika	Endemic	Fire wood	-
34.	*Anthocephalus cadamba*	Kadam	Endemic	Timber, Fire wood	-
35.	*Bamboosa hamiltonii*	Kako Bans	Endemic	Misc.use	-
36.	*Averrhoa carambola*	Kamranga	Exotic	Fruit	-
37.	*Bauhinia purpurea*	Kanchan	Endemic	Ornamental	Least Concern
38.	*Artocarpus heterophyllus*	Kathal	Endemic	Fruits, Timber	-
39.	*Phoenix dactylifera*	Khajur	Endemic	Fruits	-
40.	*Pithecellobium angulatum*	Khori	Exotic	Fire wood	-
41.	*Albizzia lebbek*	Koroi	Endemic	Timber, Fire wood	-
42.	*Ziziphus jujuba*	Kul	Endemic	Fruits	Least Concern
43.	*Litchi chinensis*	Lichi	Endemic	Fruits	-
44.	*Albizzia lucidor*	Luha siris	Endemic	Timber	-
45.	*Erythrina indica*	Madar	Endemic	No particular use	Least Concern
46.	*Bambusa nutans*	Makal bans	Endemic	Misc. use	-

S.N	Scientific Name of the species	Local Name of the species	Status (Endemic /Exotic)	Use	IUCN Status
47.	*Cocos nucifera*	Narikol	Endemic	Fruits	-
48.	*Azadirecta indica*	Neem	Endemic	Medicinal, Timber	-
49.	*Butea monosperma*	Palas	Endemic	Medicinal, Timber	-
50.	*Carica papaya*	Papa	Endemic	Fruits	-
51.	*Codiaeum variegatum*	Pata Bahar	Endemic	Ornamental	-
52.	*Psidium guajava*	Piyara	Endemic	Fruits	-
53.	*Chukrassia tabularis*	Poma	Endemic	Timber	-
54.	*Hevea brasilliensis*	Rubber	Endemic	Ornamental	-
55.	*Tectona grandis*	Sagun	Endemic	Timber	-
56.	*Moringa oleifera*	Sajna	Endemic	Vegetable	-
57.	*Alstonia scholaris*	Satiana	Endemic	Medicinal, Timber	Lower Risk/least concern
58.	*Bombex cebia*	Semul	Endemic	Medicinal, Timber	-
59.	*Samanea saman*	Siris/Beladuba	Endemic	Timber	-
60.	*Dalbergia sisoo*	Sissoo	Endemic	Timber	-
61.	*Areca catechu*	Supari	Endemic	Fruit	-
62.	*Borassus flabelliformis*	Tal	Endemic	Fruits	-
63.	*Tamarindus indica*	Tatul	Endemic	Fruits, Timber	-
64.	*Thuja elastica*	Thuja	Exotic	Ornamental	-

4. Terrestrial Fauna

157. **Methodology of Baseline Data Collection**: The animal species data were collected along the studied Asian Highway (AH-2 and AH-48) through direct sighting methods, indirect evidences and as well as the information obtained from local inhabitants. Detailed surveys and samplings were conducted at various locations within a stretch of 7 KM parallel along the highway chainage for enumeration of animal abundance. Along with the primary survey, local inhabitants were interviewed to confirm the species occurrence in the project areas. Remains of body parts of animal, dung in the area also taken into consideration for animal identification. The criteria of IUCN (2008), Wildlife Protection Act (1972) and CITES categorization were followed to describe the conservation status of the species. Identification of Mammalian, Avian and Reptilian species were made as per the available Books and published materials[26,27,28]. Analysis was done as per the standard methods[29,30],

[26] Menon, B. (2003). A Field Gudie to Indian Mammals, D. K. Publication, Delhi, pp. 201.
[27] Ali, S. and Riplley, S. D. (1987). Handbook of Birds of India and Pakistan, 2nd edition, Delhi: Oxford University Press, Oxford, pp. 700.
[28] Ahmed M.F, Das, A. and Dutta S.K.(2009) Amphibians and Reptiles of North East India, A Photographic Guide. Aaranyak, Guwahati ,Assam.
[29] Magurran, A. E. (1988). Ecological Diversity and its Measurement, London: Chapman and Hall, pp. 179
[30] Dytham, C. (1999). Choosing and Using Statistics, A Biologist's Guide, Blackwell Science Ltd. Osney Mead, Oxford OX2 OEL, pp. 218

158. **Animal Data Collection**: The entire proposed Asian Highway is passing through the urban, peri-urban, rural, roadside mosaic forest and plantation areas. Hence, the entire stretch was divided into three distinct representative type of habitat i.e., urban, peri-urban, rural and forests. Data on the faunal diversity were collected within the 50 meter, 100meter and 150 meter on each side of the road. The methods which were followed during the faunal survey are given below:

- The Forest working plans of project area were used as the secondary information source for wildlife. Also various published and unpublished reports were consulted
- Personnel Interview of local people for extracting data on the presence and relative abundance of various animal species within the project area.
- Information on data habitat conditions, animal presence both through direct sighting and indirect evidences

159. **Methodology for Birds**: For the survey of the avian species line transects was found to best suited in the randomly selected areas of the AH-2 and AH-48 by counting them in line transects. To avoid double counting of birds detectable at long range, transects were widely spaced. The birds were detected and identified and counted in the field. A detailed survey of birds was carried out in the project sites and catchment area using the literatures of Ali & Ripley, 1987. Each site was sampled for during the period of study. Usually birds were surveyed in the morning hours (Burnham et.al., 1980).

160. **Methodology for Butterfly**: Survey was carried out for butterflies at various sites in the project area using line transect methods. The butterflies were detected and identified and counted in the field (Burnham et.al., 1980). The butterflies were surveyed during the noon hours.

161. **Methodology for Fish Fauna Study:** To study the fish fauna in the rivers, common fishing methods were. For fish identification publication of Talwar and Jhingran were refered (Source Inland fishes of India and adjacent countries-Vol. 1, Oxford and IBH Publishing Co. Pvt. ltd company, New Delhi, 541 pp., 1991)

162. **Results of the Faunal Survey :** The animals observed along proposed alignments AH-2 and AH-48 are mainly mammals, reptile, amphibian, aves and butterflies which are as listed in the **Appendix 9.1**

163. **Mammal species observed along AH-2 and AH-48 alignments:** Civets and bats were the prominent mammals observed in the project area. Other mammals found were Mongoose, weasel, dogs etc. (**Figure 49** and **50**).

Figure 49. : Mammal species observed along AH-2

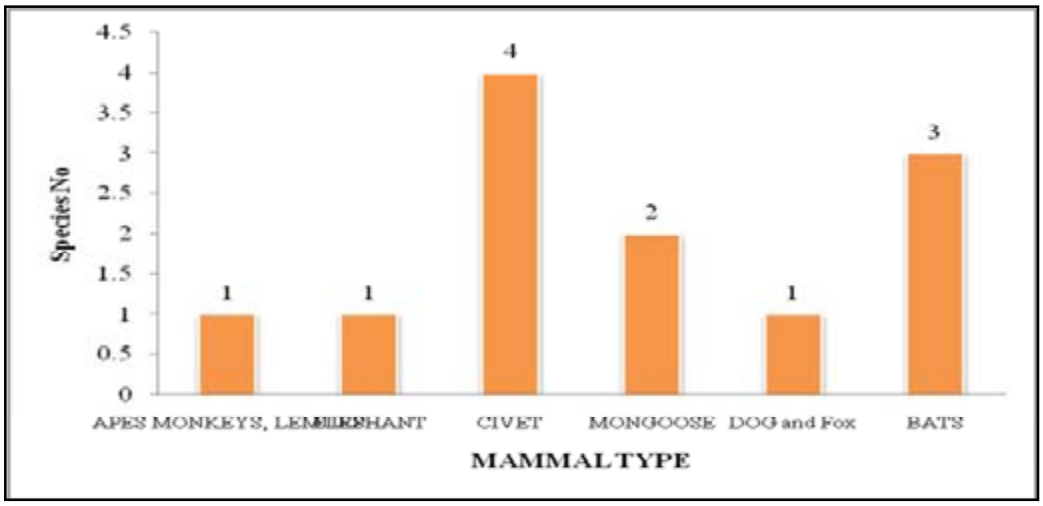
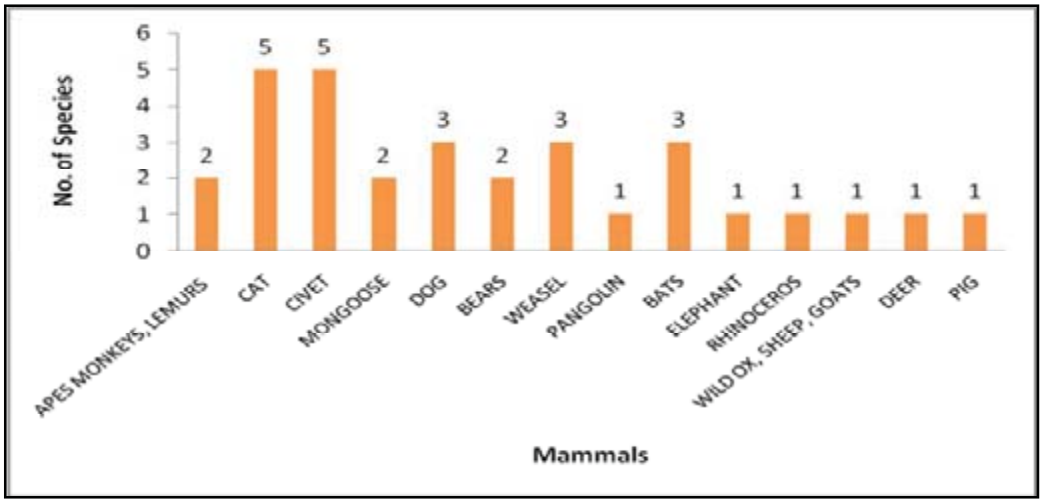


Figure 50. : Mammal species observed along AH-48



164. **Birds species observed along AH-2 and AH-48 alignments**: Altogether 84 species of avian fauna belonging 34 families were found along the Nepal-India-Bangladesh AH-2 alignment and 109 species of avian fauna belonging to 34 families were found in Bhutan-India-Bangladesh AH-48 alignment (**Appendix 9.1**). Most of the birds were found residential though several migratory birds join the fleet during the winter season. Among migratory birds were ducks, geese and waders recorded at the rivers. (**Figure 51** to **52**).

Figure 51. : Bird species observed along AH-2

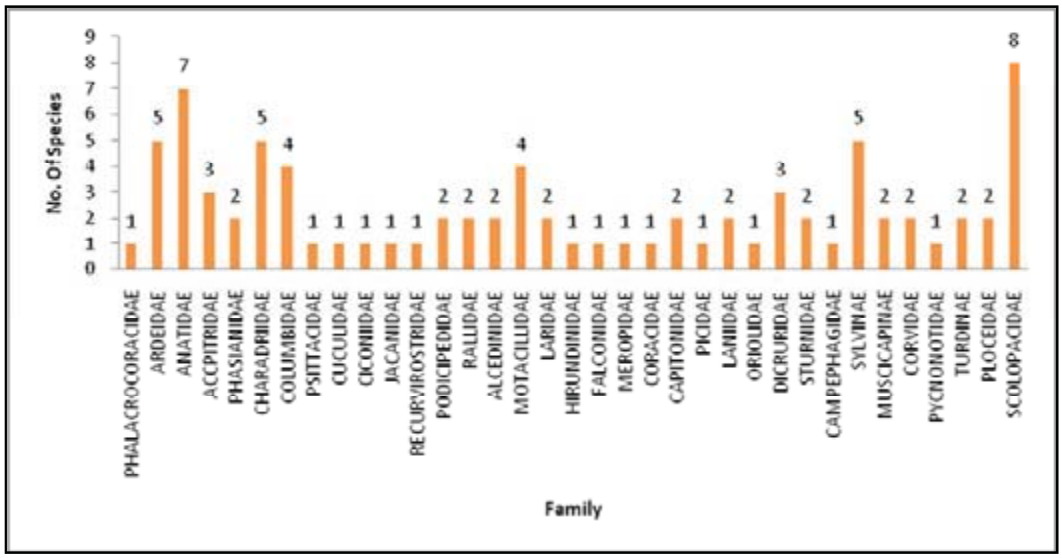
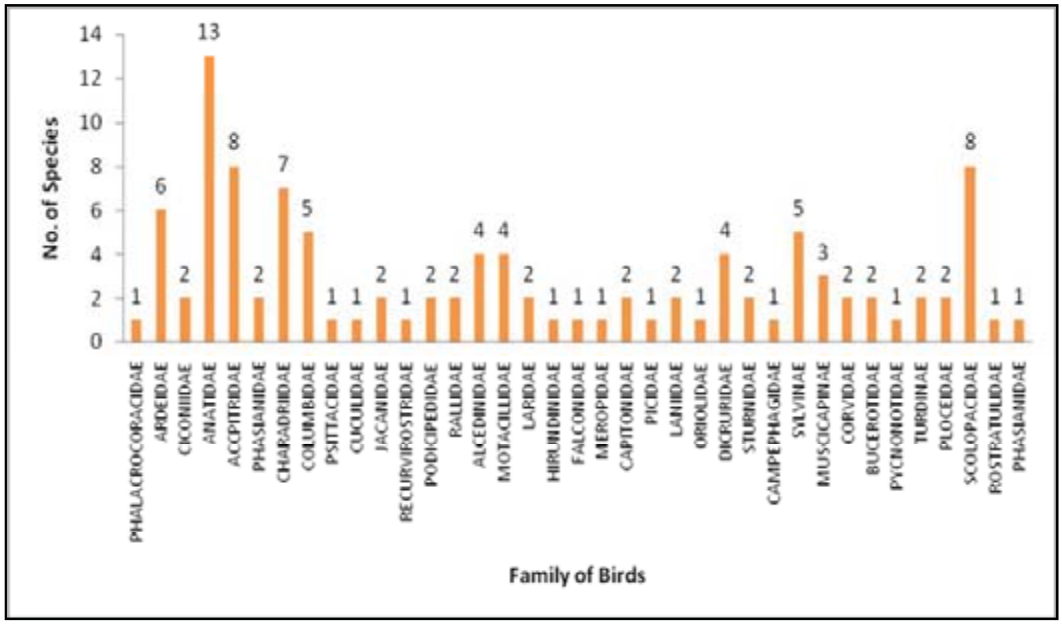


Figure 52. : Bird species observed along AH-48



165. **Reptiles species observed along AH-2 and AH-48 alignment**: Altogether 24 reptilian species were recorded which includes 13 snakes, 9 lizards and 4 turtles in Nepal-India-Bangladesh AH-2 and 30 reptilian species were recorded which includes 15 snake, 9 lizards and 6 turtles in Bhutan-India-Bangladesh AH 48. The comprehensive list of reptilian fauna is presented in **Appendix 9.1**.

166. A**mphibian Fauna observed along AH-2 and AH-48 alignment:** There were altogether 7 amphibian species recorded in Nepal-India-Bangladesh AH-2 and 13 amphibian species recorded in Bhutan-India-Bangladesh AH-48. The comprehensive list of amphibian fauna is presented in **Appendix 9.1**. The diversity of the herpetofauna is shown in the **Figure 53** to **54**.

Figure 53. : Amphibians species observed along AH-2

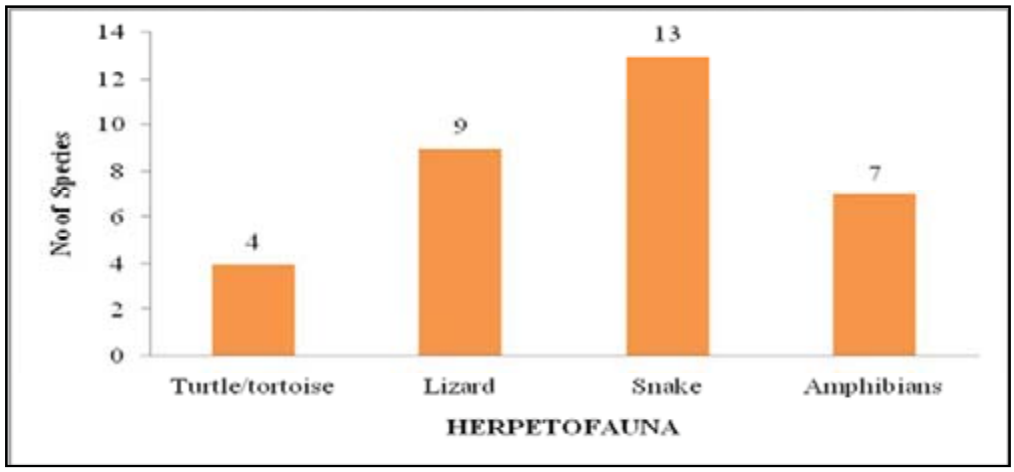
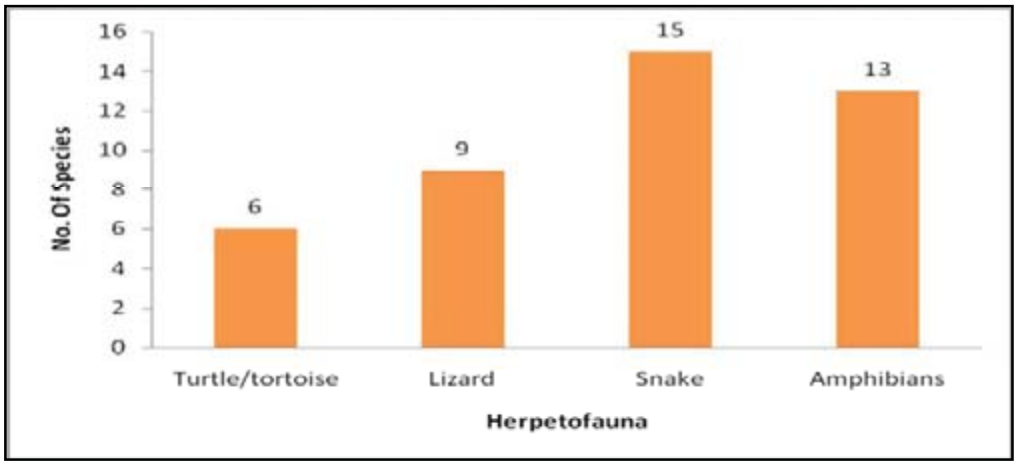


Figure 54. : Amphibians species observed along AH-48



167. **Butterfly species observed along proposed alignment AH-2 and AH-48**: There were 56 species of butterflies found in Nepal-India-Bangladesh AH 2, among them 9 species were from the family Papillonidae, 9 from Pieridae, 12 Lycaenidae, 26 from Nymphalidae. There were 107 species of butterflies were found in Bhutan-India-Bangladesh AH 48, among them 15 species were from the family Papillonidae, 12 from Pieridae, 24 Lycaenidae, 43 from Nymphalidae and 13 from Hesperildae (**Appendix 9.1)**. Some of the data were taken from the secondary sources.

Figure 55. : Butterfly species observed along AH-2

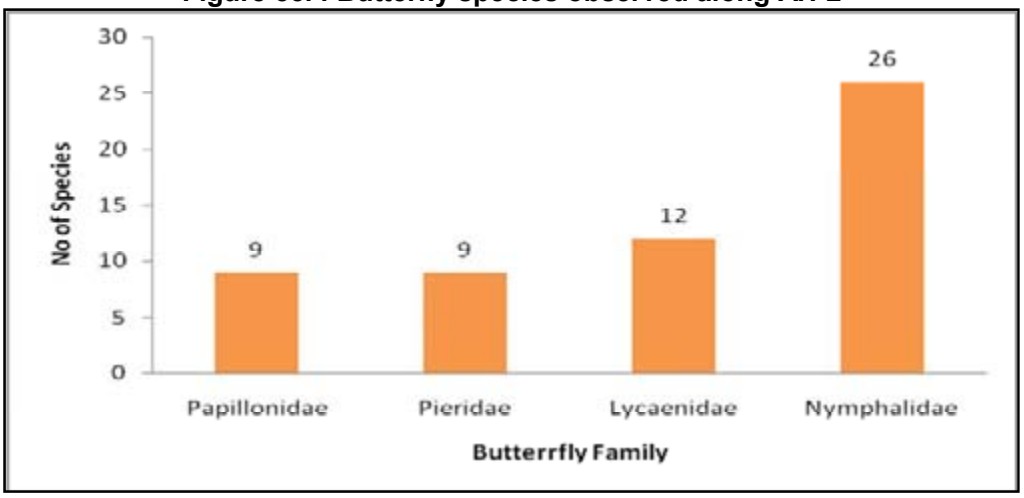
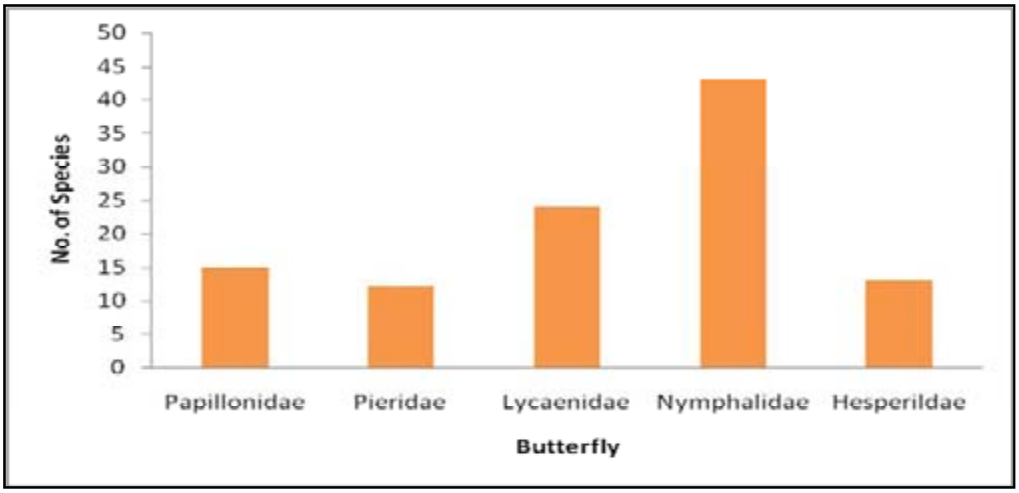


Figure 56. : Butterfly species observed along AH-48



168. **Faunal Species Diversity (Diversity Index (H) along proposed alignment AH-2:** The species diversity of Mammal, Birds, Reptiles, and Amphibians was highest in the forested/tea garden areas. The species diversity of the mammals along the proposed high way is highest after 150 meter on each side; whereas the species diversity and abundance of herpetofauna, butterflies and birds were found to be high near to the proposed alignment of the AH 2 within 50 meters on each side (**Table 48**).

169. Faunal activity pattern like foraging by the birds, herpetofauna and mammals were found to be high near the road side in the forested areas.

Table 48 : Species Diversity index of terrestrial fauna in different location of study area[31] along proposed alignment AH-2

Fauna	Value of H	Distance from Road (Transect)		
	Shanon wiener Index	50 meter	100 meter	150 meter
Mammals	H	1.762	2.123	2.058
	Variance H	0.009282	0.002144	0.001577
Birds	H	4.199	3.672	3.809
	Variance H	0.000161	0.002185	0.005083
Herpetofauna	H	2.779	3.16	3.071
	Variance H	0.004209	0.000725	0.000607
Butterfly	H	3.908	3.804	3.721
	Variance H	0.000114	0.000443	0.00433

170. **Faunal Species Diversity (Diversity Index (H) along proposed alignment AH-48:** Species Diversity index of terrestrial fauna in different location of study area[32] . The species diversity of Mammal, Birds, Reptiles, Amphibian was highest in the forested areas, which was followed by the species diversity of the rural areas, peri-urban areas and least by the species diversity in the urban areas (**Table 49**). The overall faunal composition patterns of the project stretch were as follows.

171. Abundance and the number of species present in the forested areas were found to be high in the forested areas. The animal activities in the forested areas like the Hasimara RF under the Jaldapara National Park was found to be high. In the areas where the road passes through the forest faunal activities like crossing the road, foraging, feeding, swarming etc. were found to be high. There were three migratory corridors through which the big mammals like the Asian elephant, Indian Bison, deers used cross the highway as evident from the secondary information collected during the period of the study. (**Figure 58**).

Table 49 : Species Diversity index of terrestrial fauna in different location of study area33 along proposed alignment AH-48

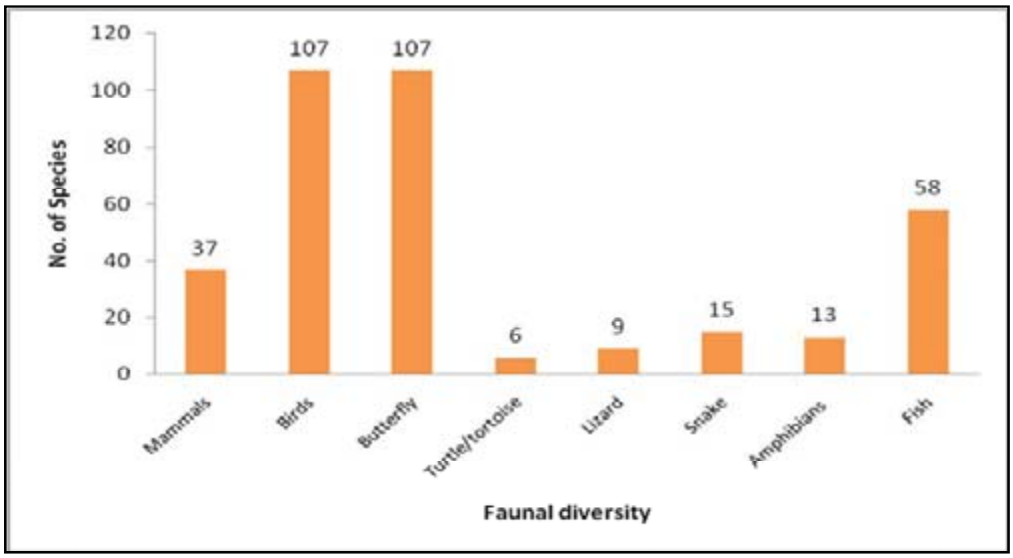
Fauna	Value of H	Distance from Road (Belt Transect)		
	Shanon wiener Index	50 meter	100 meter	150 meter
Mammals	H	2.417	3.361	3.376
	Variance H	0.00693	0.000942	0.000271
Birds	H	4.424	3.899	3.952
	Variance H	0.000152	0.001783	0.003738
Herpetofauna	H	2.837	3.178	3.084
	Variance H	0.005777	0.000644	0.000553
Butterfly	H	4.557	4.444	4.361
	Variance H	5.72E-05	0.000232	0.002372

[31] The study area for the terrestrial fauna like mammals, Aves, reptiles, amphibian was selected in the urban areas, per-urban areas, rural areas and forester areas through which the Nepal-India-Bangladesh AH 48 is passing through.

[32] The study area for the terrestrial fauna like mammals, aves, reptiles, amphibia was selected in the urban areas, per-urban areas, rural areas and forester areas through which the Bhutan-India-Bangladesh AH 48 is passing through.

[33] The study area for the terrestrial fauna like mammals, Aves, reptiles, amphibian was selected in the urban areas, per-urban areas, rural areas and forester areas through which the Nepal-India-Bangladesh AH 48 is passing through.

Figure 57. Figure: Faunal Species Diversity (Diversity Index (H) along proposed alignment AH-48

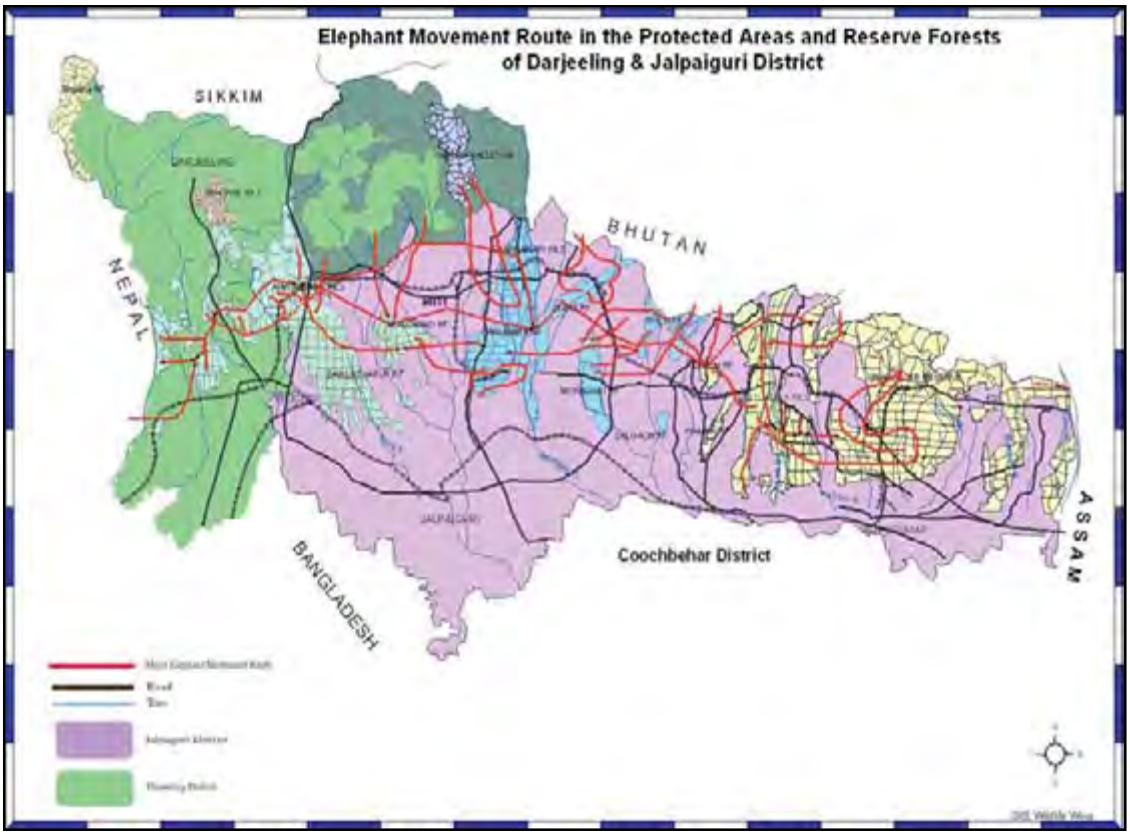


172. **Nesting Colonies of Birds along proposed alignment AH-2 and AH-48:** During the period of the study no nesting colonies were observed even in the mosaic community forested area along Nepal-India-Bangladesh AH 2 alignment. Similarly no nesting colonies were observed even in the forested area of the Jaldapara National Park along Bhutan-India-Bangladesh AH 48 alignment.

173. **Migratory Route of Terrestrial Fauna along proposed alignments AH-2 and AH-48:** As per study conducted by West Bengal Forest Department (Dr.V.K.Sood IFS, Conservator of Forests, Wild Life North Circle) following are the important corridors identified for movement of wild elephants in North Bengal.

1. Lankapara- Dalmore corridor in Wild Life - III Division (Coochbehar)
2. Titi- Dhumchi corridor in Wild Life - III Division (Coochbehar)
3. Dumchi - Dalmore corridor in Wild Life - III Division (Coochbehar)
4. Rehti-Moraghat corridor in Jalapaiguri Division
5. Central Diana – Gorumara corridor in Jalpaiguri Division & Wild Life
6. Division – I
7. Gorumara – Apalchand corridor in Wild Life –Division-II, Jalpaiguri &
8. Baikunthapur Division
9. Upper Tondu - Mal Block corridor in Jalpaiguri Division & Kalimpong Division
10. Mal Block – Apalchand corridor in Kalimpong & Baikunthapur Division
11. Mongpong – Mahananda Wildlife Sanctuary
12. Apalchand - Mahananda Wildlife Sanctuary
13. Mahananda – Lamagumpha- Bamanpokri in Kurseong Division

Figure 58. : Elephant Movement Route in the Protected Areas and Reserve Forests of Darjeeling and Jalpaiguri District



174. **AH-2:** There were no important migratory routes observed along Nepal-India-Bangladesh. However in the Naxalbari area Asian elephant occasionally crosses Nepal-India-Bangladesh corridor to reach the sal dominated forest on the western side the AH 2.

175. **AH-48:** There were three important migratory routes observed for large mammals along the Bhutan-India-Bangladesh AH 48. These three were inside the Jaldapara National Park and in between the Halong river bridge and the Toorsha river bridge. These three migratory corridors were also intersected by the railway track which runs parallel to the Bhutan-India-Bangladesh AH 48 alignment on the northern side. The Chainage of the migratory corridor of Asian elephants were in between 22.5 KM to 23.5 KM as per the proposed alignment chainage. However on the northern side of the road there were critical areas on the railway track in between the chainage 127-131. In these stretch the railway track was found to be elevated which made the track accident prone for the Asian elephant. These issues were also identified by Singh et al. (2011) (Singh, A. K., Kaul, R., Sarkar, P., Behera, S. K.,Rathna kumar, S. and Ramakrishnan, B. 2011. An Assessment of Elephant Mortality due to Train Hits in India. Wildlife Trust of India.).

Figure 59. : Map Showing Elephant corridor and over the AH-48 and elephant killing area by train in 2011

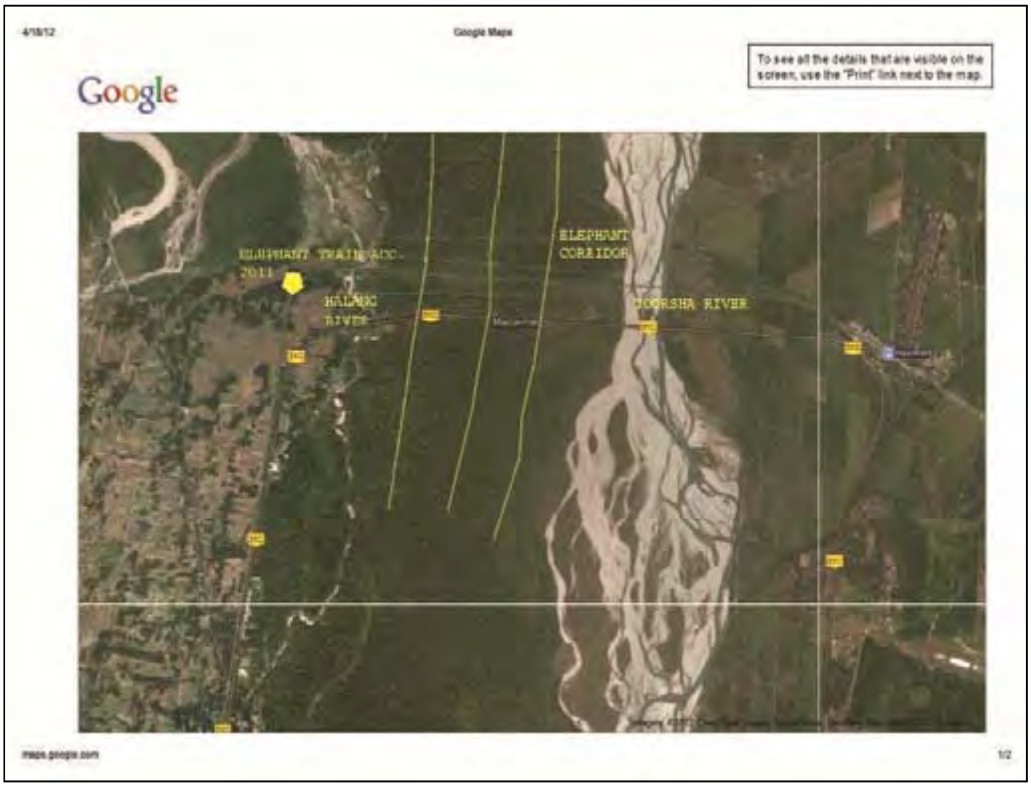


Figure 60. : Elephant crossing the train line on the New Jalpaiguri to New Alipurduar train line stretch passing through the Jaldapara National Park (Photo-Arun Karmakar)

176. **Accidental Death of Mammals along proposed alignment AH-2 and AH-48**: It was found from the data of West Bengal forest department that most of the accidental deaths happened to the Asian elephant and spotted deer while crossing the railway track/roads. The Asian elephants were found to cross AH-2 alignment in the Naxalbari area and the Chainage passing through the Hasimara RF inside the Jaldapara National Park along AH-48 alignment. (Refer **Table 50** and **51**).

Table 50 : Accidental Death of Mammals along proposed alignment AH-2

Sl. No.	Species	Number
1	Wild elephants	19
2	Leopard	1
3	Indian Bison	4
4	spotted deer	18
5	Barking Deer	1
6	Civet Cat	1
7	Langur	3
Data Source: "State Forest Report 2010-11" Published by Government of West Bengal Directorate of Forests Office of The Principal Chief Conservator of Forests, Kolkata.		

Table 51 : Accidental Death of Mammals along proposed alignment AH-48

Sl. No.	Species	Number
1	Wild elephants	19
2	Leopard	1
3	Indian Bison	4
4	spotted deer	18
5	Barking Deer	1
6	Civet Cat	1
7	Langur	3
Data source: "state forest report 2010-11" published by government of West Bengal directorate of forests office of the principal chief conservator of forests, Kolkata.		

177. **Identification of Endemic/ Threatened and Endangered Species along proposed alignment AH-2 and AH-48 :** In AH-2 There was no endemic wildlife species found in the study area except The Indian Elephant which belongs to endangered species were found to cross the Nepal Bangladesh corridor (**Table 52**).

Table 52 : Endangered Mammals in the Nepal Bangladesh corridor AH-2

Serial No.	Common Name	Species Name	WPA 1972 status	IUCN Status
1	The Indian Elephant	Elephas maximus (Linnaeus)	I	Endangered A2c

178. In AH-4 there was no endemic wildlife species found in the study except five endangered species as presented in the **Table 53** were found in Bhutan-India-Bangladesh AH 48.

Table 53 : Endangered Mammals in the Nepal Bangladesh corridor AH-48.

Serial No.	Common Name	Species Name	WPA 1972 status	IUCN Status
1	Tiger	Panthers tigris (Linnaeus) R	I	Endangered A2bcd+ 4bcd;C1+2a(i)

2	Fishing cat	Prionailurus viverrinus (Bennett) R	I	Endangered A2cd+4 cd
3	Dhole	Cuon alpinus (pallas)	I	Endangered C2a(i)
4	The Indian Elephant	Elephas maximus (Linnaeus)	I	Endangered A2c
5	Hog deer	Axis porcinus (Zimmerman)	I	Endangered A2bcd

179. **Reptiles:** There were species found in the study except three endangered species as presented in the **Table 54** were found in Nepal Bangladesh AH-2.

Table 54 : Endangered reptiles in the Nepal Bangladesh corridor AH-2

Sl.No.	Common Name	Scientific Name	WPA Status	IUCN Status
1	Bengal monitor Lizard	Varanus bengalensis (Daudin)	Schedule II	Endangered
2	Water monitor	Varanus salvator Laurenti	Schedule II	Endangered
3	Indian rock Python	Python molurus Linnaeus	Schedule IV	Endangered

180. **Reptiles:** There were species found in the study except three endangered species as presented in the table were found in Bhutan-India-Bangladesh AH-48. Among the reptiles two lizard species and one snake species is under the endangered category as given in **Table 55**.

Table 55 : Endangered reptiles in the Bhutan-India-Bangladesh AH-48.

S. No.	Common Name	Scientific Name	WPA Status	IUCN Status
1	Bengal monitor Lizard	Varanus bengalensis (Daudin)	Schedule II, Endangered	Endangered
2	Water monitor	Varanus salvator Laurenti	Schedule II, Endangered	Endangered
3	Indian rock Python	Python molurus Linnaeus	Schedule IV	Endangered

181. **Wetlands along proposed alignments AH-2 and AH-48:** There are no wetlands found near project site but several ponds were found near the Nepal-India-Bangladesh AH 2 and near Bhutan-India-Bangladesh AH 48.

182. **Peoples Dependence on Flora and Fauna along proposed alignments AH-2 and AH-48**: People residing near Nepal-India-Bangladesh AH-2 do not depend on the flora and fauna chiefly. They are primarily dependent on agriculture. Few people were found to be dependent for their livelihood on selling fuel woods from neighbouring protected forest or naturally growing tree species along Nepal-India-Bangladesh AH-2. Similar observations were made along AH-48.

183. Areas of Eco-Important Zone / Protected Area along proposed alignment AH-2 and AH-48: In AH-2 there was no protected area through which Nepal-India-Bangladesh corridor was passing. On the northern side of Nepal-India-Bangladesh corridor Jorpokhri WLS was present at a distance of 3 km from the proposed alignment of the corridor.

184. In AH-48 the Jaldapara National Park has been re-designated as national park vide notification No. 975-FOR/FR/0/IIM/44/11 dated 27/04/2012 by order of Governor through special secretary to the Government of west Bengal forest department (please refer Annexure).

185. Jaldapara National park comprises of grasslands and open canopy forest covers with an area of 216 sq kms and the Teesta river valley (from which canal will pass) of Jaldapara area in North Bengal consists of mixed deciduous forest. The forest is generally called Khair (Acacia catechu) and Sissoo (Dalbergia sissoo) forest that dominate the banks of the rivers. Other tree species which are grown along with Khair-Sissoo association are Albizia procera, A. lebbeck, Bischofia javanica, Bombax ceiba, Trema orientalis, etc. Grasses like Saccharum sp., Phragmitis karka, Themeda spp. are common in the forest floor. More than 30% of the total area is under grassland. Major Grass species form dense stands are comprised of Saccharum spp., Themeda arundinacea, T.villosa, Setaria palmifolia, Cymbopogan spp., Thysanolaena maxima, Phragmites karka, Arundo donax and Imperata cyclindrica.

186. This is a protected Area through which the Bhutan-India-Bangladesh AH 48 is passing through. The Hasimara RF near the Bhutan-India-Bangladesh AH 48 under the Jaldapara National Park holds considerable number of trees which is a good habitat for birds and small mammals. Location of the Jaldapara National Park in the Jalpaiguri district is shown in Map which is followed by Elephant Corridor map at Jaldapara National Park. (Refer **Figure 61**).

Figure 61. : Showing the location of the Jaldapara National Park in the Jalpaiguri district

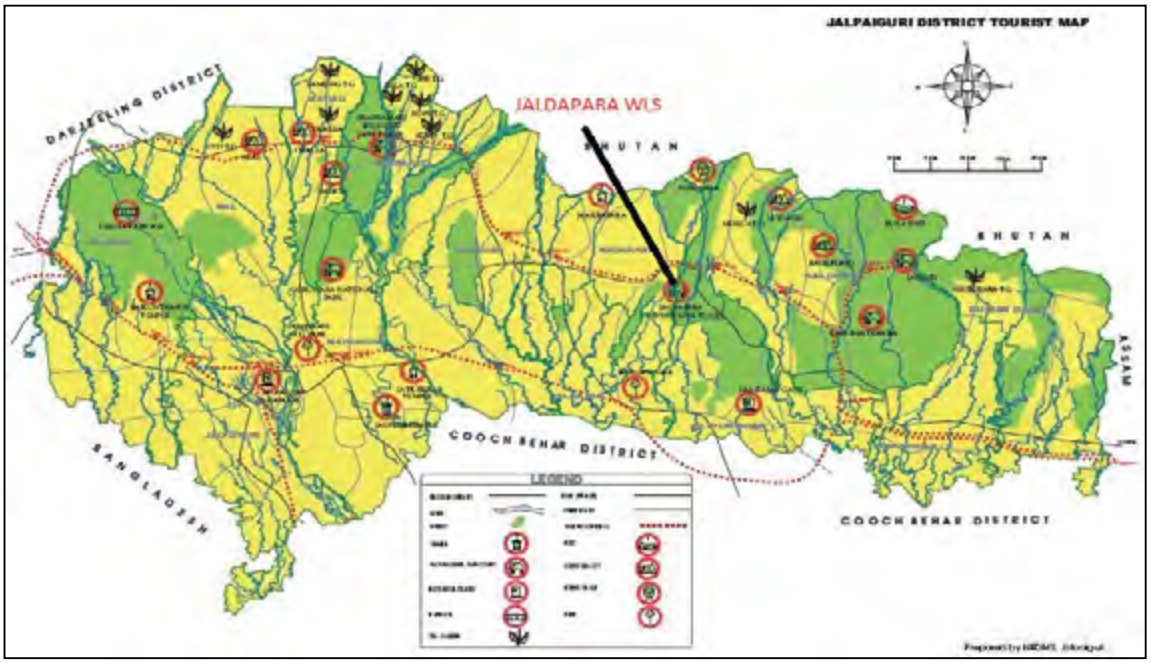
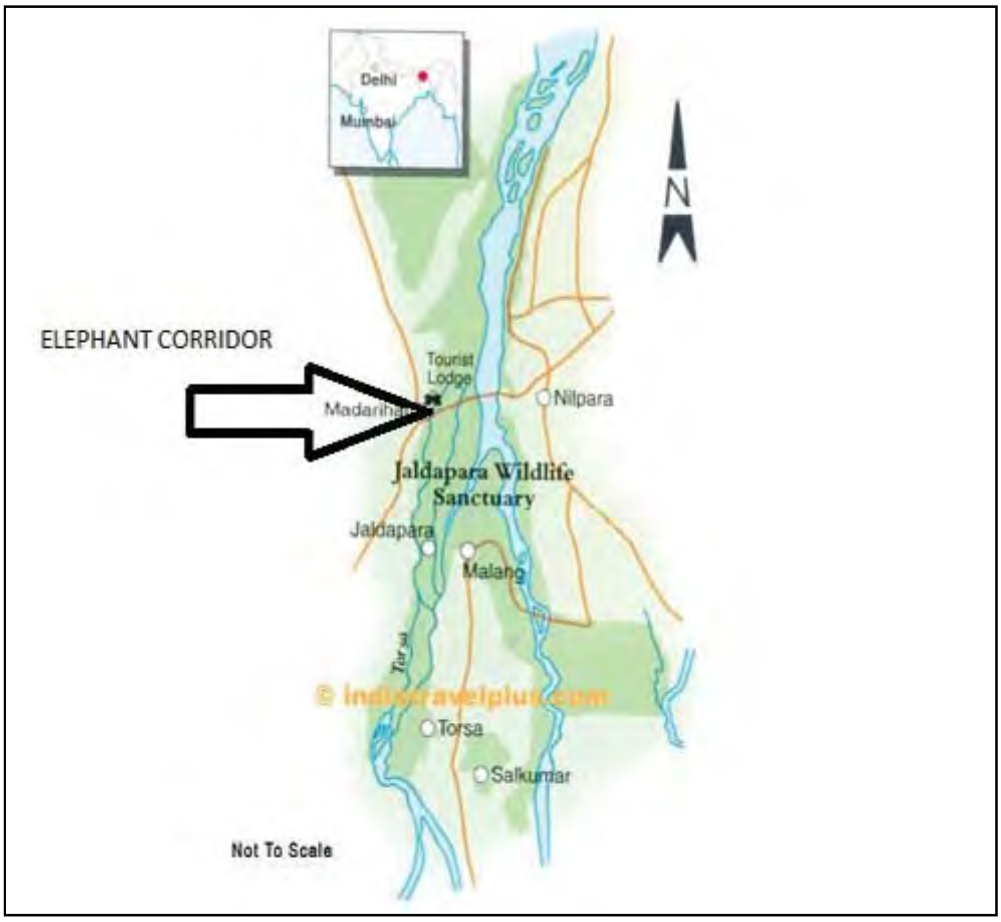


Figure 62. : Showing the Location of the Elephant Corridor in Jaldapara National Park



5. Aquatic Ecology

187. **Fish Species Diversity observed along proposed alignmen**t: In AH-2, among the 29 species of fish identified in the study area (**Appendix 9.1**) Carp species, Tor putitora species were predominant in the river Mahananda and Mithi River on the India Nepal Border. Tor was more dominant in the flood seasons.

188. In AH-48, among the 61 species of fish identified in the study area (**Appendix 9.1**) Carp species, Tor putitora species were predominant in the river Torsa. Tor was found to be more dominant in the flood seasons because it migrates through the deep channels of the river Torsa.

189. **Migratory Route of Aquatic Fauna (Fish):** In AH-2, fish species like Tor sps shows migratory behaviour through the deeper channels of the river Mahananda and in the Mithi River at the Kakarbita (Nepal Border Bridge) during the monsoon season from upstream to downstream.

190. In AH-48, fish species like Tor sps shows migratory behaviour through the deeper channels of the river Torsa. They migrate through the main channel of the river during the monsoon season from upstream to downstream.

191. **Spawning and Breeding Grounds along proposed alignment:** Along AH-2 alignment spawning and breeding grounds of major and minor carps were recorded in the

Mahananda River. Along proposed AH-48 alignment spawning and breeding ground were recorded for major and minor carps in the Torsa River.

192. **Identification of Endemic/ Threatened and Endangered Species:** Along AH-2 alignment and AH-48 alignment only Tor putitora was found to be the only fish species which is an endangered category (As Categorised by NBFGR) along AH-2 and AH-48 rivers Mahananda and Torsa respectively.

193. **Human-Elephant Conflicts:** The elephant habitat in North Bengal is characterized by a high degree of habitat fragmentation and severe human-elephant conflict resulting in not only loss of agricultural crops and property but also several human lives every year (Lahiri choudhury, 1975; Choudhury, 1997). The elephant population in North Bengal is estimated to be about 344 to 434 (vide the Census, 2007) of which about 200 is concentrated in the Protected Areas of Buxa and Jaldapara, the largest segment of forest in the region.

Table 56: Trend in Elephant Population

Parameters	Population
1986	152
1989	173
1992	186
2000	292
2005	350
2007	344 to 434

Source: Dr. V. K. Sood IFS, Conservator of Forests Wild Life North Circle

194. Due to the depredation, some retaliatory killing of elephant occurs in both India and Nepal by Electrocution, Poisoning, bullet injury or injury through arrow. In the year 2007, 3 nos. of elephant died, then during the month of June-July of 2008, one elephant died through Electrocution and other died by Gun Shot and in the year 2009 there are around 10 nos. of elephant got injured. During the month of July 2008 there are 3 nos. of elephant died in Mahananda Wild Life Sanctuary adjoining to the Simulbarie Tea Estate by poisoning through Pesticide.

195. The following **Table 57** illustrates the trend in human casualty and Elephant deaths over the last few years.

Table 57 : Human casualties and Elephant Deaths over the last few years

Years	Human Casualties	Elephant Deaths
2002-2003	-	20
2004-05	27	26
2004-05	16	18
2005-06	37	16
2006-07	31	34
2007-08	39	39
2008-09	31	22
2009-10 till date	15	5

Source: Dr.V.K.Sood IFS, Conservator of Forests Wildlife North Circle

196. **Elephant mortality on railway tracks in northern Bengal (1958-2008):** A total of 39 elephant deaths were reported during the period of 1958–2008. Twenty-nine deaths took place during the operation of meter gauge over a period of 44 years from 1958–2002 (0.6 incidents/year). Ten deaths were reported after gauge conversion in a time span of just 4

years from 2004–2008 (2.5 incidents/year). Overall the deaths of 14 adult males, 8 adult females, 2 sub-adult males, 5 juveniles/calves, and 10 of unknown sex were recorded over the time period (Roy et.al., 2009)

197. **Rhinoceros in Jaldapara National Park**: The Rhinoceros unicornis is the Flagship species for the sanctuary. As per the recent census in the sanctuary, there are around 184 rhinos which include males, females and calves in suitable proportion as compared to 149 rhinos in 2011. According to forest sources, maximum number of rhinos were spotted in Jaldapara east range (97), west and north ranges had 36 and 34 rhinos, respectively. Fifteen rhinos were spotted in Kodalbusty range and two in Chilapata range. (The Telegraph, Calcutta India, 26, Feb 2013).

198. Rhinos are voracious consumers and need at least 50 kg of vegetable every day. Again, their food habit is very selective. They forage only on the young twigs of their edible plants. That is why they need much wider areas for their foraging. (Refer **Figure 63**).

Figure 63. : Rhinoceros in Jaldapara National Park

Source: http://www.rhinoconservation.org/2009/10/30/jaldapara-elephant-safaris-halted-to-thwart-rhino-poachers/

E. Socio-Economic Environment

199. Both the project roads pass through three districts of West Bengal. Most of AH-2 road corridor section passes through Darjeeling district with only small section of 8.1 Km which passes through Jalpaiguri District. Similarly most of the AH-48 road corridor section passes through Jalpaiguri district with only small section of 9 Km which passes through Cooch Behar District.

200. The Socio economic Profile of these districts is analysed and presented in this section to understand the overall socio-Economic environment of project road areas.

1. Settlement along the project roads

201. Both the road corridors passes mostly through rural areas and few urban areas. The list of villages and urban wards along both the road corridors is given at **Table 58** and **59**.

Table 58 : AH 2 Nepal Bangladesh: List of villages / urban areas

Sr. No.	Distance Kms	Name of Village	Block	District
		Urban Area		
0	0	Mechi - River Kakarbita	Naxalbari	Darjeeling
2	1	Panitanki	Naxalbari	Darjeeling
3	1.4	Uttar Ramj yot	Naxalbari	Darjeeling
4	3.8	Rathkhala	Naxalbari	Darjeeling
5	**3.9**	**Naxalbari**	**Naxalbari**	**Darjeeling**
6	8.5	Vijaynagar TE	Naxalbari	Darjeeling
7	8.8	Hatishal	Naxalbari	Darjeeling
8	10	Atal	Naxalbari	Darjeeling
9	15.5	Upper Bagdogra	Naxalbari	Darjeeling
10	18	Bagdogra	Naxalbari	Darjeeling
11	20.5	Buriwalason + University	Naxalbari	Darjeeling
12	22	Shiv Mandir	Matigara	Darjeeling
13	22	Kadamtala	Matigara	Darjeeling
14	22	Thiknikatta	Matigara	Darjeeling
15	22	Kawakhali	Matigara	Darjeeling
16	**22**	**Ward Naukaghat**	**Siliguri**	**Darjeeling**
17	**24**	**Ward No. 31 Siliguri**	**Siliguri**	**Darjeeling**
18	**28**	**Ward No. 32 Siliguri**	**Siliguri**	**Darjeeling**
17	36.8	Tinabhatti	Rajganj	Jalpaiguri
18	38.4	Kamanagaguri	Rajganj	Jalpaiguri
19	39.8	Fulbari	Rajganj	Jalpaiguri
20	**50**	**Rangapani**	**Matigara**	**Darjeeling**
0	**54.6**	**Medical More**	**Matigara**	**Darjeeling**

Table 59 : AH 48: List of Villages located along the road

Sr. No.	Chainage in Kms	Name of Village / urban area – wards	Block	District
	0	**Bangladesh Border**	**Mekhliganj**	**Cooch Behar**
1	**1.8**	**Changlabandh**	**Mekliganj**	**Cooch Behar**
2	2.4	Kalasibandha	Mekliganj	Cooch Behar
3	12.6-14.6	Ghoskadanga	Mayanaguri	Jalpaiguri
4	17.5-18	Madhudanga	Mayanaguri	Jalpaiguri
5	20.6	Govindhanagar	Mayanaguri	Jalpaiguri
6	**22.3**	**Mayanaguri**	**Mayanaguri**	**Jalpaiguri**
7	23.6	Takatuli	Mayanaguri	Jalpaiguri
8	32.6	Jaldhaka	Dhupguri	Jalpaiguri
9	**40.6**	**Dhupguri**	**Dhupguri**	**Jalpaiguri**
10	43	Magurmari	Dhupguri	Jalpaiguri
11	43.7	Galandimor	Dhupguri	Jalpaiguri
12	45.8	Mallik Sova	Dhupguri	Jalpaiguri
13	47.5	Sonakhali	Dhupguri	Jalpaiguri
14	50.5	Dangiapara	Dhupguri	Jalpaiguri
15	**53-54.5**	**Gairkata**	**Dhupguri**	**Jalpaiguri**
16	87	Kasiyajhora	Dhupguri	Jalpaiguri
17	66.4	Birpara	Birpara	Jalpaiguri

Sr. No.	Chainage in Kms	Name of Village / urban area – wards	Block	District
18	72.2	Madhya Rengali Bajana	Rangalibazana	Jalpaiguri
19	73.4	Rengali Bajana	Rangalibazana	Jalpaiguri
20	75.2	Paschim Khairwadi	Rangalibazana	Jalpaiguri
21	80.4	Madari Hat	Birpara	Jalpaiguri
22	80.7	Shishibadi	Birpara	Jalpaiguri
23	82.9	Madarhat	Birpara	Jalpaiguri
24	**93.1**	**Hasimori**	**Jaigaon**	**Jalpaiguri**
25	94-99	Dalsingpara	Jaigaon	Jalpaiguri
26	102-109	Jaigaon	Jaigaon	Jalpaiguri
0	109	Bhutan Gate	Jaigaon	Jalpaiguri

2. Brief District Profiles

202. **Darjeeling District:** Darjeeling the northernmost district of the Jalpaiguri division is sharing its boundary with Nepal, Bhutan and Jalpaiguri district of West Bengal. Total geographical area of the district is 3149 sq. km. Darjeeling district has two distinct regions: one is the hilly areas and other one is plains. The Ah-2 road passes through plains known as Siliguri region. The Darjeeling hill area is formed of comparatively recent rock structure that has a direct bearing on landslides. The causes of the landslides vary from one locality to another. Heavy monsoon precipitation is however a very common cause of these disasters. Growing urbanization, industrialization and population pressure result in growing changes in eco system. The rivers in the district are: Teesta, Great Rangit, Mechi, Balason, Mahananda, Lish, Gish, Chel, Ramman, Murti and Jaldhaka. The district receives annual rainfall of av 3092 mm in 126 number of rainy days during June to Nov every year. However, Siliguri plain area receive an annual rainfall of 3620 mm in 113 number of days in a year (June – Nov).

203. **Jalpaiguri District:** Jalpaiguri district is sharing its boundary with Bhutan, Bangladesh, Cooch Behar and Darjeeling district. The location of the district with international frontiers on the North with Bhutan and Bangladesh on South makes it vulnerable to international exposures. Large section of AH-48 and small Section of AH-2 traverse through this district. The total geographical area of the district is 6227 sq km. The district has an average length of 144 kms from East to West and an average breath of 40 km from north to south. The main rivers are Teesta, Torsa, Jaldhaka and Raidak and Sankosh. The district is sharply divided by the river Teesta.

204. **Cooch Behar District:** The Cooch Bihar District shares its boundary with Bangladesh, and Assam state and district Jalpaiguri. The district has a geographical area of 3387 sq km. Large area of the district is agricultural in nature. The total of cultivable land in the district is 2530.63 sq km. The main rivers are Jaldhaka and Torsa. A highly humid climate / atmosphere and abundant rains characterize the climate of the district with temperature seldom excessive. Average Annual Rainfall is 5348.8 mm.

205. **Administrative Set up of the districts:** Jalpaiguri district is the largest district in the project area however, Cooch Behar district has maximum number of villages. Darjeeling District has one municipal corporation – Siliguri through which AH 02 crosses. Jalpaiguri and Cooch Behar have 4 and 6 municipalities respectively. No of blocks, sub divisions remain almost same in all districts. Details of Administrative set up of these district is summarized at **Table 60**.

Table 60 : Administrative Set up of the Districts

Sr. No.	Administrative Set Up	Unit	Districts		
			Jalpaiguri	Darjeeling	Cooch Behar
1	Area	Sq km	6,227	3,149	3,387
2	Sub divisions	No	3	4	5
3	Inhabited villages	No	742	640	1,138
4	Police Stations	No	17	17	11
5	Mouzas	No	756	708	1,202
6	Municipal Corporations	No	--	1	--
7	Municipality	No	4	4	6
8	Blocks	No	13	12	12
9	Panchayat Samity	No	13	12	12
10	Gram Panchayats	No	146	134	128
11	Gram Sansad	No	2,075	1,390	1,714

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06

3. Demographic profile of the district

206. **Population:** District wise demographic detail are given at **Table 61**. Jalpaiguri has population of 34.01 lakhs, highest in all three districts. Household size remains almost range of 5+ or – in all districts. Darjeeling District has 32.34% urban population compared to lowest 9.1% in Cooch Behar and 17.84% in Jalpaiguri district. Sex ratio varies from lowest 937 female per 1000 male in Darjeeling district where as it is 948 and 942 female per 1000 males in Cooch Behar and Jalpaiguri districts. In Darjeeling district 71.8% population is literate where as it is lower – 62.9% in Jalpaiguri and 66.3% in Cooch Behar districts. Female literacy is lower in all the district compared to literate males. Cooch Behar district has 50/11% population belonging to SC. Jalpaiguri district has 36.71% SC population. Darjeeling district has 16.09% SC population. Jalpaiguri has ST population of 18.87% whereas to so 12.68% in Darjeeling District Only 0.57% population belong to ST is recorded in Cooch Behar.

Table 61 : District wise Demographic Details

Sr. No.	Demographic Details	Units	Districts		
			Jalpaiguri	Darjeeling	Cooch Behar
1	Total Population (2001)	No	34,01,173	16,09,172	24,79,155
2	No of households (2001)	No.	6,88,139	3,18,737	5,17,878
3	Average Household size	No.	4.95	5.04	4.78
4	Urban Population	%	17.84	32.34	9.1
5	Population Density	per sq km	546	511	732
6	Sex Ratio	Female per 1000 males	942	937	948
7	Literate population	%	62.9	71.8	66.3
8	Literate Male	%	72.8	80.1	75.9
9	Literate Female	%	52.2	62.9	56.1
10	Proportion of SC population	%	36.71	16.09	50.11
11	Proportion of ST population	%	18.87	12.69	0.57

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06

207. **Languages:** Nepali, Hindi, Bengali and English are the prevailing languages in all these districts. Bengali is the language of the plains. Tribal people located in the district have their own dialect.

208. **Religion:** Hinduism, Buddhism and to an extent Christianity, remain the predominant religions in these districts.

209. **Occupation:** A bit more than one third of population in all the districts is recorded as total workers. Less than 8% population is categorized as marginal workers. Thus the proportion of non-workers is quite high in all districts.

210. Cultivators and agricultural labour constitute about 66% in Cooch Behar and 38% in Jalpaiguri. 25.7% workers depend on agriculture in Darjeeling district. Darjeeling district has more than 71% working population in other activities – employment, service, etc. Population in Cooch Behar and Jalpaiguri district is predominantly dependent on agriculture labour and cultivation. District wise occupational profile is given at **Table 62.**

Table 62 : District wise Occupation Profile

Sr. No.	Occupation Pattern	Unit	Districts		
			Jalpaiguri	Darjeeling	Coochbehar
1	Total Workers	% to pop.	38.31	35.4	38.99
2	Marginal Workers	% to pop.	8.16	5.6	8.57
3	Non workers	% to pop.	61.69	64.6	61.01
4	Cultivators	% to total workers	20.72	15.5	37.43
5	Agricultural Labourers	% to total workers	17.66	10.2	29.53
6	Household Industry workers	% to total workers	2.06	2.8	4.06
7	Other Workers	% to total workers	59.56	71.5	28.98

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06.

4. District Land Use

211. The district of Jalpaiguri is the largest in the three district having almost 50% of the total geographical areas. Darjeeling district has more than one third area under forest where as in other district the proportion is quite low – less than 5% of the total area is under forest. Cooch Behar has more than 2/3rd area as net sown area against approximately 50% area in Darjeeling and Jalpaiguri district. The district wise land Use pattern is given at **Table 63**.

212. The land use in the Darjeeling is influenced by high density of population. There is very limited scope for extension of agricultural land to cope up with increasing pressure of population. As a result pressure on forested and other restricted areas is gradually increasing. The road corridor area in Darjeeling district is characterized by high density of population, tea estates and urban area wards all along the road. In other districts however, though similar land use especially existence of tea estates is found in other districts, the urban population with high density is not the problem except two locations – Dhupguri and Jaigaon.

Table 63 : District Wise land Use Pattern

Sr. No	Land use	Unit	Districts		
			Jalpaiguri	Darjeeling	Cooch behar
1	Reporting Area	Ha	6,22,700	3,25,469	3,31,570
2	Forest Area	Ha	17,900	1,24,574	4,260
3	Area under non agri use	Ha	84,650	33,785	64,940
4	Barren / uncultivable land	Ha	3,360	4,925	2,350
5	Permanent Pasture/ grazing	Ha	0	909	10
6	Culturable Waste land	Ha	60	1,376	1,770
7	Fallow land other than current fallow.	Ha	60	3,804	670
8	Land under misc. tree groves	Ha	0	1,942	7,460
8	Current Fallow Land	Ha	14,810	11,149	670
9	Net Area sown	Ha	3,34,650	1,43,003	2,46,940
10	Area under irrigation	Ha	1,11,750	9,260	1,06,500

Source: District Statistical Handbooks – Cooch Behar, Darjeeling and Jalpaiguri 2005-06.

5. Economy

213. The cash crops of the region are fruits, tea and cardamom. Tourism contributes in a great way to the economy of the districts

214. **Agriculture:** The cereal crops are sown on most of the lands where as fibre, oilseeds, cash crops, wheat, pulses were also taken up. The mixed cropping pattern with commercial crops including tea were taken up in all the districts. Cooch Behar is leading in the agricultural activities. The details of cropping pattern and crop productivity is given at **Table 64.**

Table 64 : Cropping Pattern in the district

Sr. No.	Particulars	Unit	Districts		
			Jalpaiguri	Darjeeling	Cooch behar
1	Cropped area	Ha	334,650	143,000	246,940
2	Irrigated Area	% to total	33.39	6.48	43.13
3	Principal crops				
A	Rice	Ha	236,600	35,300	280,400
B	Wheat	Ha	16,800	2,900	14,000
C	Pulses	Ha	4,100	1,700	9,200
D	Oil seeds - Mustard, linseed	Ha	15,900	500	22,500
E	Fibre – Jute, Mesta	Ha	41,400	2,700	70,600
F	Cash crops	Ha	39,800	9,200	44,400

	Sugar cane, Potato				
	Tobacco, chilly, ginger				
G	Tea	Ha	77,300	36,800	200
H	Fruits	Ha	9,410	10,560	5,130
I	Vegetables	Ha	52,520	21,560	938,370

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06

215. Jalpaiguri district Potato productivity figure exceed state productivity level. However, the data on productivity and yield rates for selected other major crops indicates that the productivity is poor in comparison with the state productivity levels as mentioned in the **Table 65** below:

Table 65 : Crop Productivity of the selective major crops grown

Sr. No.	Crops	Productivity Kg per ha			
		Jalpaiguri	Darjeeling	Cooch behar	State
1	Rice	1,578	1,835	1,918	2,509
2	Wheat	2,329	1,683	1,683	2,109
3	Pulses	943	--	892	911
4	Oil seeds -Musterd, linseed	665	328	468	909
5	Fibre - Jute, Mesta	2,268	1,908	1,980	2,573
6	Cash crops -potato	27,864	15,050	10,100	21,053
7	Tea cultivation	2,018	1,761	1,889	1,887

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06

216. **Livestock:** The rural areas depend on the livestock for their livelihood, as an alternative and supporting to the cultivation. The following **Table 66** indicates the size and scale of livestock operations:

Table 66 : Livestock in the districts

Sr. No.	Particulars	Units	Districts		
			Jalpaiguri	Darjeeling	Cooch behar
1	Milch Cattle				
i	Cows	No	379,574	84,468	326,588
ii	Buffaloes	No	4,028	2,864	1,441
2	Draft Animal	No	270,831	162,576	266,946
3	Sheep/Goats	No	622,541	300,546	559,042
4	Pigs	No	123,956	61,205	19,629
5	Other	No	118,494	--	95,045
6	Poultry - Fowls, duck	No	2,143,252	697,149	1,667,453
	Production				
a	Milk	Tons	127,000	144,000	131,000
b	Eggs	Thousands	92,605	57,323	103,003

Source: District Statistical Handbooks – Cooch Behar, Darjeeling and Jalpaiguri 2005-06.

217. Nearly every household in all the three district has dependency on livestock for some sort of income. There is a scope for further development in the field of livestock with improved production, husbandry practices and more focus on processing of livestock produce such as meat, eggs, milk, woollen, etc.

218. **Industry:** Local variety of Tea is world renowned for its flavour, which is unequalled by other tea producing areas not only of India but also of the world. All these three districts still manufactures the tea by the original methods known as the 'orthodox' method. Most the small scale and cottage industries found the district are of recent origin. They are rice mills, wheat flour mills, and oil mills, saw mills, carpentry, stone crushing, leather works, bidi (a local verity of crude cigerate) making, cane and bamboo works, tea manufacturing etc.

219. All these districts have vast resources of commercially exploitable forest and there is good scope for development of timber based industries including manufacturing of tea boxes.

220. The rapid expansion of tea over the years changed almost completely the demographic character of the district. Greater part of the primeval forest has disappeared and has been replaced by tea gardens and human habitation especially after the partition. (Refer **Table 67**).

Table 67 : Industries and employment generated in industrial sector in the district

Sr. No.	Particulars	No of units in Districts		
		Jalpaiguri	Darjeeling	Cooch Behar
1	Registered working factories	526	281	40
2	Micro, Small and Medium scale industrial establishments	1,265	8,203	5,331
3	Employment generated in registered working factories	29,304	13,282	2,138
4	Employment generated in small, micro, medium enterprises	9,380	44,617	27,328
5	Employment in Govt. offices	15,207	19,306	9,804

Source: District Statistical Handbooks – Cooch behar, Darjeeling and Jalpaiguri 2005-06.

221. **Tea Industry:** The tea plantation is dominant in both Jalpaiguri and Darjeeling district. It is generating significant employment. Tea plantation and processing industry is single source of livelihood for majority of the households in the district of Jalpaiguri and Darjeeling. Cooch Behar district also has a few tea gardens. The No of tea gardens with land under tea cultivation and employment generation details are summarized at **Table 66**.

Table 68 : Tea Industry in the districts

Sr. No.	Particulars	Units	Districts		
			Jalpaiguri	Darjeeling	Cooch Behar
1	No of Gardens	No	158	100	24
2	Land under cultivation	Ha	72,673	24,784	1,417.32
3	No of persons employed	No	169,278	67,746	1,433
4	Average Tea Yield	Kg per ha	1,769	2,695	1,292

Source: District Statistical Handbooks – Cooch Behar, Darjeeling and Jalpaiguri 2005-06.

222. **Tourism:** Tourism contributes in a great way to the economy of the districts. There are 2 hot spots – Jaldapara National park and Jaldhaka River. Number of temples on both roads also attracts tourists to visit. Jaigaon and Panitanki are considered as "Gateway" to enter Bhutan and Nepal countries respectively. Siliguri also play an important role for the tourist visiting Sikkim. Bagdogra airport located close to the road corridor is also transfer point for Sikkim as well as Nepal and Bhutan. There are number of lodging facilities either developed by West Bengal Tourism Development Corporation or private entrepreneurs at

most of these locations. The tourists provide an important livelihood source for income to the local people around these locations (Refer **Table 69** for tourist details).

Table 69 : Tourism activity in the districts

Sr. No.	Location	Type of tourist spot	Average No of tourist visited in last three years	No of households depend on tourists
	AH 48			
1	Jaldapara	National Park	20,000	500
2	Jaldhaka, Birpara	Recreation Parks	5,000	250
3	Jaigaon	Gateway to Bhutan	50,000	1,000
4	Temples Hasimara, Dhupguri, -10 more etc.	People gather for festivals and prayers	50,000	1,000
		Sub Total	**1,25,000**	**2,750**
	AH 02			
5	Siliguri	Gateway to Sikkim	50,000	1,000
6	Panitanki	Gateway to Nepal	30,000	750
7	Bagdogra	Airport	50,000	1,000
		Sub Total	**130,000**	
	Total		**1,80,000**	**2,750**

Source: Focus Group Discussions with the community members 2012

223. **Trade: Import and Export:** The passenger movement as well as import and export trade between India, Bhutan, Nepal, and Bangladesh has shown a significant growth in recent past e.g. 136% growth in value of import goods at Chandrabandha check post. On an average 40,000 passengers, tourists, students have been traveling at this point. A 4% growth in passenger movement was recorded over last three years. Coal, stone boulders, fresh fruits, commercial plywood, Maize, Jute seeds, medicine, aluminium profile, readymade garments, melamine tableware are the key export to Neighbouring countries through this region. Bricks, cotton, yarn waste, synthetic, net fabrics, flat glass, head gear, readymade garments, table ware and synthetic and fruit juices, Fresh fruits, dolomite chips, dolomite powder, quartzite chips, lime stone lumps are key imports from neighbouring countries in this region.

6. Infrastructure

224. **Education:** Almost every village in all the districts have primary school at the maximum distance of less than 2 km form the village / urban area. In a cluster of 5-8 villages with maximum distance of about 5-6 km, high and higher secondary schools are found. Colleges however found in faraway places with a maximum distance not less than 15 km. Thus it was found that the accessibility to the educational institution in the area is within reasonable distance. Another important point is that more than 20 large size schools (1000 + students) were found along the highways in both corridors. Details of educational institutions of the districts are given at **Table 70**:

Table 70 : Educational Institutions in the Districts

Sr. No.	Type of facilities	Jalpaiguri	Darjeeling	Cooch Behar
1	Primary	2,037	1,842	1,812
2	Middle	33	81	60

3	High	179	133	127
4	Higher Secondary	140	77	93
5	College	13	15	10
6	University/ Technical	--	4	1

Source: District Statistical Handbook, Jalpaiguri, Cooch Behar and Darjeeling 2004-05

225. Health: Different levels of health facilities are located in the districts, having accessibility at a distance of maximum of 5 km from any village on the both the road corridors (Refer **Table 71** for details).

Table 71 : Health Facilities in the Districts

Sr. No.	Type of facilities	No of health facilities in the districts		
		Jalpaiguri	Darjeeling	Cooch-Behar
1	Hospital	8	38	10
2	Rural Hospitals	6	47	41
3	Block PHC	8	160	8
4	PHC/Private facilities	90	25	398
5	Total beds	3147	2763	1430

Source: District Statistical Handbook – Jalpaiguri, Cooch Behar and Darjeeling 2005-08.

226. **Road Infrastructure:** Districts has vast road network maintained by Public Works Department, District Administration (Zila Parishad) and Village Administration (Gram Panchyat), City municipalities, and Rural Road Authority under Prime Minister Rural Road Scheme (Prime Minister Gram Sarak Yojana). The villages and urban areas are well connected with the road network in these districts. The following **Table 72** gives an account of length of roads in project districts.

Table 72 : District Road Length in km maintained by different departments.

Sr. No.	Type of road maintained by authorities:	District wise Road length in km		
		Jalpaiguri	Darjeeling	Cooch Behar
1	PWD Roads			
A	National Highway	*305*	*168*	*65*
B	State Highways	*222*	*181*	*131*
C	District Roads	*505*	*179*	*323*
D	Village Roads	*234*	*88*	*289*
	Sub Total	1,266	616	808
2	Zilla Parishad Surfaced Roads	1,164	509	109
3	Zilla Parishad Unsurfaced Roads	978	1,170	240
4	Gram Panchayat Surfaced	1,124	--	263
5	Gram Panchayat unsurfaced	3,249	--	5,735
6	Prime Minister Gram Sarak Yojana	396	--	294
7	Roads maintained by Municipalities	458	601	67
	Total	8,635	2,896	7,516

Source: District Statistical Handbook – Jalpaiguri, Cooch Behar and Darjeeling 2005-08.

227. **Drinking Water Facilities – Sanitation and hygiene:** Drinking water comprised of tap water at select urban settlements. In most villages, the water source is either from bore

well or river. The water availability is year round with exceptional occasions of getting water bit dirty especially when flooding takes place in rainy season. Drainage and sanitation facilities are mostly developed in urban areas. In rural areas sanitation facilities are developed in few villages

228. **Access to electricity**: More than 95% villages electrified in Jalpaiguri and Cooch Behar District. The Darjeeling District has 78% villages electrified. The villages and urban wards in plain areas of the district are mostly electrified (Refer **Table 73** for details).

Table 73 : No of Villages (Mouzas) electrified in the district

Sr. No.	Particulars	Districts		
		Jalpaiguri	Darjeeling	Cooch Behar
1	No of Mouzas in the district	742	708	1,202
2	No of Mouzas electrified	756	537	1,150
3	% of Mouzas electrified	99.73	77.93	95.67

Source: District Statistical Handbook – Jalpaiguri, Cooch Behar and Darjeeling 2005-08.

7. Road Safety and People's Perception

229. Increasing traffic and population of registered vehicle has caused large no of accident in the area. Between 2005 to 2008 622 accidents happened in Jalpaiguri district alone out of which 252 person died (Refer **Table 74** for statistical details).

Table 74 : Number of accidents on roads in the district

Sr. No.	Particulars	Districts No of cases		
		Jalpaiguri	Darjeeling	Cooch Behar
1	No of accident occurred (average five years)	622	333	216
2	No of persons injured (average five years)	781	498	214
3	No of persons died average five year	252	139	83

Source: District Statistical Handbook – Jalpaiguri, Cooch Behar and Darjeeling 2005-08.

230. During community consultations, the enumerators tried to capture the community perception of prevailing accident patterns in the last three years. The main concern raised by the school management and heads regarding safe passage and approach to school. There have worries due to accidents occurred in the past. A summary of perception analysis is presented at **Table 75.**

Table 75 : Community Perception of prevailing accident patterns in last three years

Sr. No.	Particulars	AH 2	AH48	Total Locations
1	No of locations	12 Locations (Upper Bagdogra, Bihar More, Shivmandir, Naukaghat and 8 schools locations)	16 Locations (Maya naguri, crossing, Dhupguri, Gairkata, Telipara, Dalsing para, Jaigaon and 10 school Locations)	28
2	No of accident prone locations	12	16	28
3	No of accidents Nature – Fatal	2	4	6
4	No of accident –Grievous	15	12	27
5	No of accidents simple injury	20	18	38

Source: Focus Group Discussions with the village / urban communities 2012

8. Inventory of Physical and Cultural Resources:

231. The inventory of physical and cultural resources (PCRs) was carried out on both the road corridors. A total of 87 PCRs are identified along the road. These PCRs are schools, religious places, cremation ground, hospitals and dispensaries, parks, recreation facilities. The summary of PCRs is given in **Table 76** below:

Table 76 : Summary of PCRs on Road Corridors AH 02 and AH48.

Sr. No.	PCR	Total No of PCRs on highways		
		AH 02	AH48	Total
1	Schools	6	16	22
2	Temples	5	14	19
3	Mosque	0	3	3
4	Church	1	1	2
5	Market	3	4	7
6	University	1	0	1
7	College	1	0	1
8	Govt. Off	5	3	8
9	Playground/club	1	1	2
10	Cremation	1	5	6
11	Park / Gardens	0	2	2
12	Community Hall	1	0	1
13	Canal	1	0	1
14	PHC / Hospital	1	5	6
15	Shop Mall	0	1	1
16	Parking Place	1	2	3
17	BDO Office	0	2	2
	Total	28	59	87

232. There are 17 number of educational institutions, 6 number of major temples, 13 number of public utilities such as land custom offices, recreation parks, market, hospitals, Gram Panchayat Samity office, Teesta canal, public limited company/factory office, cremation grounds were also identified. Same way, on the AH 48, majority of the resources were schools, hospitals, PHCs, cremation ground, church, mosque, temple, and parks. The lists of PCRs is placed at **Appendix 8.3.**

9. Archaeological Important monuments in the Project Area

233. No Archaeological Protected Monument is located in the close vicinity of the road. There are two protected monument in Jalpaiguri District one namely Jatileswar Siva Temple located at a distance of about 3.5 Km from AH-48 and Historical Fort and Prison on Mountain Clif at Buxa located at about 13 Km from AH-48. There are three protected monument in CoochBehar district. However these are more than 30 Km away from AH-2.

10. Land acquisition and Project Affected Persons

234. Though required ROW is available along most of the section of both the project corridors, the land will be required for bypasses, realignment and improvement of curves. About 67 Ha land (About 12 Ha for AH-2 and 55 Ha for AH-48) is estimated to be acquired. This land includes about 44 Ha Government land and 23 Ha private land. The project Affected person assessment will be assed as part of DPR preparation. PAH is estimated to be minimal since most of the private land is agricultural land.

IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Impact on Physical Environment

235. Environmental impacts have been assessed considering present environmental setting of the project area, nature, and extent of the proposed activities. Suitable approach and methodology was adopted to ascertain likely impacts both during design and construction and operation stage. Valued Environmental Components were identified during initial site visit followed by its detailed investigation during later stage of the study.

B. Design Stage

1. Climate

236. Climate consideration has been made. Key findings with design recommendations are as follows:

- Developmental projects like Asian Highway, which is passing through forests and adjoining areas and requiring felling or clearing of trees and vegetation, may alter the local micro-climate if trees felled are in substantial numbers
- Climate Change predictions strongly suggest increase in events like erratic and intense rainfall and temperature increase. All these, together can cause repercussions on developmental projects like that of Asian Highway Network. The area has an history of flooding, but few zones (Panitanki, Naxalbari, Shiv Mandir and North Bengal Medical area, Fulbari, Rangapani in AH-2 and Chandrabandha, Dhupguri, Jaldapara, Madrihat in AH-48) requires better planning and management from climate change perspective through watershed management and drainage management and raised culverts/road.
- Assuming that total 1258 woody tree species (according to our assumption of more C sequestrating species), within 2km stretch of Jaldapara Section of AH-48 Alignment are to be cut, which may lead to a loss of 2152 tC. Considering in terms of Carbon value, trees of high Organic Carbon contents need to be planted more for faster recovery of C loss.

237. **Mitigation Measures:** The project envisages approximately 62,500 trees as a compensatory plantation on 1:5 basis against cutting of 12,500 trees for both road sections. To maintain and further enhance the micro climate and aesthetics, it is recommended that avenue plantation of at least one row shall be done along roadside during up-gradation of the project road.

238. There is need to undertake Carbon Stock assessment study for impacted areas of proposed AH-2 and AH-48 alignment, which will give a clearer picture for restocking of area with appropriate species and numbers to compensate for loss of carbon stock due to felling of trees during project construction phase.

239. Considering average life cycle of trees as 30 years, the number of trees to be planted against loss should be 30 times to recover in one year, but, it is not feasible practically, thus ratio of 1:5 times for tree plantation should be undertaken to recover the C-loss in approximately 6-7 years period (based on favourable ecological conditions). Therefore, as carbon enhancement measures, the ratio of woody trees to be planted for compensation of felled trees shall be around 1:5. This plantation will be carried out in addition to the payments for Net Present Value (NPV) made to the concerned Forestry Department for diversion of forestland as well as felling of trees.

240. Educate & aware forest dependent communities to participate in GHG reduction measures and provide suitable alternatives to them

2. Natural Hazard

241. **Impact:** Both the project corridor is located in seismic zone IV which is high damage risk zone. This may cause failure of civil structures in the event of earthquake if design consideration related to seismicity is not taken into consideration.

242. **Mitigation Measures:** Relevant IS codes shall be adopted while designing the civil structures to sustain the earthquake of highest magnitude in Seismic zone IV.

3. Road Widening, Utilities shifting and Safety Planning

243. The entire road section largely has enough ROW availability. Therefore, the proposed road improvement work will be undertaken mostly along the existing alignment and within available land except in the bypass road area. Road widening may affect various utilities which are mostly located in urban areas and mostly water pipes and telecommunication cables. Certain structures belonging to encroachers and squatters may require shifting. The road widening and increase traffic may damage drainage system and create safety concern to people residing along the road and will require due design considerations at planning stage. Low road levels in habitat areas may accumulate domestic waste discharged by habitat occasionally and damage the road.

244. Widening planning (left aligned, left aligned or centric) shall made considering minimum affect to trees, utilities, community structure, damage to drainage system, safety of habitat located along the road. Pavement design selection will have adequate provisions of drainage in habitat areas. Road level shall be raised above the neighbouring areas with provision of adequate side drains to evacuate the rain water and domestic discharges (drained by habitats occasionally) to prevent damage to road and rain water entry to habitats' houses and embankment stabilisation. Provision of adequate cross drainage structure shall also be made to ensure natural flow of rainwater across the road.

245. Adequate safety provisions like crash barriers at accident prone areas, rumble strips in habitat areas to regulate speed, retro-reflective warning sign boards nears school, hospital, religious places (Preferably PCC boards with retro- reflective paints to avoid its theft) shall be made. All utilities requiring shifting shall be largely made before start of construction and without causing any affecting any essential supplies to habitat like water supply.

4. Air Quality

246. The stone aggregate are planned to be sourced from licensed quarries Pakur located within West Bengal. No new quarries shall be open for the project. The pollution related aspects to these quarries are to be independently complied by the quarry owner. The aggregate will be transported in the covered quarries through existing national and state highways.

5. Noise

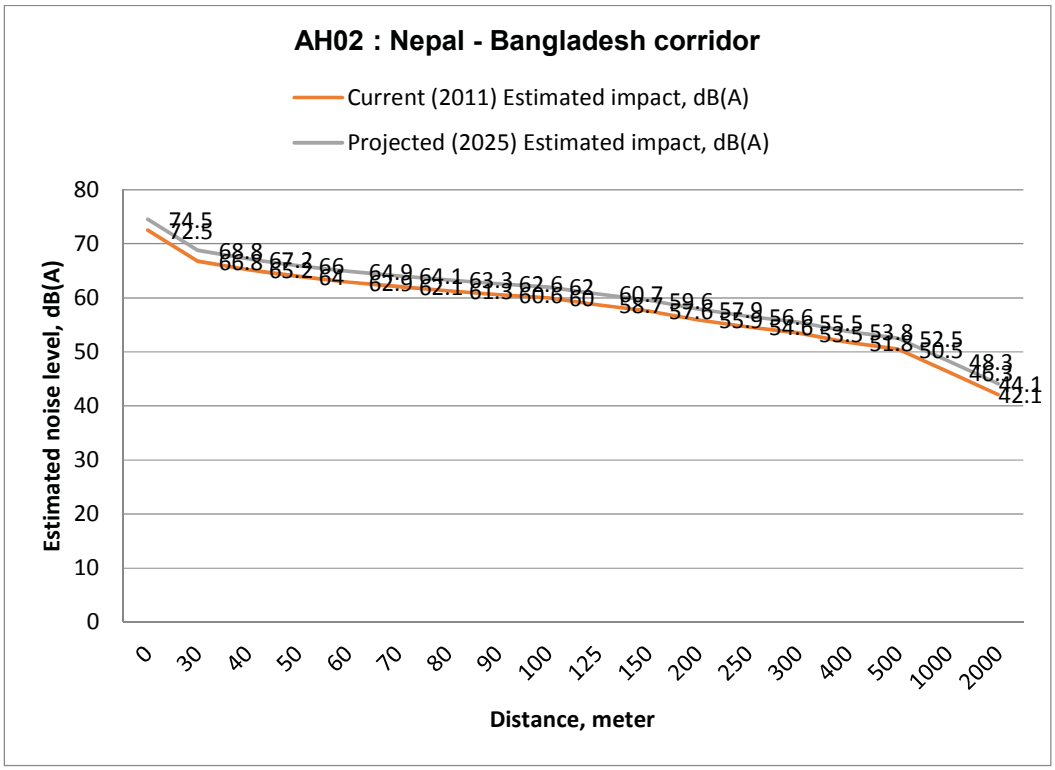
247. Noise level may increase during construction and operation stages of project near the sensitive receptors like hospitals, schools religious structures. An assessment of likely noise levels is made based on existing and predicted traffic level of 2025 based on Technical Guides - Calculation of Road Traffic Noise 1988. The modelling results are

presented at **Table 77** and Figure 64. The Current and predicted Noise level at sensitive receptors are also presented at **Table 78** and **Table 79**.

Table 77 : Noise Level Prediction Results based on current and predicted Traffic levels.

Nepal-Bangladesh																		
Distance from Road Edge, m	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**00**	**25**	**50**	**00**	**50**	**00**	**00**	**00**	**000**	**000**
Current (2011) Estimated impact, dB(A)	2.5	6.8	5.2	4	2.9	2.1	1.3	0.6	0	8.7	7.6	5.9	4.6	3.5	1.8	0.5	6.3	2.1
Projected (2025) Estimated impact, dB(A)	74.5	8.8	7.2	6	4.9	4.1	3.3	2.6	62	0.7	9.6	7.9	6.6	5.5	3.8	2.5	48.3	4.1
Bhutan-Bangladesh																		
Distance from Road Edge, m	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**90**	**00**	**25**	**50**	**00**	**50**	**00**	**00**	**00**	**000**	**000**
Current (2011) Estimated impact, dB(A)	8.5	2.8	1.2	60	8.9	8.1	7.3	6.6	56	4.7	3.6	1.9	0.6	9.5	7.8	6.5	2.3	8.1
Projected (2025) Estimated impact, dB(A)	0.5	4.8	3.2	62	0.9	0.1	9.3	8.6	58	6.7	5.6	3.9	2.6	1.5	9.8	8.5	4.3	0.1
Reference: Technical Guides - Calculation of Road Traffic Noise 1988																		

Figure 64. : Noise Attenuation Pattern



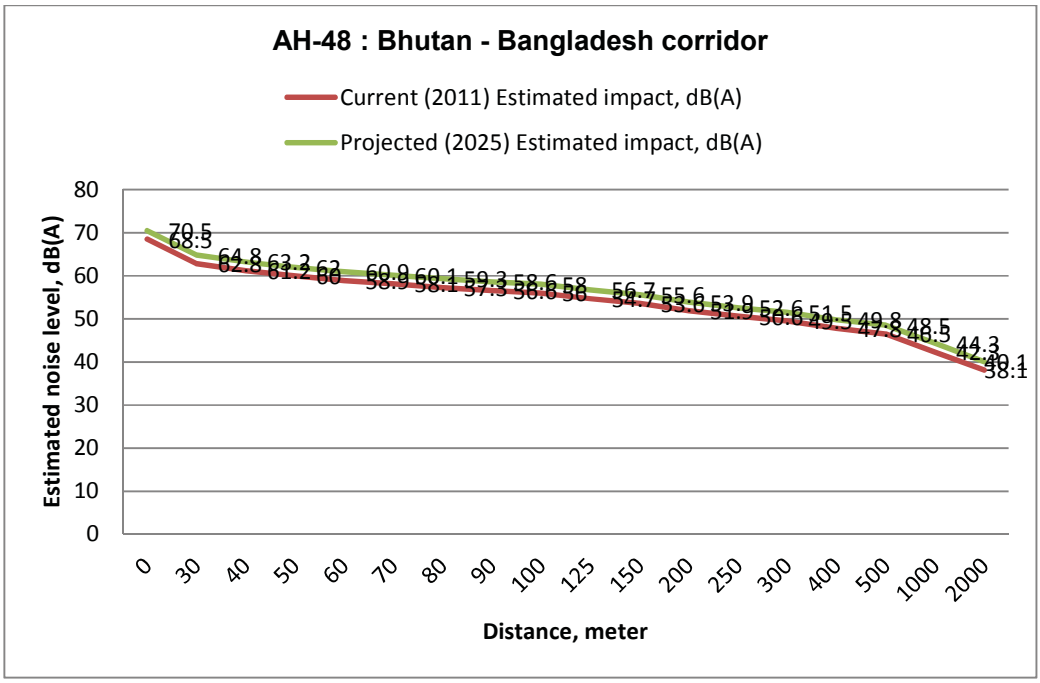


Table 78 : Current and Resultant Noise Level at Sensitive locations of AH-2

Chainage (AH-2)(Km)	Receptors	Distance from edge of the road (meters)	Current Measures Noise level (dB(A)	Predicted Noise level based on traffic volumes dB(A)	
				2011	2025
8.53	School - Durga Temple Mangal	10	62	72.5	74.5
4.94	Shishu Niketan	10	65	72.5	74.5
7.10	Hindi Higher Secondary School	5	65	72.5	74.5
17.00	Bagdogra Balika Vidyalaya	2	67	72.5	74.5
16.80	Hebron High School	10	62	72.5	74.5
19.70	College Kalipad Vidyalaya	50	71	64	66
16.40	Shishu Shiksha Kendra	5	63	72.5	74.5
27.36	Jr.High School	2	65	72.5	74.5
27.00	North Bengal Medical College	100	62	60	62
27.2	Kali Temple	2	62	72.5	74.5
24.50	Sanyasi Baba Mandir	5	63	72.5	74.5
24.20	Durga Mandir	20	66	72.5	74.5
22.57	St Paul School	0	76	72.5	74.5
21.80	North Bengal University Dep. Law	10	76	72.5	74.5
32.00	Mata Maya Kali Mandir	10	60	72.5	74.5
45.00 (alternative road)	Nimtala Smashan	40	61	65.2	67.2
47.00 (alternative road)	Ranidanga Kalaram High School	5	68	72.5	74.5
48.00 (alternative road)	Ranidanga Jr. Girls High School	5	65	72.5	74.5

Table 79 : Current and Resultant Noise Level at Sensitive locations of AH-48

Chainage (AH-48)(Km)	Receptors	Distance from edge of the road (meters)	Current Measures Noise level (dB(A)	Predicted Noise level based on traffic volumes dB(A)	
				2011	2025
0.42	Temple (Shani)	0	72	72.5	74.5
0.40	Jr. Girls High School	35	70	66.8	68.8
1.22	Primary Health Centre	40	70	66.8	68.8
1.50	Temple (Shani)	0	70	72.5	74.5
1.8	School St Johns	5	52	72.5	74.5
2.4	Temple	2	75	72.5	74.5
12.6	School	10	62	72.5	74.5
14.6	School	100	58	60	62
17.5	Temple (Kalibari)	20	58	72.5	74.5
18.00	Temple -Bateswar	10	73	72.5	74.5
18.00	Jr. Basic School	20	72	72.5	74.5
20.6	SP Primary School	40	68	66.8	68.8
23.6	Temple, Juba Club	40	63	66.8	68.8
40.6	Temple	50	67	64	66

43	School	200	60	55.9	57.9
43.7	Cremation Ground	20	60	72.5	74.5
45.8	Raj Mohan h. School	5	61	72.5	74.5
47.5	Mazar Sharif	40	60	66.8	68.8
54.5	Ajay Ghosh P.School	10	60	72.5	74.5
87.00	Cremation Ground	5	74	72.5	74.5
66.4	Shiv Mandir	2	66	72.5	74.5
73.4	Mahakali Temple	10	46	72.5	74.5
80.7	Cremation Ground	40	60	66.8	68.8
72.1	Temple	10	60	72.5	74.5
99	Church	10	60	72.5	74.5
94	High School/club	10	61	72.5	74.5
93	Kali temple	10	62	72.5	74.5
93	Cremation Ground	10	59	72.5	74.5
80	Mad. Hat H.S. School	10	63	72.5	74.5
109	New Ero High School	10	63	72.5	74.5
109.5	Jaigaon Vedvyas H/S	15	61	72.5	74.5
110	Kali Mandir	20	64	72.5	74.5
100	Bahrut-Ul-Shame Ghousia	15	59	72.5	74.5
99	Masjid-e-Mohammadi	10	62	72.5	74.5
98	Dalsingpara Public School	5	60	72.5	74.5
91	Laxmi Narayan Temple	5	58	72.5	74.5
87	Toorsa Smashan Kali Tem.	5	63	72.5	74.5

248. It is assessed that incremental noise level due to current traffic and project traffic is of the order of only 2 dB(A). The current spot measurement level at various sensitive receptors is much below than traffic volume based assessment. This indicates that noise is being attenuated due to to various existing berries like tree. Though, the noise level is exceeding the prescribed ambient noise levels at most of the places, the public at large has shown no concern to Noise pollution.

249. **Mitigation Measures:** It is proposed to plant trees as a natural barrier to noise propagation along the road. The provision of noise barrier can be made at certain sensitive locations located within 200 ft or 61 Meter of the road, as Noise barriers are normally most effective in reducing noise within this distance. The Noise barriers can be constructed from earth, concrete, masonry, wood, metal, and other materials. To effectively reduce sound transmission through the barrier, the material chosen must be rigid and sufficiently dense (at least 20 kilograms/square meter). All noise barrier material types are equally effective, acoustically, if they have this density. To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the home or receiver to the barrier. A provision of five Noise barrier locations in each corridor is made which should be provided based on the willingness of the school/temple or religious structures authorities and technical feasibility.

6. Land and Soil

250. The proposed up-gradation of the project road will be largely within the existing ROW except bypasses and select areas. 12 Ha (9 Ha government land and 3 ha private land) for AH-2 and 55 Ha (35 HA government land and 20 Ha private

land) is required for the project. Therefore, no significant adverse environmental impact is anticipated on the land use pattern. This acquisition will change the land use of the acquired land area. All efforts will be made to minimise the land acquisition.

251. Land use may partially change at the borrow areas but the same will be done as per the agreement with land owner and as such this change will also be insignificant in nature.

7. Ground Water

252. Water will be required primarily for compaction of formation and for domestic purpose in the workers camp. Water for construction activities and domestic purpose for workers camp will be mainly sourced from groundwater. The project road area falls under safe zone as per Central Ground Water Authority classification of ground water resources in India. The uncontrolled abstraction can stress the water availability locally during summer season.

8. Surface Water Bodies

253. The project roads cross many rivers. Other water bodies are seasonal in nature. Widening of 57 bridges reconstruction of 1 bridge and construction of 3 new bridges are proposed over water bodies crossed by the project road. Construction of bridges on water body will be undertaken during dry period. No significant impact is anticipated on any of the river water due to bridge construction. However, siltation of river water may affect the aquatic life of the river.

254. **Mitigation Measures:** Water flow should not be stopped fully. Continues flow of the water in a channel with a pond and puddle upstream (about 50 m) shall be maintained for aquatic flora and fauna.

9. Hydrology and Drainage

255. **Impact:** The project road will be up-graded within existing ROW along the existing alignment except bypasses. Water flooding situation may arise in the bypass area if adequate provision of cross drainage structure is not made.

256. The project road will not alter any water body or pond. Therefore, no impact is anticipated on the hydrology of the area. Diversion of water channels during construction of cross drainage structures or otherwise is not envisaged.

257. **Mitigation Measures:** Provision of adequate cross drainage structure is to be made in the all the three bypass road sections.

258. Adequate cross drainage structures shall be provided. Additional balancing culverts shall be provided in flood prone areas. The embankment height shall be designed consistent with the existing topography of the region and shall be higher than the HFL.

259. Elaborate drainage system shall be provided to drain the storm water from the roadway and embankment and to ensure minimum disturbance to natural drainage of surface and subsurface water of the area.

260. The design of drainage system such as surface and sub-surface drainage shall be carried out as per IRC: SP: 42 and IRC: SP: 50. Surface runoff from the main

highway, embankment slopes and the service roads shall be discharged through longitudinal drains, designed for adequate cross section, bed slopes, invert levels and the outfalls. If necessary, the walls of the drains shall be designed to retain the adjoining earth.

261. IRC: 34-1970: Recommendations for road construction in waterlogged area and IRC: 75 and MORSTH guidelines for Design of High Embankments shall be referred.

10. Terrestrial Ecology: Flora

262. **Impact:** There is no national park, wildlife sanctuaries or any other similar eco-sensitive areas within 10 km distance of the AH-2 road corridor area. However AH-48 project road corridor passes through Jaldapara National Park and Khairbari reserved Forests. The impact and mitigation on terrestrial flora is discussed below:

- About 3,500 and 9000 numbers of trees are proposed to be cutl for widening and improvement of project road corridor in AH-2 and AH-48 respectively which would lead to substantial loss of local flora.
- About 5.0 ha of Khairbari reserved forest land outside Jaldapara National Park and 3 Ha land within Jaldapara National Park will be diverted for non-forest purposes for the road improvement and construction of underpasses for elephant movement. This will lead to ecological disturbances and soil erosion.
- Vulnerable species Delonix Regia (Gulmohar) the only vulnerable specie may get affected due to project activity. But this is an exotic species of the region.

263. **Mitigation Measures:**

- As mentioned in Section IV.B.1, compensatory afforestation for felled trees at the rate 1:5 will be undertaken for the project. It is proposed to establishment nurseries at appropriate places.
- Prior forest clearance shall be obtained for diversion of forest land. Adequate budgetary provision shall be made equal to twice the forest land diversion area and Net Present Value as per Forest (Conservation) Act.
- The project envisages plantation of approximately 62,500 trees (Based on 1:5 basis.) along both sides of road. Besides, additional plantation shall be done on river banks near bridge sites to enhance the aesthetics and check soil erosion, degraded forestland including parks, and to extent possible other government compounds. The tree plantation works maybe included under the responsibility of the civil works contractor. However, possibility can also be explored to plant trees through Village Panchayats who are will to contribute for the same. However, to ensure effective monitoring of EMP including trees plantation District level committee headed by District commissioner is proposed to be formed which will comprise of members from forest department, PWD, revenue. This committee will periodically monitor the progress of tree plantation and its survival. The large tree plantation will improve the local climatic conditions as well in long term.
- A range of 10-15 m centre-to-centre is recommended for spacing of trees (parallel to the road). Setback distance of trees in different situations shall be based on IRC: SP: 21 and IRC: 66. The distance

between the kerb, if any, and the nearest edge of tree trunk shall be at least 2 m. The plantation in median shall comprise shrubs whose height would normally not exceed 1-1.5 m and shall be as per IRC SP: 21.

- For safe traffic operation, vertical clearance between the crown of the carriageway and lowest part of overhang of the tree available across the roadway shall conform to the standards laid down in IRC: SP: 21. The pit size, fencing, watering, and manuring requirements shall also conform to the above standard. The use of pesticides shall be avoided or minimised to the extent possible. Planting shall be such that it does not obstruct the visibility of traffic from any side and shall be pleasing in appearance.
- Local species shall be planted. Delonix Regia (Gulmohar) shall be planted more in numbers.

11. Terrestrial Ecology: Fauna

264. Impact: There are no national park, wildlife sanctuaries or any other similar eco-sensitive areas within 10 km distance of the AH-2 road corridor area. However AH-48 project road corridor passes through Jaldapara National Park and Khairbari reserved Forests. The impact and mitigation on terrestrial fauna is discussed below:

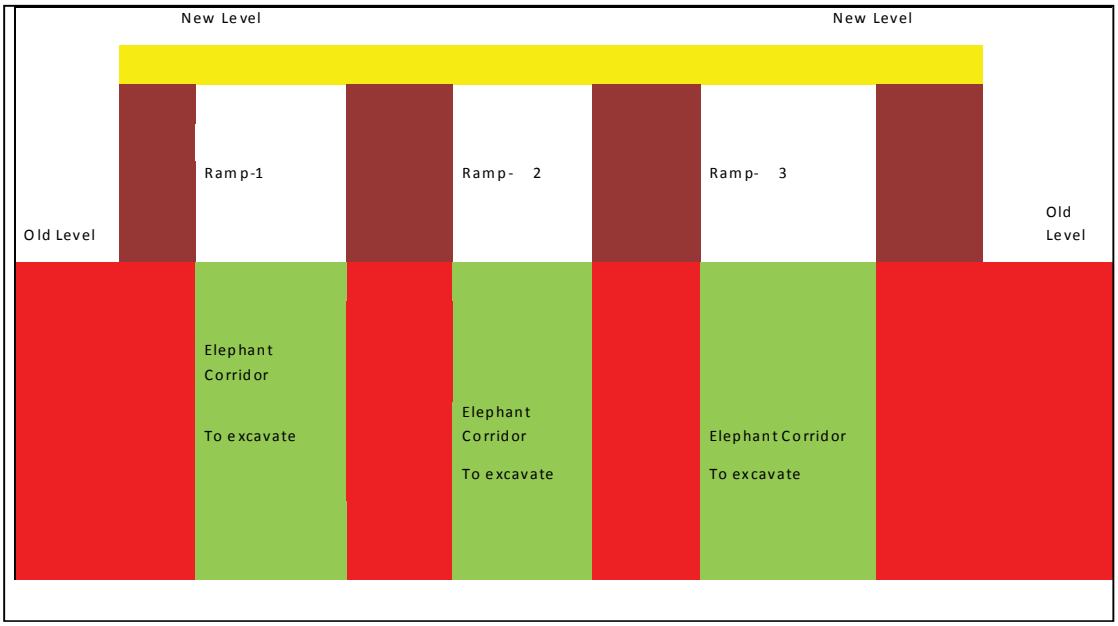
- Some portion of AH-48 project road corridor fall within Elephant conservation area between Hasimara to Jaigaon and Pasakha, access road which will have an adverse effect on elephant movement if adequate measures are not taken.
- The AH-48 road corridor passes through 2700m within Jaldapara National Park causing severe disturbance and loss of fauna. This section also falls within Elephant migratory corridor at three locations. Various other animal (blue bull in particular) crossing the road leads to Man-Animal conflict as well. Improved road condition with increased speed will worsen the situation.

265. **Mitigation Measures:** Three underpasses shall be constructed for safe passage of Asian elephant in the Jaldapara National Park area. The height of each of the underpass shall be more than the 10 meters from the forest floor level and length should 100 meters. The soil where the ramp will be constructed should be excavated away to level it with the forest floor. This will help the Asian elephant and other large mammals to walk on a levelled ground and will use the under passes under these ramps. Guide rails shall be installed along the both side of the underpass to direct the elephant and animal movement to the underpass. Camouflaging plantations shall be made along the rails to provide privacy to the elephants. The exact locations of underpasses are to be decided in consultation with Jaldapara National Park authorities. Pictorial view of type of underpass is shown at **Figure 65**. Further detailed engineering drawings on the underpass is given in Appendix 11.1. However, exact design shall be finalized at detailed design stage.

- Provision of retro-reflective warning sign boards shall be made in the elephant movement area near Between Hasimara and Pasakha Bypass area.
- Wild Life Clearance shall be obtained for construction of Underpasses, diversion of land in the Jaldapara National Park and road improvement in the elephant conservation areas.
- Mobile ambulance and rescue team for handling cases of man-animal conflicts.

- Top soil of the diverted area of the reserved forests or National Park shall be preserved used for reforestation activates as these soil are very rich in nutrients.

Figure 65. : Pictorial view of underpass in Jaldapara National Park area



12. Aquatic Ecology

266. No impact is anticipated on the aquatic life; however, this can be affected if material storage or construction camps are planned close to water bodies. Temporary sedimentation and water quality deterioration is expected from the project during the construction stage. Accidental spill of materials, chemicals, and fuels may also deteriorate receiving water quality.

267. **Mitigation Measures:**

- No construction camp or material storage site shall be selected close to water bodies.
- Provision shall be made to release fish fries and fingerlings in perennial rivers to enhance local fishery with the help of fishery department as an enhancement measures.

13. Socio-Economic Impact

268. About 120 PAH, 95 structures completely and 44 structures partially are likely to be affected in AH-02. Similarly about 310 PAH and 250 structures completely and 145 structures partially are likely to be affected in AH-48.

269. People at large have raised concern of safety during public consultation stage. Many accident cases are reported in the past safety, which is of major concern around schools and hospitals.

270. **Mitigation Measures:** A separate SIA and R & R study is undertaken as per SPS09. This aspect will be dealt with as per finding or these assessments. The

provision of Land compensation Act 1898, National Highway Act 1956 and National R & R policy 2007 and ADB SPS09 provision will be followed for land acquisition.

271. Adequate provision shall be made in project design for safety near schools, hospitals and other sensitive locations. Provision of adequate caution signage near school, sensitive locations, shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Steel base signage shall be avoided to prevent theft of the same. Crash barrier shall also be installed at appropriate locations particularly near school to provide safety to school children. Provision of speed breakers shall also be made near schools and religious places.

C. Construction Stage

1. Climate

272. For up-gradation of the project road, cutting of approximately 12500 trees will have minor to negligible impact on microclimate of the region. However, this aspect is already covered under design stage measures.

2. Air Quality

273. Construction Stage: The potential sources of air emission during the construction phase of the project are: (i) dust from earth works (during site preparation), (ii) emissions from the operation of construction equipment and machines, (iii) fugitive emissions from vehicles plying on the road, (iv) fugitive emissions during the transport of construction materials, (v) air emissions other than dust arise from combustion of hydrocarbons particularly from the hot mix plants, and (vi) localised increased traffic congestion in construction areas. Most of the emissions will be in the form of coarse particulate matter, which will settle down in close vicinity of construction site. Installation of crusher unit will also lead to air pollution. Hot mix plant will generate carbon monoxide (CO), un-burnt hydrocarbon, sulphur dioxide, particulate matters, and nitrogen oxides (NOx) emissions. This may affect the air quality of nearby areas especially due to emission discharge from low height stack. However, this will be a temporary phase and hence, no significant impact is envisaged.

274. **Mitigation Measures**: Following measures are proposed to minimise the dust and emission generation.

- Road design and pavement roughness shall be as per IRC specifications.
- Geometric adjustment shall be made if required and technically safe, to minimise cutting of trees. Undertake additional plantation as feasible on riverbanks, borrow areas, sensitive locations to increase green cover as improve aesthetics. Preference shall be given to pollutant absorbing trees for plantation.
- Vehicles delivering loose and fine materials like sand and aggregates shall be covered.
- Loading and unloading of construction materials shall be made at designated locations in project area with provisions of water fogging around these locations.
- Storage areas should be located downwind of the habitation area.
- Water shall be sprayed on earthworks periodically
- Regular maintenance of machinery and equipment. Vehicular pollution check shall be made mandatory.

- Mixing plants and asphalt (hot mix) plants shall be located at least 1 km downwind of the human settlements. The asphalt plants, crushers and the batching plants shall be sited at least 500m in the downwind direction from the nearest settlement and after securing a No-Objection Certificate (NOC) from the West Bengal State Pollution Control Board (SPCB). Hot mix plant shall be fitted with stack of adequate height as may be prescribed by SPCB to ensure enough dispersion of exit gases.
- Feasibility shall be explored to adopt cold mix technology instead of hot mix technology.
- Bitumen emulsion and bitumen heaters should be used to the extent feasible.
- Only crushers licensed by PCB shall be used.
- LPG should be used as fuel source in construction camps instead of wood. Tree cutting shall not be allowed for fuel wood.
- Regular water sprinkling of unpaved haulage roads.
- Mask and other PPE (Personal protective equipment) shall be provided to the construction workers.
- Diesel Generating (DG) sets shall be fitted with stack of adequate height as per regulations (Height of stack = height of the building + 0.2 √ KVA.
- Low sulphur diesel shall be used in DG sets as well as construction machineries.
- Air quality monitoring should be carried out during construction phase. If monitored parameters are above the prescribed limit, suitable control measures shall be taken.

3. Noise

275. Ambient noise level may increase temporarily in the close vicinity of various construction activities, maintenance workshops and vehicles and earthmoving equipment. These construction activities are expected to generate noise levels in the range of 80 - 95 dB(A) (at a distance of about 5 m from the source).

276. Although this level of noise is higher than the permissible limit for ambient noise level for residential/commercial levels but will occur only intermittently and temporary. This noise level will attenuate fast with increase in distance from noise source. Impact due to noise during construction activities will be minimal to inhabitants since most of the built-up areas are located at safer distance from the road.

277. Along the project road, various schools, hospitals and religious facilities are located, which may experience increased noise levels due the construction of the project road. However, plantation and boundary wall along the schools will work as noise barrier. Provision of noise barrier is also made for sensitive locations likely to experience higher noise levels. After up-gradation of project road, improved road conditions will also help in reduction of noise levels. Therefore, anticipated impact of noise levels will be insignificant.

278. **Mitigation Measures:** All equipment shall be fitted with silencers and will be properly maintained to minimize its operational noise. Noise level will be one of the considerations in equipment selection, which will favour lower sound power levels. Stationary noise making equipment shall be placed along uninhabited stretches.

279. The timing for construction activities shall be regulated such that all noise generating construction activities happen after school hours. The provision of temporary noise barrier (Barricading) shall be made near identified sensitive locations or near the noise source during construction. Plantation along the boundary wall shall be made at start of construction itself.

280. Protection devices (earplugs or earmuffs) shall be provided to the workers operating near high noise generating machines. Construction equipment and machinery shall be fitted with silencers and maintained properly. Noise measurements should be carried out to ensure the effectiveness of mitigation measures and develop a mechanism to record and respond to complaints on noise.

4. Impact on Land and Soil

281. **Loss of Productive Soil and Change in Land use:** Borrow areas may loose its productivity if top soil is not preserved. Similarly, land area used for locating construction camp may loose its productivity, if it is not restored to its original stage after disbanding the construction camp.

282. **Mitigation Measures:** The top soil from the productive land shall be preserved and reused for plantation purposes. It shall also be used as top cover of embankment slope for growing vegetation to protect soil erosion. It shall be ensured that the land taken on lease for access road and construction camp is restored back to its original land use before handing it over back to land owner.

283. **Soil Erosion:** Soil erosion may take place at locations of sharp bend near bridge construction locations, along steep and uncompacted embankment slope, and wherever vegetation is cleared. Soil erosion may have cumulative effect viz. siltation, embankment damage, and drainage problem. Loss of soil due to run off from earth stockpiles may also lead to siltation of nearby water bodies. The intensity of soil erosion at different locations will be influenced by the lithology, topography, soil type and climatic condition (mainly rainfall) and drainage pattern.

284. **Mitigation Measures :** Following mitigation measures are proposed for prevention of soil erosion:

- Bank protection measures shall be taken at erosion prone areas. The protection measures may include use of geo-textiles matting, bio (vegetative) - turfing.
- Provision of side drain to guide the water to natural outfalls.
- Stone pitching wherever necessary.
- When soil is spread on slopes for permanent disposal, it shall be buttressed at the toe by retaining walls.
- Side slopes of the embankment shall not be steeper than 2H:1V. Turfing of embankment slopes shall be done along the stretch.
- Shrubs shall be planted in loose soil area.
- In rural stretches, longitudinal side drains shall be intercepted by drains serving as outlet channels to reduce the erosion.
- IRC: 56 -1974 recommended practice for treatment of embankment slopes for erosion control shall be taken into consideration.
- Soil erosion shall be visually checked on slopes and high embankment areas. In case soil erosion is found, suitable measures shall be taken to control the soil erosion further including bio-turfing.
- While planning or executing excavations, contractor will take all adequate precautions against soil erosion as per MoRSTH.

- The earth stockpiles to be located downwind and provided with gentle slopes to prevent soil erosion

285. **Borrow Areas and Quarries:** The project area is flat terrain. Farmers are willing to provide earth from their field up to certain depth on adequate compensation, it is recommended that borrowing from agricultural land shall be minimised to the extent possible.

286. Borrow areas if left un-rehabilitated may pose risk to people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector born disease.

287. Illegal quarrying may lead to unstable soil condition; destroy the landscape of the terrain, air and noise pollution. Opening of new quarries is not envisaged due to the proposed project. Quarry material will be sourced from existing nearby quarries.
Mitigation Measures

288. Borrow pits shall be selected from barren land/wasteland to the extent possible. Borrow areas should not be located on cultivable lands except in the situations where land owners desires to level the land. The top soil shall be preserved and depth shall be restricted to the desired level.

289. Borrow areas should be excavated as per the intended end use by the owner. The Indian Road Congress (IRC):10-1961 guideline should be used for selection of borrow pits and amount that can be borrowed.

290. The depths in borrow pits to be regulated so that the sides shall not be steeper than 25%. To the extent possible, borrow areas shall be sited away from inhabited areas. Borrow areas shall be levelled with salvaged material or other filling materials which do not pose contamination of soil. In addition, it shall be converted into fishpond in consultation with fishery department and if desired by land owner/community. The borrow area shall be rehabilitated following the broad guidelines given at **Appendix 7.7**.

291. 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 PMU. 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 if new quarries are proposed to be opened.

292. **Compaction and Contamination of Soil:** Soil in the adjoining productive lands beyond the ROW, haulage roads, and construction camp area may be compacted due to movement of construction vehicles, machineries and equipment, and due to sitting of construction camps and workshops. Approach road either paved or unpaved is available for most the bridge approaches. However, for some bridges approach road has to be constructed.

293. Soil may be contaminated due to inappropriate disposal of liquid waste, (lubricating oil and fuel spills, waste oil and lubricant and vehicle/equipment washing effluent) and solid waste (fuel filters, oily rags) likely to be generated from repair and maintenance of transport vehicles, construction equipment and machinery. Soil may be contaminated due to inappropriate disposal of domestic solid waste and sewage from construction camps.

294. **Mitigation Measures:** Fuel and lubricants shall be stored at the predefined storage location and away from drainage channels. The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils. Construction vehicles and equipment will be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil.

295. All efforts shall be made to minimise the waste generation. Unavoidable waste shall be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fuelling areas, “oil interceptors” shall be provided. Oil and grease spill and oil soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized Waste Oil Recycler.

296. To prevent soil compaction in the adjoining productive lands beyond the ROW, the movement of construction vehicles, machinery and equipment shall be restricted to the designated haulage route.

- Approach roads shall be designed along the barren and hard soil area to reduce the compaction induced impact on soil.
- The productive land shall be reclaimed after construction activity.
- Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided at construction camp.
- Domestic solid waste at construction camp shall be segregated into biodegradable and non-biodegradable waste. The non-biodegradable and recyclable waste shall be sold off.
- Efforts shall be made that biodegradable waste shall be composted in the mechanized and movable composter by the contractor. Non-biodegradable and non-saleable waste shall be disposed off to authorized landfill site. 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

297. Construction waste constitutes debris, which are generated due to dismantling of pavement quarry dust and unused iron bars or damaged support structures. Uncontrolled disposal of these wastes may affect soil and even receiving water bodies may cause contamination of soil, and landscape of the area.

298. **Mitigation measures:** Construction waste shall be disposed of in environmentally acceptable manner. Some of the measures are as follows:

- The existing bitumen surface can be utilized for paving of cross roads, access roads, and paving works in construction sites and camps, temporary traffic diversions, and haulage routes. All excavated materials from roadway, shoulders, drains, cross drainage should be used for backfilling embankments, filling pits, and landscaping. Unusable debris material 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. For removal of debris, wastes and its disposal MoRSTH guidelines should be followed.

299. The locations of dumping sites should be selected with following considerations:

- Unproductive/wastelands shall be selected for dumping sites.
- Away from residential areas and located at least 1000 m downwind side of these locations,
- Dumping sites do not contaminate any water sources, rivers
- Dumping sites have adequate capacity equal to the amount of debris generated.
- Public perception and consent from the village Panchayats about the location of debris disposal site shall be obtained before finalizing the location.

5. Groundwater

300. Contamination of groundwater is not envisaged since construction camps will have septic tanks or mobile toilets depending on the number of workers in each camp.

Mitigation Measures

301. The contractor shall arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Water intensive activities shall not be undertaken during summer season.

6. Surface Water Bodies

302. Temporary pollution of water bodies may occur due to spillage of chemicals and oil at construction sites and disposal of waste from construction camps.

303. **Mitigation Measure:** To prevent siltation of roadside ponds, provision of retaining wall is made along the road for the ponds located next to the road. As enhancement measures, efforts shall be made to increase the water holding capacity of the ponds (other than those affected) in the region by using the bed material as borrow earth. Following measures shall be followed additionally:

- Bridge construction activity including piling is recommended during non-monsoon (October to End of May) period.
- 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.
- Silt fencing and/or brush barrier shall be installed for collecting sediments before letting them into the water body. Silt/sediment should be collected and stockpiled for possible reuse as surfacing of slopes where they have to be re-vegetated.
- All wastes arising from the construction should be disposed in an environmentally accepted manner so as not to block the flow of water in the channels. The wastes should be collected, stored and transported to approved disposal sites.
- No vehicles or equipment should be parked or refuelled near water bodies, so as to avoid contamination from fuel and lubricants

- Substructure construction should be limited to the dry season and cofferdams may be constructed and utilized to lift the spoil directly out of it and carried to the riverbank for land disposal.
- Construction camps shall be located away from habitation (at least 1 Km Away) and water bodies. Sewage from labour camps will be treated through septic tanks. No untreated/treated sanitary wastewater shall be discharged into surface water bodies as these are used for bathing and washing purpose.
- The borrow areas may also be converted into ponds with the concurrence of the landowners. Fisheries activity can be encouraged in such ponds through institutional support from concerned department

7. Hydrology and Drainage

304. Construction material and waste may contaminate or clogged the small drains if stored or disposed close to water body or pond

305. **Mitigation Measures**: No construction material will be stored or disposed near any after body except for reusing it for enhancement measures such as embankment raising.

8. Impact on Biological Environment

306. **Terrestrial Ecology - Flora:** The impact and mitigation due to tree cutting has been discussed in the design stage impacts. Cutting of trees may create hazardous traffic situation if cutting is not undertaken in a planned manner.

307. Various tea gardens are located in close vicinity of both the project roads and bypasses. The tea cropped area may reduce equal to the tea garden area being diverted for road and bypasses construction purposes. Crops may get further damaged due to uncontrolled construction waste disposal and movement of construction vehicles. As such no long term impacts on tea species is anticipated, since tea species can withstand the vehicular pollution as can be seen from flourishing tea garden existing from decades all along the busy highway in this area.

308. **Mitigation Measures:** Requisite permission from Forest Department shall be obtained for cutting of roadside trees.

309. It shall be ensured that tea crop is not affected beyond the tea garden area diverted for road and bypass construction. Construction truck and equipment shall move only in the designated area and without affecting the adjacent tea garden crops. No construction waste shall be dumped in the tea gardens.

310. Tree cutting shall be well planned to avoid any kind of inconvenience to local people and traffic.

311. **Terrestrial Ecology: Fauna**

- Construction activities are likely to cause some disturbance to the wildlife population especially in stretch within the protected areas through which the Bhutan-India-Bangladesh AH 48 is passing.
- The operation of various construction equipment is likely to generate significant noise. Noise disturbance may cause migration of the large mammals like elephants, bison to other areas.

- Movement of animals to other areas may lead to man-animal conflicts causing accidents with the trains running on the railway track near the Bhutan-India-Bangladesh AH 48.
- Setting of construction equipment go-downs, stores, labour camps, may generally disturb surrounding fauna.
- Bird and butterfly niche will be affected due to the changes which will be brought about because of construction activities at the project sites.

312. **Mitigation Measures**

- Minimization of any untoward incidence and probable harm due to poaching activities from immigrant labour population. Strict anti-poaching surveillance measures need to be implemented, especially during project construction phase in the areas of Jaldapara national park.
- Signage for no-noise zones, wildlife conservation boards should be installed at the required project sites.
- Noise generating equipment like DG set, compressors shall have acoustic enclosures. These should not be installed at least in one Km area of National Park or Reserved forests. Noise generating activities should not be permitted during night.
- Drivers should be warned to move slowly in the wild life movement areas.
- If any elephants come within the vicinity of 100m from the construction site construction works must immediately stop and resume only after the elephants have moved away
- Provisions of signage as a precautionary measure to provide awareness about animal movement shall be made to avoid accidents.

313. **Aquatic Ecology:** Temporary sedimentation and water quality deterioration is expected from the project during the construction stage. Accidental spill of materials, chemicals, and fuels may also deteriorate receiving water quality.

314. **Mitigation Measures:** The construction activities over rivers or near water, bodies shall be undertaken during summer season when most of rivers and water ponds are practically dry. Best construction practices shall be adopted to prevent increase in siltation level of the water. All precautionary efforts shall be taken as given under surface water section to prevent accidental damage of water quality.

9. Socio-Economic Impact

315. The project road may have both positive and negative impact on socioeconomic aspects as narrated below.

i. Positive Impacts

316. Economic activities supporting transport like fuel stations, automotive repair shops, lodging, and restaurants are expected to increase with increase of traffic and induced development of the area. The improved road will provide better connectivity which will 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.

ii. Anticipated Negative Impacts

317. The only irreversible minor impact is removal of encroacher, squatter and kiosk. The other impacts are expected due to sitting and operation of construction camp, loss of common property resources and safety of road users during and after construction.

318. **Labour and Construction Camp:** Construction workers expected to be about 150 per day per package are likely to be employed during construction. Most of the workers will be employed locally. However, some may be from nearby areas. This will cause additional burden on local resources. However, this impact will be temporary and will not have the potential for changes in the demographic scenarios of the area. The outside workers will be housed at the construction camp, which is expected to one per package. Poor sitting and improper management of construction camp may lead to several adverse impacts on environment viz. (i) loss of vegetation due to use of wood as fuel source for cooking (ii) deterioration in nearby surface water bodies' quality (iii) compaction and contamination of soil due to uncontrolled disposal of solid waste (iv) Poor sanitation may result to transmission of communicable diseases among the workers and the host communities. This includes the possible spread of sexually transmitted disease, diseases from improper handling and supply of foodstuffs, poor water supply, and insect-borne diseases.

319. **Mitigation measures:** Construction camp shall be sited at such locations to utilise the existing infrastructure. No productive land should be utilised for construction camp. All sites must be graded, ditched and rendered free from depressions to avoid water stagnation. Accommodation and ancillary facilities including recreational facility for workers shall be erected and maintained to standards and scales approved by PIU. All camps should maintain minimum distance of 1000 m from habitation and water bodies.

320. All construction camps shall be provided sanitary latrines and urinals with provision of septic tanks attached with soak pits or mobile toilets fitted with anaerobic digestion system. Storm water drains shall be provided for the flow of used water outside the camp. Drains and ditches shall be treated with bleaching powder on a regular basis. Garbage bins must be provided in the camp and regularly emptied and disposed off in a hygienic manner. LPG cylinders shall be provided as fuel source for cooking to avoid any tree cutting.

321. The Contractor will ensure the following:

- The good health and hygiene of all workers to prevent sickness and epidemics. These include the HIV/AIDS prevention program to reduce the risk and transfer of HIV virus between and among the workers and community, promote early diagnosis and assist affected individuals. Activities under the program include monthly information, education, and consultation communication campaigns to workers, drivers, delivery crew, and communities on the risk, dangers, and impacts of STD and HIV/AIDS. Contractor will also provide first aid facilities at the camp and organise regular health check-up camps as well.
- Availability of safe drinking water and sufficient supply of suitable and hygienically prepared food at reasonable price is available to the workers.
- Adoption of 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.

- Prohibition on supply or availability of alcoholic liquor or prohibited drugs at the camp.
- Regular health check-up and immunization camps shall also be organized for the workers and nearby population.

322. **Safety:** The road construction activities may create various unsafe situations. This will require attention to the following safety aspects viz. (i) safety of construction workers, (ii) safety of road users including pedestrians and cyclists (iii) safety to cattle; (iv) safety of local community (iv) unsafe/ hazardous traffic conditions due to construction vehicle movement need to be considered during design and construction stage and (v) conduct of safety audit.

323. **Mitigation measures:** During the construction phase, contractors shall be required to adopt and maintain safe working practices. Internationally accepted and widely used safety procedures should be followed during (i) road works (ii) handling of large construction equipment and machineries, (iii) handling of chemicals and hazardous materials and inflammable substances (iii) welding and (iv) electrical works. Contractor shall also arrange required PPEs for workers, first aid and fire fighting equipment at construction sites. Contractor will also prepare an emergency preparedness plan, which shall be duly approved by EA to respond to any emergency and unsafe conditions. To avoid disruption of the existing traffic due to construction activities, comprehensive traffic management plan shall be drawn up by the contractor. Retro-reflectorized traffic caution signs shall be used during construction. Regular safety audit or periodic review shall be made to assess the effectiveness of safety measures adopted during construction.

324. Adequate caution signage near school, sensitive locations, speed control, caution notes shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Steel base signage shall be avoided to prevent theft of the same. Crash barrier shall also be installed at appropriate locations particularly near school to provide safety to school children. Provision of sped breakers shall be made near schools and religious places.

325. **Obstruction and Disruption of Traffic:** Disruption of access to infrastructure or social resource due to construction activity will cause nuisance and to a certain extent additional cost to the public in terms of longer travel period due to diversion or traffic. It will also pose risk of accident to motorist at night if these blockages and disruption are not clearly demarcated.

326. **Mitigation Measures:** The road widening will happen with traffic movement on one part of the road while widening work will continue in parallel. In such a situation, shoulder will be provided on one side of the existing road by the contractor with the following minimum requirements:

- At least one 3.5 m lane to remain to traffic at all times
- The surface used by the through traffic will be firm bituminous compacted surface free of defect
- The maximum continuous length over which construction under traffic may take place is limited to 750 meters.
- Construction activity will be restricted to only one side of the existing road.

327. On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. These paved diversions will comply with standards on junctions and temporary cross drainage. The

contractor will submit a traffic plan to the concerned nodal officer of the field unit at least two weeks before the construction starts for such diversions. The plan will list all measures like diversion route, traffic management, safety aspects of the pedestrians and workers and delineation of the roadway at night, design of barricades, delineators, signs, markings, lights, and flagmen, among others.

10. Impact on Common Property Resources

328. There are various types of community structures/facilities/utilities along the project alignment. Geometric adjustments have been made to minimize the loss to any such facilities. Any such structures even falling within ROW but out of required formation width shall be saved. Alternate access has to be provided to these structures during construction stage. All community structures likely to be dismantled shall be suitably relocated.

329. Precautionary Measures: Various measures are suggested in previous section concerning, air, water, Noise and soil pollution as well as safety aspects which shall be followed while undertaking any construction activities close to habitat and areas important to community like religious structures, hospitals. Certain additional precautionary measures shall be followed while shifting the common property resources:

- Shifting of any community structure shall be made with concurrence of the community
- Area shall be barricaded wit requisite caution sign.
- No waste accumulation shall be allowed close to such place
- Guard shall be placed to regulate the traffic at such places.
- Demolition waste either shall be used for rebuilding the structure at relocation place or reuse for land filling
- All safety caution shall be followed such as use of PPEs, placing warning board before starts of demolition

D. Operation Phase

330. The subproject road is located in vast open agricultural land, which will provide adequate dispersion of gaseous emission from vehicle. Further, proposed plantation will ameliorate/enhance the micro climate. No adverse climatic changes/impacts are anticipated during operation stage other than GHG (CO_2) emission due to increased traffic including in bypass area though construction of road will bring permanent change in land use of the virgin area of bypasses, , which would be largely offset with better fuel efficiency and reduced vehicle idling due to improved road conditions.

1. Air Quality

331. Based on current and predicted traffic volume an assessment of likely increase of NOx and CO is undertaken through modelling exercise using California Line Source Dispersion Model, June 1989 version. Emission factor for HC, CO, NOx, PM and CO_2 was arrived using Draft report on "Emission Factor development for Indian Vehicles" as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies. Based on calculated levels and models input requirements predicted level of pollutants were arrived for both (AH-02 and AH-48) project roads and all three bypasses. The key finding are summarised below:

- Traffic flow is very less for modelling excise.

- Present (2011) and projected (2025) concentrations of CO are less than 0.1ppm (model threshold). Means CO level is unlikely to change level beyond the threshold level of 0.1 ppm.
- In general, NOx concentration may increase by 0.1ppm above ground level concentration due to the current/projected traffic upto 100 m in AH-2 and 80 M in AH-48. This is also very less incremental levels indicating insignificant impact with respect to NOx.
- In bypass area, Ambient Air Quality would change to the similar level as found in rural areas existing close to the AH-48 roads plus incremental level due to likely increased traffic. Since, current ambient Air Quality level in most of the rural area along AH-48 is within the prescribed National Ambient Air Quality levels and likely increment pollutant levels is going to insignificant, the expected ambient air quality level in the proposed bypass area is expected to remain within prescribed National Ambient Air quality levels up to long term predicted level of up to next 25 years due the project road.

332. Since road corridor is passing through vast open agricultural land area, dispersion level will also be high. As such insignificant air pollution is anticipated due to vehicular emission.

333. With improved road condition, traffic dust generation level will reduced substantially resulting in improved Ambient Air quality with respect to particulate matters.

334. **Mitigation Measures:** Road shall be maintained well to avoid dust generation from damaged roads. Plantation is one of the preferred solutions to check air pollution. Plants serve as a sink for pollutants, reduce the spread of dust. Tree plantation along roadsides and other places shall include pollution absorbent species. Awareness signboards shall be installed at prominent location to educate drivers for good driving and vehicle maintenance practices.

2. Noise

335. During the operational Stage, movement of traffic will be the prime source of noise. Traffic congestion and pedestrian interferences increase the use of horns. This may result in increased noise levels at nearby schools and religious places. The noise level will increase in the bypass area equal to the predicted noise level in rural area along AH-48 road. Since, bypass road is passing through open area and noise receptors are located at distant places from proposed bypass alignment, the noise impact in bypasses area is anticipated to be minimal but long term.

336. **Mitigation Measures:** Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch. Speed limitation and honking restrictions may be enforced near sensitive locations. Increased plantation along the road and boundary wall will also work as noise barrier. The improved road conditions and multi-layered plantation will be helpful in attenuation of noise levels. The effectiveness of these measures shall be monitored. If noise levels are still found higher than the prescribed ambient noise standards at these sensitive receptors, adequate noise barrier shall be installed.

3. Land and Soil

337. The better access can lead to conversion of agriculture land for residential and commercial purposes close to roads and especially in rural and urban area.

338. **Mitigation Measures:** The EA may explore the feasibility of restricting about 50 m-100 m area either side of the road as no development zone on the line restriction are imposed for National Highways authority of India.

4. Soil Erosion

339. No impact on soil is anticipated during operation phase of the project except bridge approaches where unexpected rainfall may erode the embankment formation and deterioration of borrow areas if not rehabilitated properly.

340. **Mitigation measures:** Embankment stabilisation shall be check periodically during operation stage and suitable stabilisation measures shall be taken wherever any erosion is identified. Borrow areas will also be rehabilitated following the guidelines given at **Appendix 7.7**.

5. Groundwater

341. No impact is anticipated on groundwater due to the project during operation phase of the project hence, no specific mitigation measure is proposed.

6. Surface Water Bodies

342. No major or long-term impact is anticipated during the operation phase on the surface water bodies due to the project implementation activities. Oil contaminated runoff from the road during monsoon will have minimal impacts considering their low concentration.

7. Hydrology and Drainage

343. Regular removal/cleaning of deposited silt shall be done from drainage channels and outlet points before the monsoon season. Rejuvenation of the drainage system by removing encroachments/ congestions will be regularly conducted.

8. Impact on Biological Environment

344. **Terrestrial ecology – Flora:** Positive impacts on terrestrial ecology are expected during the project operation stage due to the increase in vegetation and landscaping along the state highway. The project will coordinate with the local communities to maintain and enhance the trees planted along the state road. ”No adverse impact is anticipated during operation stage except accidental damages or absence of proper tree management.

345. **Mitigation Measures:** Arrangement shall be made to ensure survivability of the tree plantation. The tree survivability audit shall also be conducted at least once in a year to assess the effectiveness of the programme.

346. **Terrestrial Ecology - Fauna:** Post project scenario is expected to reduce the Man-Animal conflict. However, strict vigil will be required to prevent such conflicts.

347. **Mitigation Measures**: It is proposed to carry periodic visual check of functionality of underpasses and other measures taken for the protection of animals. Periodic data shall be collected from wild life authorities regarding Man Animal conflicts and suitable corrective action shall be initiated in-case conflict level is found increasing.

348. **Aquatic Ecology:** No impact is envisaged during operation phase of the project and hence no mitigation proposed. However, periodic surveillance shall be conducted to check erosion and siltation in major water bodies.

9. Socio-Economic Impact

349. Economic activities supporting transport like fuel stations, automotive repair shops, lodging, and restaurants are expected to increase with increase of traffic and induced development of the area. The improved road will provide better connectivity which will 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.

10. Safety

350. Important issues related with safety during operational phase are monitoring of emergencies and establishing procedures to carry out rescues during sudden emergency such as accidents.

351. **Mitigation Measures**: Adequate caution signage near school, sensitive locations, speed control, caution notes shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Steel base signage shall be avoided to prevent theft of the same. Crash barrier shall also be installed at appropriate locations particularly near school to provide safety to school children. Provision of sped breakers shall be made near schools and religious places.

352. Provision of Ambulance shall be made, which shall be available at every 30 km for rescuing the accident patients. The centralized easy to remember toll free telephone number shall be designated for the Ambulance. This number shall be given good publicity for easy remembrance by the people.

353. **Induced Environmental Impacts:** An assessment is made of likely induced impacts due to improved project activities. The trade level between border countries is on rise since a very long period. The damaged road condition have little deterrent on trade in the past through, it has posed substantial inconvenience to people and trading community. The region to which both the road traverse is already developed in terms of industry and trade aspects for supply of commodities required by neighbouring countries. The improved road is expected to increase transport through this region but is unlikely to trigger exponential development in this region. Setting up few new industries and increase in trade volume though cannot be ruled out. As such no significant induced environmental impact is anticipated due to proposed project activity.

V. ALTERNATIVE ANALYSIS

354. The analysis of alternatives is an effective tool to examine the number of options (locational & technological) and establishing most environmentally favourable alternatives or which cause minimum environmental loss to the natural and social environment. This project is site specific and involves improvement of roads along the existing road alignment. The road improvement is necessitated to cater to increasing trade and traffic between Nepal Border (Kakarbita-Panitanki) to Bangladesh Border (Fulbari -Banlabandha) part of AH-2 and Bhutan Border (Pheuntsholing-Jaigaon) to Bangladesh border (Chandrabandha-Burimari) part of AH-48. Required ROW is mostly available along the proposed project road sections of AH-2 and AH-48. Therefore, no alternative analysis from location aspect is undertaken. Road is very congested due to slow moving traffic and/or less ROW availability or encroachments at Panitanki (Nepal Border), Hasimara town, and Pasakha Access (Bhutan Border). Feasibility stage assessment has suggested existing alignment improvement at these locations except for Pasakha bypass. However, considering social, environmental aspects, the alternative analysis is carried out for possible bypasses or realignment options at these three locations and presented in this section. Initial finding of design team is also considered to reaffirm the analysis of alternate realignment/bypass options at these locations.

355. To determine whether the project is beneficial to the environment or not, a 'do-nothing' or 'without project' option was evaluated against the "with-project" option. The following sections address these issues.

A. Alternatives to the Project

356. The scope of assessing alternatives to the project is limited to the "with" and "without project" (means do nothing or status quo) options and the same is analysed below:

1. 'Without Project' Option:

357. Physical Environment. In the 'without project' scenario, the capacity of road will remain constrained particularly at heavy built areas with low ROW availability. Continued overpressure on poorly designed roads will deteriorate the road conditions further resulting in slow traffic movement, traffic jams which will continue to deteriorate air quality and Noise levels caused by idling of vehicles and dust generation at damaged road locations.

358. Biological Environment. In the 'without the project' scenario, man - animal conflict will continue at elephant and other animal movement corridors in Jaldapara a National Park stretch. No other direct impact is anticipated on biological environment. However, the very need of road transportation, and resultant widening of roads may lead to cutting of trees and loss of productive agriculture land.

359. Socio-economic Environment. Without the project, the agricultural produce may not move from field to market places in a timely manner, which may result in loss of income to farmers. Public at large will continue to waste time in waiting at traffic jams triggered at railway crossing and congested road locations. The project of this size brings substantial investment, employment, and business opportunities, which in turn contribute improving the socio-economic condition of the area. In absence of the project, the project area will be deprived of such benefits.

2. 'With Project' Option:

360. Physical Environment. In the "with project" scenario, the air quality, noise levels are likely to improve around the railway crossings, congested and many settlement areas (where dust generation is high due to damaged road conditions), due to the provision of ROBs, grade separation, junction improvement and bypasses /realignment and improved road design at most of such locations. The project will immensely enhance the much-needed capacity for fast transport of goods between border locations. The air pollution and noise level are likely to increase during construction phase but that will be confined within the close vicinity of construction sites and will be temporary in nature. The water withdrawal from ground will not stress the ground water resources significantly as the area fall in safer zone as per Central Ground Water Assessment. This impact get minimised with the provision of water harvesting and natural recharge through vast agricultural fields and river plain. With project scenario will also result in reducing likely generation of GHG emissions and hence contributing in preventing global warming.

361. Biological Environment. In the 'with project' scenario, the overall impact of the project is likely to be insignificant on the biological environment except in terms of loss of trees which will be minimised and also regenerate over a period of time due to proposed compensatory tree plantation. 'With Project' Scenario will help in minimising Man animal conflict and reduce killing of wild animal in road accident particularly in Jaldapara National Park area.

362. Socioeconomic Environment. The 'with project' scenario will bring large investment to the project area and host of employment and business opportunities resulting in substantial improvement in the overall socio-economic conditions of the area. This will also ease the problem of traffic jams and long wait at congested areas preventing loss of productive man-hours.

363. **Conclusion:** During the EIA, a number of public consultations have also been carried out with the local communities and stakeholders. The overall findings of the consultations are that most of the people consider this project as timely and much needed. They are in favour of the 'with-project' option. Though, proposed project is for widening to two-lane configuration, public at large in AH-2 section rather prefer for four lane configuration. Though four lane configuration is not feasible due to traffic projection and economic consideration at this stage.

364. Under the circumstance, and in light of the assessment of the available alternatives, the 'with-project' option is deemed as the optimal solution, as far as its feasibility and sustainability during its project life and beyond can be ascertained. It will generate overall positive social, environmental, and economic impacts and their negative impacts can be mitigated through appropriate safeguard measures as defined under the EIA and the social safeguards assessments.

B. Alternative Analysis of Bypasses/Realignment

365. Alternative Analysis is carried out for following bypass/realignment locations:

1. Panitanki Realignment (NH-31C to Nepal Border of AH-2)
2. Pasakha Realignment of AH-48
3. Hasimara Bypass of AH-48

366. The alternate options with length and route for each of above bypass/realignment is given at **Table 80.**

Table 80 : Route and Length of Various Bypass/Realignment Alternatives

Option	Starting Point	End Point	Route	Length (in km)
Panitanki Realignment				
Alternative –I : Existing Alignment and preferred option As per feasibility report	Kakarbita	NH-31 C	Kakarbita to NH-31C junction to NH-31	1.850
Alternative-II	Kakarbita	NH-31 C	Kakarbita – parallel to Mechi river-to semi urban area to NH-31C	1.550
Pasakha Realignment				
Alternative-I : as per feasibility report	Bhoolan Chowpathy (Chainage 102.700 of AH-48)	High Tension Line Crossing at lowest mountain point on the mountainous Bhutan Road in Pasakha Area	Bhoolan Chowpathy - traverse along the existing concrete road – river bridge – turn north eastern direction - existing road on the Bhutan side near the high tension line crossing at Pasakha area	7.42
Alternative-II	start immediately before the major bridge avoiding the river crossing and the blind sharp curve before the Bhoolan Chowpathy junction	High Tension Line Crossing at lowest mountain point on the mountainous Bhutan Road in Pasakha Area	Passing through dense habitation	6.62
Hasimara Bypass				
Alternative I : Existing Alignment and preferred option as per feasibility report	Start before Hasimara town	End after new Hasimara settlement	The existing road alignment on eastern side of Hasimara railway station.	5.5
Alternatives II	Start before Hasimara town	End after Hasimara town	Western side of existing road	3.55

1. Panitanki Realignment :

367. The two alternatives are analysed for this section. The brief above each of the alternative alignments is given below. Each of the alignment is analysed for environmental, social and engineering consideration to identity the most preferred option (Refer **Table 81** for alternative analysis).

368. **Alternative – I:** Existing Alignment: Kakarbita is the starting point of the project road situated at India - Nepal boarder separated by Mechi River, which is partly in India and partly in Nepal. The bridge across Mechi River is 7 m wide and major portion of the bridge is on the Indian side. From the bridge, state highway connects to the NH 31 C and the distance from the Nepal border to NH 31C junction is about 1200 m. Passenger crossing at the border is mainly using slow moving vehicles or by walk. There is also a large pedestrian traffic crossing the bridge. A railway line runs parallel and close to the NH 31 C and a level crossing is provided on this state highway section. The existing state highway alignment between NH 31C and Nepal border is highly congested with narrow right of way, large commercial activity and large scale encroachments. The view of existing alignments is shown at **Figure 66.**

Figure 66. : View of the alignment

369. **Alternative – II**: Alignment: The proposed alignment moves on the northern side[34] of the existing alignment. The alignment run parallel to Mechi river initially and then turn right to join NH 31C. A ROB is proposed at the level crossing and NH 31C. The ROB approach in eastern side turn north east and run along NH 31C. The view of the alignment is shown at **Figure 67.**

[34] The alignment on southern side of the existing alignment just after the LCS was examined but this was not considered considering the significant resetellement issue and impact on forest land.

Figure 67. : View of the alignment

Table 81 : Summary of Alternative Analysis of Panitanki Realignment

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
I. Environmental Aspects			
1.	Ecological Impact (Loss of trees, impact on forests)	Very less no. of trees are likely to be cut.	The no. of trees (about 140) may need to be cut mostly near Mechi riverbank.
2.	Wildlife and its movement	None specific	None specific
3	Environmental Impacts (Air, Water, noise & vibration)	Air, Noise, quality likely to be affected during construction stage but will be temporary in nature.	Air, Noise, quality likely to be affected during construction stage but comparatively impact will be minimal due to open agriculture land.
4	Loss of natural resources (water bodies, minerals)	None, though alignment crosses one natural drain near railway crossing	None, though alignment crosses one natural drain near railway crossing
5	Traffic Management during construction	The construction work will create hazardous traffic situations due to congested road and built-up area	No major traffic issue since most of the road alignment is passing through agriculture field
6	Environmental Legislative Implications	None	Construction of new re-alignment will classify under the category of state highway and would required environmental clearance under Environmental Impact Assessment Notification 2006.
II. Social Aspects			
1	Land Use Change	No private agriculture land is required to be acquired.	About 2.83 ha of land needs to be acquired. Out of this 1.51 ha is private agriculture land is involved.
2	Rehabilitation & Resettlement	About 367 households may loose residence, livelihood, or both.	About 46 households may loose residence or livelihood or both

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
3	Loss of community structures	5 community structures (Places of worship, Bus shelter and Public toilets) may be affected.	No community structure is likely to be affected.
4	Public Acceptability	Public acceptability for improvement of road but great assistance for loss of households.	Acceptable comparatively to Alternative – I.
III. Engineering Aspects			
1	Technical Feasibility	Apart from the large resettlement impact, the alignment has substandard curves. The traffic capacity analysis indicated the requirement of 4-lane carriageway, which will have much larger settlement impact. The provision of grade separation at the level crossing is technically not feasible at this location without large resettlement impact.	This option will have good highway geometry but the skew angle with the railway line is 60^0 which will increase the cost of ROB. The linkage to the proposed LCS will also need to be redesign considering the nature of traffic.
2	Financial Feasibility	Exists	Exists
Recommended Option			**Preferred Option**

2. Pasakha Realignment of AH-48 :

370. The existing alignment upto Jaigaon is in good condition and will be part of the proposed road improvement project. Therefore, alternative analysis is carried out for access options to LCS and connectivity to Pasakha of Bhutan. Two alternatives are analysed for environmental, social and engineering consideration to identity the most preferred option (Refer **Table 82** for alternative analysis). The brief about each alternative alignment given below.

371. **Alternative – I**: as per the Feasibility report: The feasibility study is recommend this bypass with the proposed LCS located on the bypass alignment and connect to Pasakha in Bhutan thus avoiding the congested Jaigaon and Pheushilong commercial areas. It starts at Chainage 102.700 km towards Jaigaon from Bhoolan Chowpathy and traverse initially along the existing concrete road having built-up area on either side of the alignment and after crossing the river it turns towards north eastern direction and finally connects the existing road on the Bhutan side near the high tension line crossing at Pasaka area. The view of the alignment is shown at **Figure 68.**

372. **Alternative – II:** Alignment: Alignment start immediately before the major bridge avoiding the river crossing and the blind sharp curve before the Bhoolan Choupathi junction. This alignment bypasses the built-up location of Bhoolan Choupathi area and takes off on the right hand side of the BRO road at km 102.700 and passes through tea plantation of Torsa Tea Estate and then through open land, largely uncultivated before it meets the Option I alignment after the causeway location. After joining the Option I alignment, it traverses slightly north of Option I

alignment to have sufficient clearance from high tension line through open land where cultivation is intense, before joining the Barsa river bank along the Bangu settlement. The view of the alignment is shown at **Figure 68.**

Figure 68. : View of the alignment

Table 82 : Summary of Alternative Analysis of Pasakha Realignment of AH-48

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
I. Environmental Aspects			
1.	Ecological Impact (Loss of trees, impact on forests)	About 700 trees may need to be cut.	The tea garden plantation and about 250 trees may need to be cut.
2.	Wildlife and its movement	The area falls in the elephant movement area and may lead to man animal conflict.	- The area falls in the elephant movement area and may lead to man animal conflict. However, this possibility is much lesser compared to Alternative - I
3	Environmental Impacts (Air, Water, noise & vibration)	Air, Noise, quality likely to be affected during construction stage but comparatively impact will be minimal due to open agriculture land except in the built-up area.	Air, Noise, quality likely to be affected during construction stage but comparatively impact will be minimal due to open agriculture land.
4	Loss of natural resources (water bodies, minerals)	None, though the alignment crosses same river twice.	None, though the alignment crosses two small local drains.
5	Traffic Management during construction	The construction work will create traffic disturbances in the built-up area	No major traffic issue since most of the road alignment is passing through tea garden land

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
6	Environmental Legislative Implications	Construction of new re-alignment will classify under the category of state highway and would require environmental clearance under Environmental Impact Assessment Notification 2006. The area is also considered falling within the elephant corridor would require permission National Wildlife Board and Supreme Court.	Construction of new re-alignment will classify under the category of state highway and would required environmental clearance under Environmental Impact Assessment Notification 2006. Since the entire region including this section considered to be part of elephant movement the permission from National Wildlife Board and Supreme Court would be required.
II. Social Aspects			
1	Land Use Change	About 21.64 ha land need to be acquired. No private land is involved. Most of the land is under tea garden (the govt. encroached land)	About 31.15 ha land need to be acquired. No private land is involved. Most of the land is under tea garden (the govt. encroached land)
2	Rehabilitation & Resettlement	About 115 households may loose residence, livelihood, or both.	About 20 households may loose residence or livelihood or both
3	Loss of community structures	3 community structures (Places of worship) may be affected.	No community structure is likely to be affected.
4	Public Acceptability	Public acceptability for improvement of road but may have resistance from project affected households.	Acceptable comparatively to Alternative – I.
III. Engineering Aspects			
1	Technical Feasibility	The alignment apart from the resettlement impact also has substandard curves but technically considered feasible.	It involves additional land from tea estate but gives good geometry and is almost 800 m shorter. Technically this option is considered more feasible then alternative - I
2	Financial Feasibility	Exists	Exists
Recommended Option			**Preferred Option**

3. Hasimara Bypass of AH-48:

373. The two alternatives are analysed for this section. The brief above each of the alternative alignments is given below. Each of the alignment is analysed for environmental, social and engineering consideration to identity the most preferred option (Refer **Table 83** for alternative analysis).

374. **Alternative – I**: Existing Alignment: This alignment follows the existing alignment and traverse through New Hasimara, a relatively new settlement abetting the Hasimara railway station, with an available right-of-way (building to building) of about 17m; and Old Hasimara, the heavily built-up settlement with significant commercial activity where the available right-of-way is about 11m. This alignment has presence of sharp curves, level crossing and narrow right of way with ribbon

development along either side of the alignment. The view of existing alignments is shown at **Figure 69.**

375. **Alternative – II Alignment**: This alignment is located on western side of the existing alignment. It starts before the Old Hasimara settlement and crosses the railway line after the railway curves and joins the existing road after the New Hasimara settlements. The view of the alignment is shown at **Figure 69.**

Figure 69. : View of the alignment

Table 83 : Summary of Alternative Analysis of Hasimara Bypass of AH-48

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
I. Environmental Aspects			
1.	Ecological Impact (Loss of trees, impact on forests)	Few tree (<less than 100) may need to be cut.	The entire length of this alignment passes through Sathali and Beech tea estates. In addition to tree plantation loss, about 100 tree providing shade in the tea estate.
2.	Wildlife and its movement	None specific.	None specific
3	Environmental Impacts (Air, Water, noise & vibration)	Air, Noise, quality likely to be affected during construction stage but will be temporary in nature. The existing schools close to the road alignment may	Air, Noise, quality likely to be affected during construction stage but comparatively impact will be minimal due to open tea garden land.

S. No.	Issues	Alternative–I: Existing Alignment and preferred option As per feasibility report	Alternative-II
		have higher noise level due to increased traffic.	
4	Loss of natural resources (water bodies, minerals)	None	None
5	Traffic Management during construction	The construction work will create hazardous traffic situations due to congested road and built-up area	No major traffic issue since most of the road alignment is passing through agriculture field
6	Environmental Legislative Implications	None	Construction of new re-alignment will classify under the category of state highway and would required environmental clearance under Environmental Impact Assessment Notification 2006.
II. Social Aspects			
1	Land Use Change	Nil. The alignment traverses through existing corridor.	About 18.40 ha mostly tea garden land.
2	Rehabilitation & Resettlement	About 495 households may loose residence, livelihood, or both.	About 10 households may loose residence or livelihood or both
3	Loss of community structures	4 community structures (Places of worship, Bus shelter and Public toilets) may be affected.	No community structure is likely to be affected.
4	Public Acceptability	Public acceptability for improvement of road but great assistance for loss of households.	Acceptable comparatively to Alternative – I.
III. Engineering Aspects			
1	Technical Feasibility	Apart from the resettlement impact, also have substandard curves. Grade separation at the rail crossing or geometric improvement is not feasible without substantial improvement through the town, which will further increase the social impact. Therefore, alignment through the town is not considered to be technically viable to provide acceptable level of service. With local traffic and highway traffic, the two-lane development will also get severely congested.	This alignment though involves additional land from tea estate but gives good geometry. This alignment technically is considered to be viable to provide acceptable level of service.
2	Financial Feasibility	Moderate	Exists
Recommended Option			**Preferred Option**

C. Conclusion:

376. Considering the environmental, social and technical consideration the alternative - II of above three bypasses / realignment is considered to be most suitable and is are recommended as preferred option.

VI. ENVIRONMENTAL MANAGEMENT PLAN AND GRIEVANCES REDRESS MECHANISM

377. The aim of the Environmental Management Plan (EMP) is to ensure implementation of the recommended mitigations measures effectively. The mitigation measures are designed either to prevent impacts or by mitigating those to reduce the effect to an acceptable level by adopting the most suitable techno-economic option. The EMP also ensures that the positive impacts are conserved and enhanced.

A. The EMP

378. The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring and institutional measures to be taken up during the design, construction and operation stages of the project. The plan also includes the actions needed for implementation of these measures. The major components of the Environmental Management Plan are:

- Mitigation of potentially adverse impacts
- Monitoring during project implementation and operation
- Institutional Capacity Building and Training
- Implementation Schedule and Environmental Cost Estimates
- Integration of EMP with Project planning, design, construction and operation

379. The Environmental Management Plan (consisting of summary of environmental Impact, mitigation measures, locations, time frame, costs and implementation and supervisory responsibility) is detailed Appendix 7.

380. The two roads comprise both national highway (NH) and state highway (SH) sections and a LCS each. For the NH sections the EA will be MORTH and IA will be the West Bengal Public Works Department (WBPWD). For the SH sections both the EA and IA will be the West Bengal Highway Development Corporation (WBHDC) of India. For the LCS the EA is yet to be identified, however IA will be the Siliguri-Jalpaiguri Development Authority (SJDA) for the Panitanki LCS and the Jalpaiguri Development Authority (JDA) for the Pasakha LCS. However SJDA will provide implementation support to JDA for NH and SJDA for the LCS.

381. All EA's can take guidance on environmental assessment, management and reporting from the Environmental Impact Assessment Guidance Manual for Highways 2010 issued by MOEF and the IRC Guidelines for Environmental Impacts Assessment (IRC:104-1988) of highway projects issued by MORTH. As part of the EMP various issue specific technical guidelines maybe issued, which shall be followed by contractors to evolve their package specific Environmental Health and Safety (EHS) management plan. Few sample technical guidelines, prepared based on best construction practices and prescribed standards are included as **Appendix 7.6 to 7.9**. The sample guidelines included covers the following aspects (i) Borrow Area Management (ii) Tree Plantation (iii) Solid Waste and Debris Disposal and (iv) Emergency Preparedness. Each contractor shall prepare package specific EHS management plan indicating the following and submit the same to EA for formal approval before implementation:

- Areas of concern in the package

- Graphical representation of location of borrow areas with current use and rehabilitation plan
- Expected quantity of solid waste and debris generation and proposed reuse and disposal plan. It should also include disposal plan for domestic solid waste likely to be generated from construction camps.
- Water sourcing and conservation plan
- Waste water (generated from construction camp or construction site) treatment and deposal plan
- Measures proposed to comply various legislation like no use of child labour, providing safe drinking water to workers at construction camps, provision of first aid facilities.
- Regulatory Approval status such as Consents from State Pollution Control Board for setting up Hot Mix Plan
- Auditing, monitoring and reporting compliance preparedness plan

382. Other impacts during construction entail typical road construction issues such as generation of dust from earthworks; noise and exhaust from operation of equipments/machinery/vehicles; generation of construction waste as well as wastes from construction and worker camps; water contamination and water supply issues; occupational health and safety issues with the workers and local communities; issues of erosion and siltation and removal of trees. Mitigation measures to address these issues which are to be defined in EMP. Monitoring system for implementation of the mitigation on different environmental issues are pre-defined; namely whether Third Party Engagement is to be made.

1. EMP Implementation Timetable

383. The months of construction phase starting from year 2014 and Operating Phase of 25 years (refer Appendix 7.3)

2. Social Development Program

384. A separate social impact assessment study is undertaken and social development programme is addressed as per SIA. The various impacts having significant impact of social nature like agriculture have also been addressed under this study.

3. Contingency Response Plan

385. Field study, public consultation, and consultant's experience reveal that this project may have only one environmental emergency i.e. accidents of trucks carrying Chemicals or petroleum.

386. It is suggested that the communication and response system be developed and practiced to minimize the response time. This should be covered under environmental guidelines to be prepared by EA for effective implementation of mitigative measures. EA should ensure accidental spill management either by developing in-house capabilities or by associating with any competent third party.

4. Authorities and Their Responsibilities for Implementation of the EMP

387. An officer in MORTH (with the support of WBPWD), WBHDC and respective EA for LCS will be responsible for ensuring that all environment safeguard requirements are complied with during implementation of the project.

388. An officer at the EA level within MORTH, WBHDC and respective EA for LCS will be designated to serve as the overall authority and authorized signatory for formal approval and endorsement of all reports, forwarding letters, communications and any document related to environment safeguards under the project. WBPWD, SJDA, JDA and WBHDC at the IA or PIU level will be directly responsible for implementing the detailed requirements of the EIA and EMP at the project office and site level. An Environmental Focal Person (EFP) will be appointed in WBPWD, SJDA and WBHDC. This person can be part of a separate unit such as a Social and Environment Management Unit (SEMU) assigned for taking care of environment, social and resettlement issues. The designated person at the EA level (MORTH and WBHDC) and EFP at IA level (WBPWD, SJDA JDA and WBHDC) will be supported by environmental specialists under Construction Supervision Consultants (CSC), and EFP of each contract package as given in figure 70. Since this is an environment category A subproject an external monitor to conduct annual third party monitoring will also be engaged.

389. During implementation of the project MORTH, WBPWD, SJDA JDA and WBHDC will collaborate with each other and work closely to fulfil all environment safeguard requirements in a proper, timely and efficient manner.

B. Responsibilities of MORTH and WBHDC at the Executing Agency level

390. The EA's responsibilities will mainly be focussed on addressing national or state level environment safeguard issues and decisions concerning the subprojects. Specific responsibilities on environment safeguards at the EA level are:

i. Ensure that all environment safeguard requirements as given in the ADB SPS 2009, and applicable laws and rules under MOEF are being complied with during all stages of the project.

ii. Reviewing and approving all environment safeguards related documents such as EIA or IEE, monitoring reports etc. prepared under the project with recommendations and clarifications from the IA where necessary.

iii. Timely endorsement and signing of key documents and forwarding to the respective agency such as those required for processing of environmental clearance, forestry clearance etc. and disclosure on ADB website.

iv. Taking proactive and timely measures to address any environment safeguards related challenges at the national or state level such as delays in processing of clearances (during pre-construction stage), significant grievances (during construction stage)

v. Recruiting an external monitor to conduct annual third party environmental monitoring

B. Responsibilities of WBPWD WBHDC, SJDA and JDA at the Implementing Agency level

391. The IA's responsibilities will mainly be focussed on implementing environment safeguard requirements in accordance with the EIA and EMP at the project and site level. Specific responsibilities on environment safeguards at the IA level are:

i. Review the budgetary needs for complying with the environmental budget as given in table 82.

ii. Prepare forms, reports and all documents etc. for processing of environmental, forestry and related clearances in a timely manner and submit them for further review and signing to the respective authorized officer

iii. If any problems or long delays are encountered when processing the clearance documents, immediately alert the authorized officer at the EA level and seek ways resolve the problem at the soonest

iv. Ensure that all necessary regulatory clearances are obtained prior to commencing any civil work of the respective contract package or road section;

v. Ensure that the EMP which include required mitigation measures and monitoring requirements with defined Bill of Quantity, forms part of bidding document;

vi. Ensure that contractors have access to the EIA report including EMP of the subprojects;

vii. Ensure that contractors understand their responsibilities to mitigate environmental problems associated with their construction activities

viii. Ensure and Monitor that all required permits, no objection certificates etc. are obtained by the contractor for establishment and operation of equipments and facilities

ix. With the support of the EFP of the contractors and CSC ensure that the contractor implements the EMP including Environmental Monitoring Plan as given in chapter VI;

x. In case of unanticipated environmental impacts during project implementation stage, with the support of CSC prepare and implement an updated EMP to account for such impacts after seeking concurrence from ADB. The updating shall be carried out after due consultation with the stake holders and concerned government agencies;

xi. In case during project implementation a subproject needs to be realigned, review the environmental classification and revise accordingly, and identify whether supplementary EIA study is required. If it is required, prepare the TOR for undertaking supplementary EIA and hire an environment consultant to carry out the study;

xii. Ensure that construction workers work under safe and healthy working environment;

xiii. Ensure effective implementation of Grievance Redress Mechanism to address affected people's concerns and complaints,

xiv. Submit semi-annual environmental monitoring reports on the implementation of all environment safeguard requirements including the EMP to ADB and make these reports available for public disclosure; and

392. The authorities and responsibilities for the implementation of the environmental management plans shall be tiered based on the activity. The suggested hierarchy and information flow will follow the organization structure given in **Figure 70**.

393. All the policy decisions, including incorporation of the EMP requirements in compliance to loan covenants shall be the responsibility of the EA.

5. Construction Supervision Consultant (CSC)

394. The Environmental specialist under the CSC will be responsible for the following:

- Oversee the implementation of Environment Health and Safety (EHS) plan submitted by respective contractors and EA's commitments as per EIAs and EMP.
- Facilitate in updating the EIA/EMP reports depending on site requirements.
- Supervising the implementation of EMPs
- Undertaking audit independently and submit to SEMU
- Recommending payments to contractor linked with the EMP

6. Mechanisms for Feedback and Adjustment

395. WBPWD WBHDC, SJDA and JDA with the help of contractors will maintain monthly progress report on implementation level of EMP. Any deviation from the contract requirements with respect to proposed EMP should be corrected within a fortnight and records maintained for the same.

396. As part of the feedback mechanism, the EFP with the support of the CSC environmental specialist shall monitor project compliance with respect to:

- Environmental Management Plan
- Applicable laws, rules and regulations

397. Public involvement shall be encouraged and ensured throughout the lifecycle of the project. The PIU shall gather and maintain information on any damage or public concern that may be raised by the local people, NGOs and local authorities. While immediate solutions are to be worked out with the help of contractor, a detailed report will be submitted to the EFP for information or detailed consideration, as the case may be. The PIU will be responsible to bring it to the notice of the EFP. Resulting decisions shall be communicated back to PIU and contractor for correction and future implementation. An operation-period workshop may be required for effective implementation of the EMP.

398. The external monitor will work in close coordination with MORTH, WBPWD, SJDA JDA and WBHDC and conduct third party technical monitoring. He/she will provide feedback and technical advice to enhance the effectiveness of implementation of the EMP

B. Environmental Monitoring Plan (EMoP)

399. The aim of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards.

400. A monitoring schedule has been drawn up based on the environmental components that may be affected during the construction and operation of the project. Since project is likely to have impact on various components of environment, a comprehensive monitoring plan covering soil erosion, drainage congestion, tree plantation, air quality, water quality, noise, wild life movement and Man -Animal accidents, are provided as **Appendix 7.2**. Monitoring Plan has been separately suggested for construction phase and operation phase. Monitoring points have been selected based on the sensitivity of the location with respect to sensitive receptors.

1. Monitoring Schedule

401. The monitoring schedule has been developed based on the possible occurrence of adverse impacts and required mitigation actions. However, this monitoring schedule is subject to change depending on the analysis results obtained. The protocol for changing the monitoring schedule is given below :

a. Air and Noise Quality

Due to the variability of the construction activities, namely changes in batch composition, type of construction activity and other anthropogenic influences, the air quality in the project area may change. If the air quality with respect to any parameter exceeds by more than 25% of its last monitored value, the monitoring frequency shall be doubled and cause of the increase investigated. If the construction activities are found to be the reason for this increase, suitable measures should be adopted. Similarly due to the variability in traffic movement, namely changes in traffic volume, traffic compositions and other anthropogenic influences, the noise quality in the project area is likely to change. If the noise quality exceeds by 20% of the applicable ambient noise quality standard or 5% of its last monitored value, the monitoring frequency shall be increased. If the construction activities are found to be the reason for this increase, suitable measures should be adopted.

b. Water Quality

402. No significant change in water quality is perceived due to the project in the operation phase. Hence, it is suggested that if the monitored value for any water quality parameter exceeds by more than 20% of its last monitored status the monitoring frequency shall be increased and suitable measures taken if increase in value is due to project activity reasons.

c. Tree Plantation

403. The 75% survival rate of re-plantation shall be monitored on the first year of the operation phase. If the survival rate is found below 70%, survival rate monitoring shall be again taken up after 3 years. This cycle should continue until the 70% survival rate is achieved.

d. Terrestrial and Aquatic Fauna – Wild Life Movement

404. The underpasses for elephant movement shall be monitoring for water logging, siltation. Functionality of these underpasses shall be ensured all the time. Availability of caution board placed at animal road crossing, areas will be cheeked periodically. It shall be ensure that all caution boards are available at the defined locations. Details about animal movement and man-animal conflict shall be periodically collected from forests officials and take appropriate if man – animal conflict scenario is found on increasing trend.

e. Soil Erosion and Drainage Congestion / Water Logging

405. No significant soil erosion problem is anticipated due to the project either in the construction phase or in the operation phase. However, in the construction phase, some localised soil erosion may be noticed owing to construction activities. However, if soil erosion is noticed during construction and operation phase including around borrow areas, the corrective action shall be initiated and frequency of check be increased to assessed the tendency of recurrence.

406. The drainage pattern and flow of rainwater will be closely monitored to assess the effectiveness of cross drainage structures and drainage network. If any new water logging situation is identified along the embankment, than appropriate corrective action will be taken to avert the water logging problem.

f. Safety

407. Safety provision like signage board, crash barrier, and speed control are proposed near school, hospital, religious places. Periodic physical check shall be made. If any of safety aspect is found damaged or missing or ineffective, appropriate corrective action shall be taken.

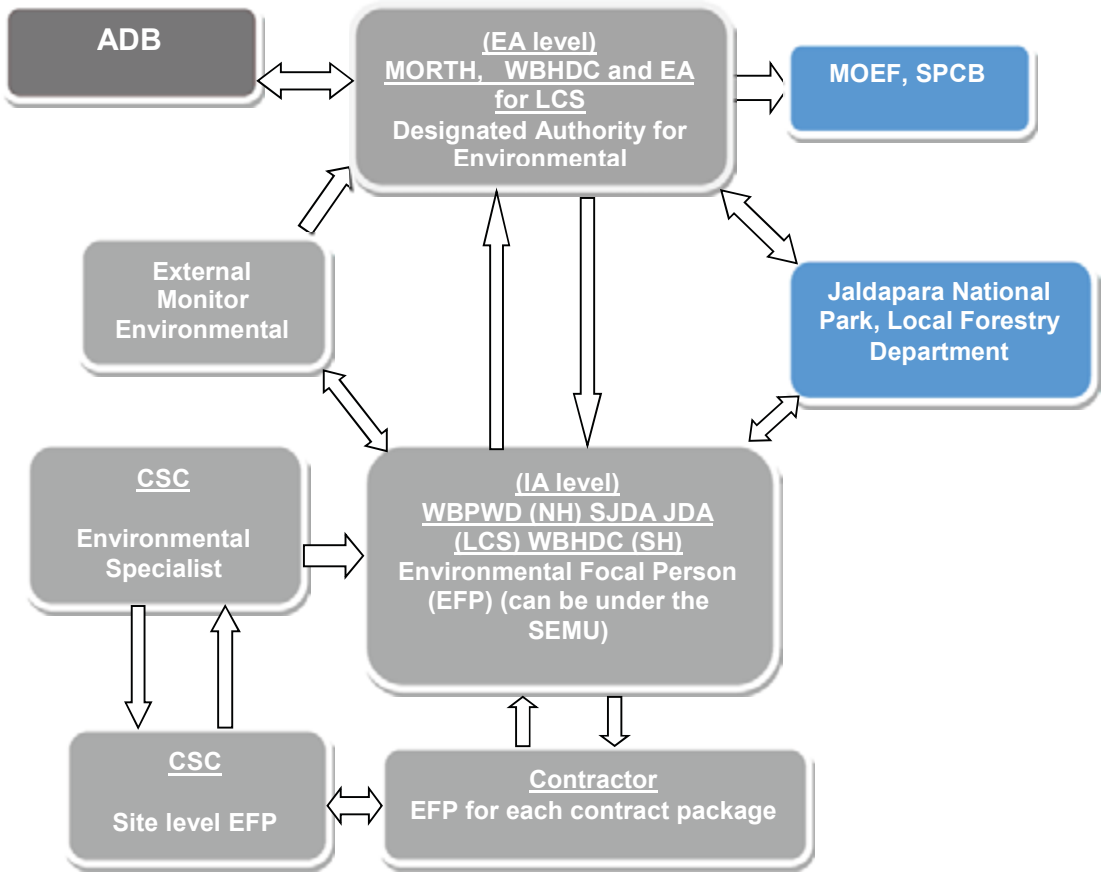
2. Authorities and their Responsibilities for Implementation of EMoP

408. The most essential component of the Environment Monitoring Plan is the execution of the Plan in accordance with the monitoring schedule provided therein. The SEMU and concerned PIU will be responsible for timely monitoring of various parameters and compliance with the mitigative measure proposed. A resultant data base is proposed to be maintained.

C. Institutional Capacity

409. The proposed organisation structure to implement the Project and the environmental management plan is shown in **Figure 70**.

Figure 70. Proposed Organisation Structure for EMP Implementation



410. It is also suggested to identify subject experts by EA who can be approached by them for specific problem (if any) during construction and operation stages of project implementation.

411. Capacity Building: To enhance the capacity of the SEMU for effective implementation of proposed mitigation measures and monitoring the resultant effect, some training programs are proposed. The detailed training plan is provided at **Appendix 7.4**.

412. It would be essential to understand the legislative framework and enhance capacity of EA officials for analysing the applicability of various environmental legislations and clearances, approvals and compliance monitoring requirements. An environmental legislation applicability matrix and legislative framework has already given in Chapter 2 above for ready reference.

D. Regulatory Clearances /Permission Required

413. Various environmental clearances are required at the start and during the construction stage of the project to be obtained by EA or its contractor. The clearances required are summarised at Table 1 The most important and time-consuming clearances are Forest Diversion Wild Life and Environmental clearances which EA must obtain before start of construction.

E. Mitigation, Monitoring and Institution Strengthening Cost

414. The environmental budget has been worked out for the entire project and summarised in the **Table 84 below**. The mitigation cost, inclusive of monitoring cost and training during the project life cycle (construction and operation phase) amounts is estimated to be a total of Rs 352.79 Mn or US $ 6.41 Million[35] . This is approximately 2% of total project costs based feasibility study estimates. Of the total environmental costs, Rs 112.29 Mn (US$ 2.04 Mn) is for AH-@ and Rs. 240.5 Mn (US$4.37 Mn) is for AH-48. Approximately 29% of the costs under AH-2 is part of the civil works cost for items which concerns environmental issues. Similarly approximately 22% of the costs under AH-48 are part of the civil works costs.

415. The mitigation cost including monitoring is estimated as Rs. 267.52 Mn during design and construction phase and Rs. 30.78 Million during operation phase. The costs of establishment and training are estimated as Rs 37.5 million. The detailed break up is given at **Appendix 7.5 under Environmental Budget**.

Table 84 : Summary of Mitigative, Monitoring and Institutional Costs

Sl. No.	Description	Budget (Rs in Million)
1.	**Design and Construction Stage**	**267.52**
	Technical Support for preparation of environmental Guidelines and performance indicators	2.50
	Clearing of plantation and compensatory plantation	187.5
	Additional Tree plantation for climate change consideration of 1:5 basis considering woody trees of 34%	42.5
	Diversion of Forest land for Non forestry Purposes (Diversion of Reserved Forests and National Park land	12.8 + Net present Value
	Developing floral Nurseries and Fisheries	8.0
	Health Check-up Camps for construction workers and Safety signage	2.96
	Environmental Monitoring during Construction Stage	7.66
	The costs towards various mitigative measures such dust management, soil contamination prevention, drainage congestion and disposal of accumulated water, water management, noise and vibration and safety aspects are considered part of engineering costs and not separately indicated as EMP costs	3.6
2.	**Operation Stage**	**30.78**
	Costs of visual Checks are considered part of project management costs and separately identified as EMP costs	-
	Emergency Preparedness – Provision of Ambulances	25.5
	Environmental Monitoring during operation stage	5.28
3.	**Training and Awareness**	**4.60**
4.	**Establishment & Management systems**	**32.90**
5.	**Contingencies (@5%)**	**16.79**
	Total	**352.79 Or say US $ 6.41** (@ 1 US $ = Rs 55)

[35] Total project cost estimated at feasibility study stage is 420.5 milllion. US$1

F. Grievance Redress Mechanism

416. Grievances related to the implementation of the project, particularly regarding the environmental management plan will be acknowledged, evaluated, and responded to the complainant with corrective action proposed using understandable and transparent processes that are gender responsive, culturally appropriate, and readily accessible to all segments of the affected people. Records of grievances received, corrective actions taken and their outcomes will be properly maintained and form part of the semi-annual environmental monitoring report to ADB.

417. Depending on the nature and significance of the grievances or complaints, the grievance redress mechanism (GRM) will comprise procedures to address grievances i) first by the SEMU at the PIU level and ii) second at the EA level and iv) third at the Grievance Redress Committee (GRC). Most serious complaints which cannot be addressed at the EA level will be forwarded to the GRC. The GRC will comprise members from the EA, IA, CSC, contractor, local community and local forestry authority. Grievances at the PIU level will be addressed within 30 days of the receipt of the complaint. The time for addressing grievances received at the EA and GRC level will be dependent on the nature of complaint received. However, all efforts will be made to respond to the grievances efficiently with a corrective action plan and not take longer than 30 days from the receipt of grievance at the respective level. Hence, to the extent possible corrective action plans along with clear timeline will be communicated to the complainant within 30 days of the receipt of a complaint within the respective level.

VII. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

A. Consultation Method Applied

1. Purpose

418. The purposes of the Public consultation in conformity with ADB policy on environment are as follows:

- To inform the community, Govt. officials and NGOs on the project impact on the socio economic and environment in the project area.
- To assess positive as well as adverse socio economic and environmental impacts in the area through participatory methods such as walk through and focus group discussions
- To understand suggestions and opinions of the community, Government officials and NGOs on mitigation measures to counter and check the adverse and negative impact that threaten the socio economic environment in the area.

2. Methodology

419. The mode of consultation employed during the course of the study was both formal and informal consultations. The attempts were made to encourage participation in the consultation process of the Government officials from different departments that have relevance to the project. Same way, local people from different socio economic backgrounds in the villages as well as urban areas along the road alignment and at detours, residents near the existing road, local commuters, and other concerned were also consulted. Public consultations were held during the different site visits from March-May 2012 in different stages of EIA report preparation including before and after impact prediction. The inputs and feedback received during these consultations was helpful. A final round of consultation for both roads involving all relevant stakeholders such as the local community representative, women representatives, NGO's, forestry department, national park warden are held in July 2013. The purpose of this consultation was to present the draft EIA report and recommendations and seek their feedback.

420. The team prepared a check list for data collection in the field and also prepared a questionnaire to be filled in. (**Appendix 8.2**). The questionnaire was useful in listing of the physical and cultural resources along the road. It was decided to list all the resources within the width of 50 m from the centre of the existing road.
The questionnaire was also helpful as a checklist to disclose information and take note of the suggestions and opinions on mitigation measures to counter the adverse impact on the socio economic environment in the project area.

421. Following steps were followed:

a) Preparatory Activities including getting up to date road maps, Before beginning field work involving participation of the community and other stakeholders, the team consulted the project documents to understand the project alignment and components. Additional section of Fulbari to Medical More section via Rangapani on AH 02 and Additional Section of Bholanchupati to Phuentshing via Pasakha road on AH 48 were also studies.

b) Contacted Govt. officials to understand their point of view and also invite them in the public consultation exercises. The officials from Project Management Unit, Forest Department, Revenue Department, and Block Development Officers were contacted and informed about the project. They were also invited for the public consultation at both at the roadside as well as in their offices.

c) Reconnaissance visit was undertaken for both the road corridor. During the visit, all the public community structures were identified and listed with GPS coordinates. Photographs were also snapped at each location for record and documentation purpose. This was followed by identification of sensitive location such as schools temples with high number of followings. A total of 41 locations on AH 48 and 15 locations on AH-02 out of total 87 PCR were identified as sensitive locations for public consultation.

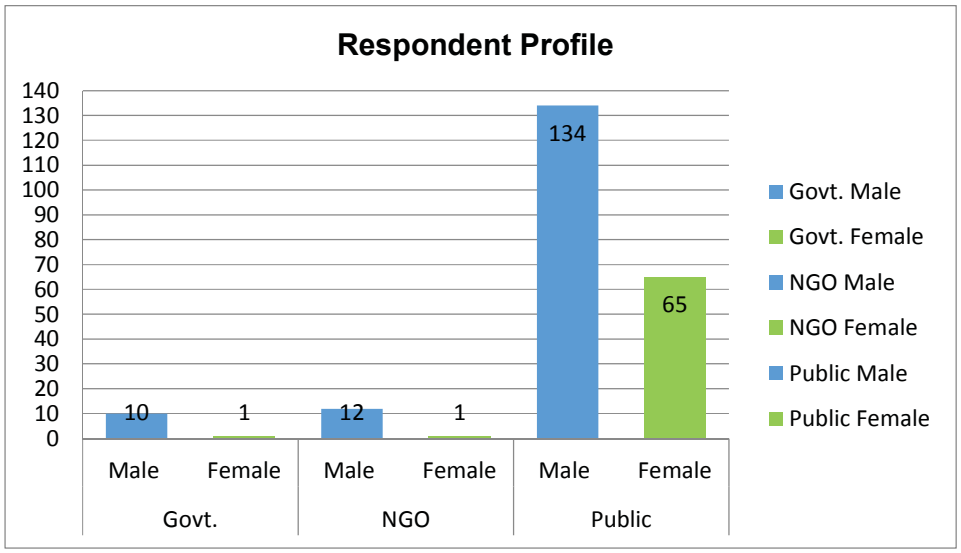
d) Conducting Public Consultations with participation of the Govt. officials, NGOs and the community members along the road. Public Consultations were held at each of the sensitive location.

e) Data collected was collated, analysed for assessment and mitigative measures identification. Mitigative measures were shared with key stakeholders. Finalised measures were incorporated in the project design and environmental management plan.

B. Public Consultation Milestones

422. The different stakeholders viz Govt. officials, NGOs , Village Panchayats (Village Administration), people (male, female) were contacted and consulted during the course of the study. The mode of consultation employed during the course of the study was informal consultation. Government officials from different departments that have relevance to the project were consulted. Local people from different socio economic backgrounds in the villages along the alignment different site visits from June 2009 till March 2010 in different stages of EIA report preparation including before and after impact prediction. The inputs and feedback received during these consultations was helpful. Respondent profile is shown at **Figure 71 and 72**.

Figure 71. : Respondent Profile



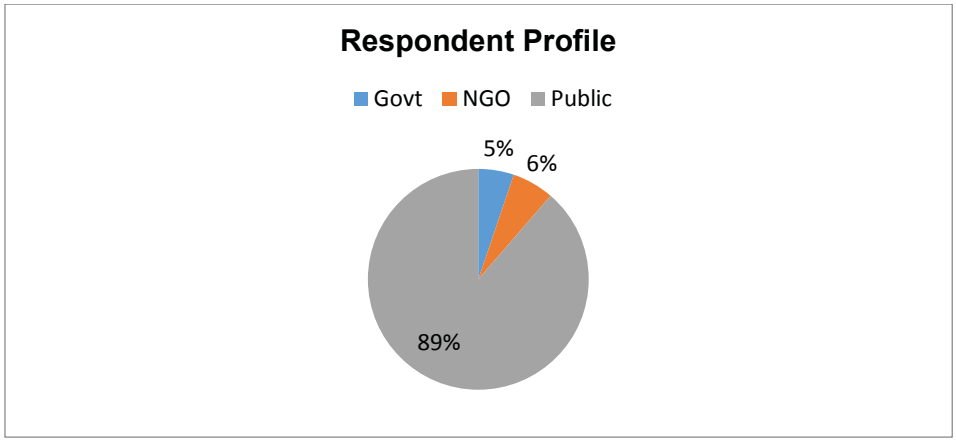
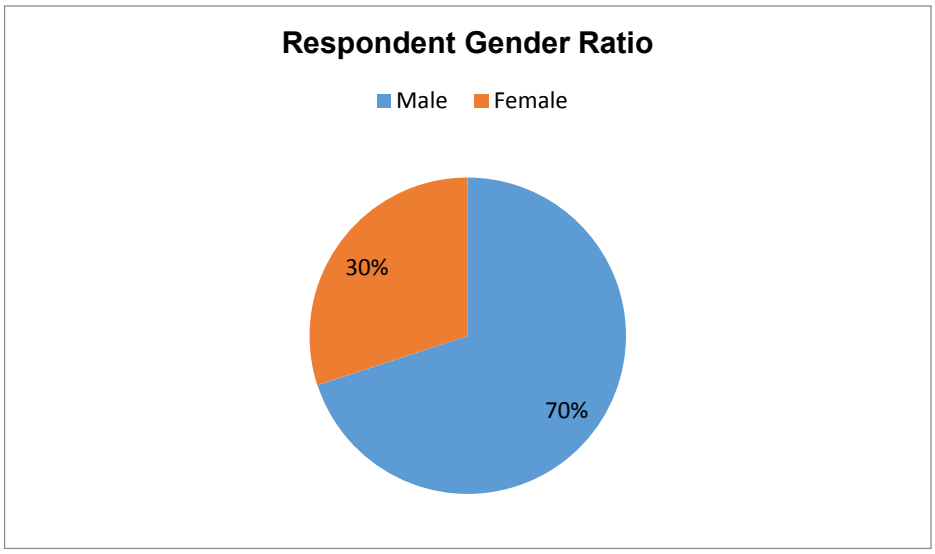


Figure 72. : Respondent Gender Ratio



C. Information disclosed

423. During each of the public consultations, the Enumerators and Consultants introduced themselves and informed about the project to the participants. In the first phase, the road will be renovated and constructed as Asian Highway connecting Nepal and Bhutan with Bangladesh. The AH 48 and AH 02 will provide a road corridor for movements of goods and passenger traffic. After having made clear the purpose of environment impact assessment was explained. Initially the Consultants made an attempt to build successfully the rapport with the community members / Government officers and NGO members so that they are encouraged to participate in the consultation process. After having discussions on the brief outline of the project, the participants were requested to reflect on the project and give their opinion. Environmental issues and nature of impacts were conveyed including air -noise – water pollution, loss of trees, accident and safety issues, movement of animals, and movement of wild animals. The participants were requested to provide their concern in any of these issues and sought their suggestions to minimize the adverse impact.

D. Compliance with Applicable Regulatory Requirements for Public Consultation

424. MoEF GOI Requirements: In India, public consultation is mandatory only in case of Category A and B projects[36] in select conditions. As per regulation, public hearing is required for the proposed project under the environmental impact notification, 2006 and amendments thereof. The requirement of public consultation during the implementation of the project is proposed as part of the mitigation plan.

425. ADB Safeguard Requirements: Public consultation was undertaken as per the ADB SPS09 requirements. All the five principles of information dissemination, information solicitation, integration, coordination and engagement into dialogue were incorporated during the task. A framework of different environmental impacts likely from the project was strengthened and modified based on opinions of all those consulted, especially in the micro level by setting up dialogues with the village people from whom information on site facts and prevailing conditions were collected.

426. As per ADB safeguard requirement, public consultation is to be carried out before and after impact identification. Public consultation was carried out twice with key stakeholders particularly with wild life authorities and NGOs. In the second stage consultation, mitigative measures were discussed and concurrence of stakeholders was obtained. Man-Animal conflict in Jaldapara National Park area.is the main concern under this project. Various options were proposed and consensus was arrived for construction of underpass for the movement of elephant and other animals.

E. Major Comments received and Community Acceptability of the Project

427. In all the public consultations the community members, Government officials and NGO members voiced that the proposed project will contribute in social and economic development of the region. No negative social impact is anticipated except minor land acquisition and relocation of few structures. The proposed project shall contribute to increase employment opportunities for the local people during and after project implementation. The communities welcomed the project and all were in favour of the project. The level of acceptance is shown at **Figure 73.**

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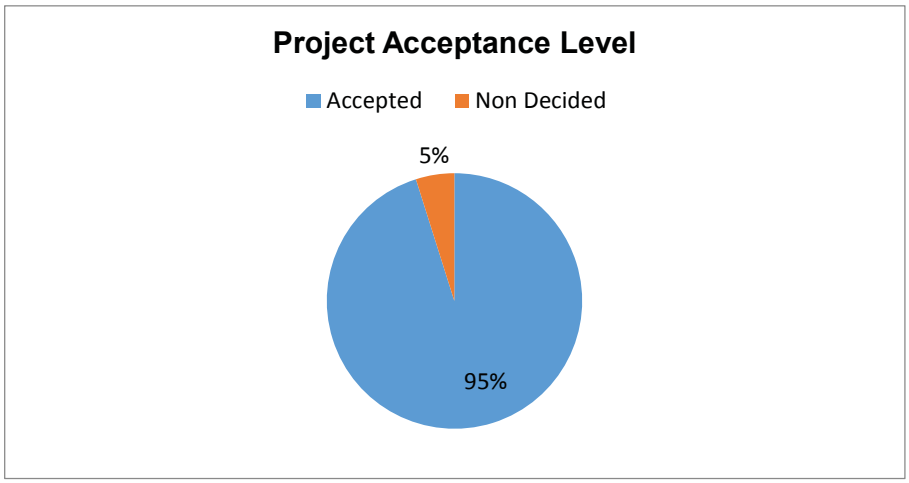
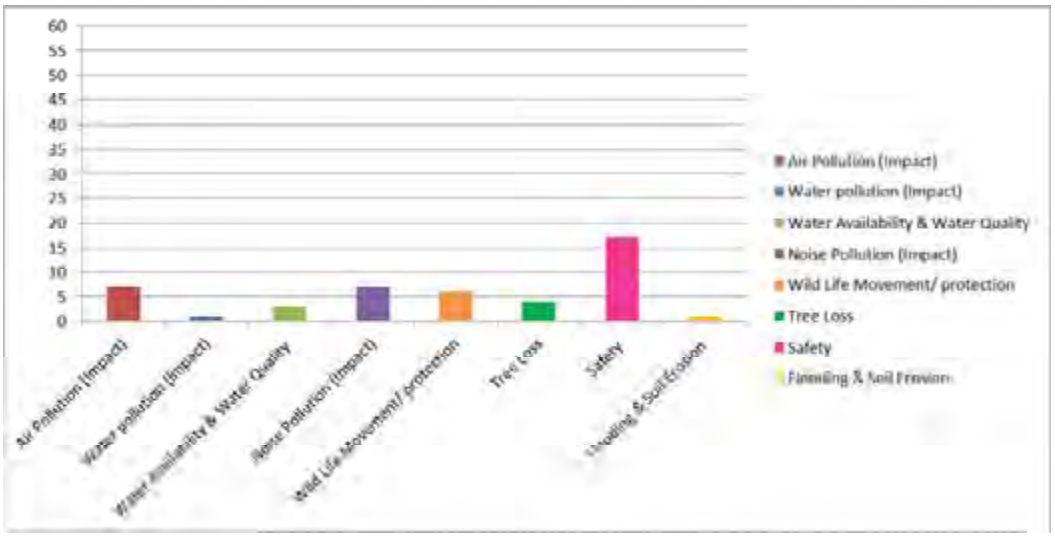
[36] As per schedule I of EIA notification number S.O. 1533, dated 14th September 2006 and amendments thereof. This notification also defines when a public consultation is mandatory. As per this notification, any new National or State highway construction will require environmental clearance and public hearing. Public hearing is to be conducted under the chairman ship of district commissioner in each district through which road is passing. Public hearing notice is to be advertised in the two leading daily newspaper, 30 days in advance.

Figure 73. Project Acceptance Level



428. The participants mentioned that there will be no adverse impact of the project on agriculture, drinking water facilities and local economy. Few raised concern regarding air, and noise impact, safety and Man –animal conflict. Nature of comments received are also summarised below and shown at **Figure 74**.

Figure 74. : Summary of Nature of Comments Received



429. Government officials and Pradhan (President) of the Gram Panchayats on both the highways, suggested that widening shall be done for four lane instead of two lane at this stage itself since land acquisition and all other activities may be difficult in second phase.

- Man-Animal Conflict is major issue in Jaldapara National Park, Hasimara and Naxalbari area. Wild life authorities have made suggestion for construction of underpass for elephant movement in the Jaldapara National Park area. Provision of Caution sign and sped control are also proposed.

- Villagers have suggested to make provision for safe passage of student and people near sensitive locations. The main bottleneck surfaced is at the schools / hospitals especially bigger schools with more than 600+ require some safety measures such as signal, safe passage, and road over bridge to cross the highway, barriers, speed breakers. At some sensitive locations and where habitation on both sides provision of underpasses will reduce accident risks and improve social interaction between communities.
- Medical College Hospital Superintendent at Shushruta nagar suggested to upgrade the present emergency ward facility with more space and equipped with Trauma Ward, necessary supplies, equipment and staff to deal with road accident situations.
- Public have suggested to make measures for air pollution and noise barrier near sensitive locations. The structures like temple and other religious places including cremation grounds etc. are managed by local committees. These committees are willing to discuss with authorities the impact and mitigation measures such as relocation, provision noise barrier as may be required.
- In both road corridors, the Government officials, custom officials, community members, and all concerned requested for an early implementation of the proposed road project due to present very bad road conditions.
- NGOs have raised concern for tree los and Man – Animal conflict. They have suggested to plant trees on minimum 1:3 ratio. Village Panchayat have volunteers to contribute for compensatory tree plantation.

430. The details of informal consultation held with various stakeholders with outcome is summarized in **Appendix 8.1.**

F. Integration of Comments into the EIA

431. During discussions, notes were taken for any issue raised and suggestions made. References have been taken from public opinion where no official data were available for understanding of the study area characteristics. Each of the issues were then analysed for practical and scientific basis. The opinions were used for identifying impacts and developing management and monitoring plan, depending on their importance and practicality. For any significant concern, preventive or mitigative measures have been suggested drawing points from all the suggested measures.

G. II Stage Consultation: Post EIA Consultation

432. II stage consultation was conducted through formal approach at three workshops organised in the month of July 2013. The finding of the EIA report was presented to the workshop participants. Efforts were made to involve women, NGOs, public leaders and concerned Government officials. An international consultant WWF was also consulted at this stage. The details and outcome of these consultations are given below:

1. Public Consultation Stage-II : Workshops at Naxalbari and Maynaguri, North Bengal

433. These workshops were held at Naxalbari and Maynaguri; areas of North Bengal where the findings of EIA study were discussed with local people, stakeholders. Efforts were made to involve women, NGOs, self-help groups and other stakeholders. These consultation workshops were held on 23rd July, 2013 at Naxalbari United club and on 26th July at Maynaguri Sparsh Welfare Society where. The workshops were organized through an NGO Naxalbari Integrated Development Society and Sparsh Welfare Society. The workshop saw huge participation of women (**Refer Appendix 8.1A for Photograps and Appendix 8.1B : List of Participants**) as out of total 94 numbers of participants, 74 were women who belonged to different NGOs, self-help groups and societies namely: Panitanki Rural Development Education Society, Panitanki Baagan Mahel Dal, Janiti Saw Niran Dal, Naxalbari Women and Child Development Society, Aparagita, Radhagovinda, Dream P, Tulsi, Janani, Bhalababa, Baba Loknath (all local NGOs).

434. All the participants supported the project. They made following suggestion. Relevant suggestions were suitably addressed under mitigative measures and EMP.

- Participants requested that tree plantation should be undertaken through Gram Panchayats with the involvement of self-help groups (women) and NGOs. They suggested that strict vigil shall be made for maintenance of the trees as they have noticed poor plantation management in previous similar projects.
- They suggested that drainage shall be maintained. Cross drainage structure shall not allowed to be clogged with construction debris.
- Some of participants suggested to make provision of adequate lighting Belgachi tea state about 7-8 Km away from the project road for protection from Elephants.
- They suggested that project affected people should be duly and timely compensated.
- Participants suggest making adequate measures for safety in rural and urban areas.

2. Public Consultation Stage-II : Work Shop at Siliguri, North Bengal

435. Third workshop was held on 27th July, 2013 with the help of WBPWD. All leading NGO, Forests and Wild Life Officials, and other stakeholders were invited for the workshop. The workshop was attended by participants from NGOs, self-help groups, Government Officials and few local people who while accepting the project gave valuable suggestions for the improvement of the project. The program was presided by Mr. A.R. Modak, Superintending engineer, Highway circle-III. Other dignitaries were Mr. Nirmal Mondal, Executive Engineer, National Highways, Siliguri, Mr. R. Nair, DPR Team Leader. The presentation was made by Mr. S.K. Jain, Environment consultant, ADB Project. Following are important issues which were raised during the workshop:

- Proper guidelines and procedure shall be followed. Selection of species and number shall be pre-planned before start of plantation. It was agreed that plantation would be made through village Panchayat with the active participation of self-help group and under supervision of Social Forestry Department of West Bengal Forests Department.
- Suggestion was made that contractor be insisted under contract to employ local labourers to the maximum possible. .
- Suggestion emerged that supervision for effective implementation of EMP is made.

- Suggestion emerged that adequate provision shall be made for the protection of health of the labourers and prevention of communicable disease which may be carried by outside labourers. Pre-employment check shall also be undertaken.
- Suggestion was made to effective implementation measures pertaining to borrow area rehabilitation, selection of construction camp site (minimum 1 Km away from habitat).
- Suggestion was made that education and awareness programme for public shall also be conducted on environmental and animal protection.
- Suggestion was made that land acquisition shall be made with all transparency and following National R & R policy.

3. Public Consultation Stage-II : Interaction With International NGO WWF

436. Interaction meeting was held on 31st July 2013 at WWF office at Delhi with Dr G Ghose Director Species and Landscape programme and who is actively working in North Bengal. He is comfortable with our underpass measures provided the length and width specification proposed by us is actually implemented. He suggested to take measures for elephant habitat improvement by making provision of plantation of fodder and shade trees and water body so that elephant do not have to cross over the roads. WWF suggestion was duly integrated under EIA.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

437. The project is aimed at improving to widened the project road (AH-2 and AH-48) along the existing alignment except bypasses. Most of the existing alignment passes through agricultural and tea garden areas.

438. The project is unlikely to cause significant environmental impacts except in protected area where it will have impact on elephant movement and its land use. As per findings of detailed EIA, the environmental impacts are largely temporary in nature in most of the section of the roads except in forests & protected areas. Impacts can be mitigated with minimal residual impacts in all impacted areas. The project involves land acquisition, diversion of forests land, and movement of elephant, shifting of physical cultural structures and borrowing of earth. Most major impacts are associated with these activities.

439. The project is classified as category 'A' by ADB SPS 09 due to its impact on Elephant Movement in Jaldapara National Park and the conservation area near the Bhutan border in Pasakha. Some sections of the roads also involve substantial widening and earthworks from two lane to four lane standard.

440. The EIA study was carried out between April 2012 to May 2013 based on feasibility Study inputs and is based on primary and secondary base line information. The environmental study covered the project area, as well as the area of direct and indirect impacts. The environmental assessment report was prepared in accordance with relevant applicable laws and regulations of the Government of India; and in conformity with the ADB SPS.

1. Potential Negative Impacts, Mitigation, Management and Monitoring

441. Significant Impact during design stage is mainly associated with climate change consideration, diversion of Reserve Forests and National Park land, tree cutting, and disruption to elephant movement, and traffic noise. Some of measures suggested include:

- The compensatory afforestation will be undertaken on 1:5 basis.
- Provision is made to construct three underpasses in consultation and agreement with concerned Jaldapara National Park Authorities for safe passage on Elephant and other wild animals. Provision of Warning signage, speed control is made in Ah-2 and Hasimara and Pasakha Bypass road sections to minimise man- animal conflict.
- Provision of noise barrier is made for noise sensitive facilities located close to the road such as school, hospitals and temples.
- Provision is made for .to bypass the congested area of Panitanki through a bypass and shifting the proposed Pasakha bypass somehow away from elephant movement area to the extent feasible.

442. The significant impact during construction is mainly associated with minor increase in dust borne air pollution, increased noise level, nuisance due to movement and operation of vehicles, establishment of temporary facilities and hindrance in accessibility to common property resources. The mitigative measures have been suggested to eliminate or minimise the impacts. Some of the measures suggested include:

443. Key measures suggested to control increased noise level during construction include provision of temporary noise barriers and measures such as regulating construction timings near sensitive locations. Sitting and management of temporary construction facilities i.e. construction camp, workers camp, hot mix plant, batching plant, dumping sites, shall be done in an environmentally acceptable manner as mentioned in EIA

444. A proper traffic management plan shall be in place well before the start of construction. Access to community structures/resources shall not get affected during any stage of the project.

445. Soil erosion along embankment slope, bridge approaches, and river/canal banks shall be checked regularly as per EMoP suggested in EIA. Dismantled material shall be reused to the extent possible. Leftover debris shall be disposed off in an environmentally acceptable method and at designated sites as per the guidelines suggested in the EIA.

446. Borrow area shall be rehabilitated as per EMP. IRC: 10-1961: guidelines shall be followed regarding identification; usage and rehabilitation of borrow area.

447. With the implementation of suggested mitigative measures, no significant impacts are anticipated during operation stage.

2. Post EIA Surveillance and Monitoring

448. While an EIA is meant to provide a comprehensive understanding of the environment status of the area under the study, post EIA surveillance is the means to ensure that the significant impacts identified are adequately mitigated as per the proposed mitigation plan. The Environmental Management Plan provides a detailed monitoring plan. Air, surface water quality, ground water quality, noise, soil erosion, drainage pattern, tree survival rate monitoring, Gathering details for man –animal conflict and reporting along with the follow up actions in case of deviation from the norms has been detailed out. The frequency has been set in consideration to the likely impacts.

3. Irreplaceable Resources

449. 3 ha of Jaldapara National Park land and 5 ha of reserved forests land will be diverted to non-forests purposes. This will lead to permanent change of land use of National Park land. Though the floral diversity of this area will be lost but all the floral species found in these areas are available in abundance in this region and no threatened or endangered species is likely to be affected. Compensatory tree plantation in compensatory land in twice the area will compensate the loss over a time.

4. Public Consultations

450. Although, there is displacement of people, still the project received unanimous support and consent from all local people. Large number of people raised the concern of Man – Animal conflict and safety of people. Very few people raised the concern of air pollution due to damaged road and noise pollution. People have suggested fixing caution signage in the elephant movement area, speed control and

underpasses as feasible. People have also suggested to make provision of safe passage of student and public to minimise the accident on the road.

B. Recommendations

451. The EIA was carried out while the feasibility study was being prepared and initial finding of DPR preparation stage. Therefore, the detailed engineering design was not available. In this regard, any major changes during detailed design, or any major additional work other than the proposed project activities will require updating this environmental assessment. Also it may have to be sent to ADB for concurrence before civil works commence. Moreover, the executing agencies have to submit the detailed engineering designs to ADB, which will review them and examine whether major changes or major additional works have been included. In this context, changes with respect to alignment, and any significant change in design specification of the project components need to be reported to ADB.

452. Adequate provision is made for safety of the people in the EMP budget. Institutional mechanism shall be evolved for utilising the emergency Ambulance facility proposed under the EMP.

453. Mechanism to monitor the tree plantation and effectiveness of measures for preventing Man-animal conflict shall be strengthened. It is proposed to form committee consisting of concerned EA Sr. official, DFO and one officer from revenue department who shall oversee the implementation of floral and faunal measures.

454. For effective implementation of the project in an environmentally sustainable manner, it is recommended to develop environmental guidelines and EHS management system supported by Environmental Management Information software/system. Performance indicators may also be developed as part of these guidelines to monitor and assess the effectiveness of the mitigation measures.

455. Adequate training shall be imparted as proposed under environmental management plan to enhance the capability of concerned EA officials. Awareness programme for contractor and workers shall also be organised for effective implementation of EMP.

456. EMP implementation progress and monitoring report shall be sent to ADB every half yearly

Appendix 1.1 : Rapid Environmental Assessment Checklist

ROADS AND HIGHWAYS

Instructions

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES), for endorsement by Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country / Project Title: ***India: SASEC Road Connectivity Sector Project***

Sector Division: ***Transport Sector***

Screening questions	Yes	No	Remarks
A. Project Siting Is the project area adjacent to or within any of the following environmentally sensitive areas?			
Cultural heritage site		X	No archaeologically protected monument or cultural heritage site in located within the road ROW or even within 2 Km distance from the road. Though, few religious structures like temple are located close to the roads.
Protected Area	X		AH-48 passes through Jaldapara National park and Elephant Conservation area. The road is crossed by migrating elephants at two – three locations.
Wetland		X	Seasonal Waterlogged type wet land is located near Rangapani. However, even the same is unlikely to be affected by the project activities.
Mangrove		X	Project road is not located in coastal areas.
Estuarine		X	No Estuarine is located in the project area.
Buffer zone of protected area		X	No such area is located in the project vicinity.
Special area for protecting biodiversity		X	No such area is located in the project vicinity.
B. Potential Environmental Impacts			
Encroachment on historical/ cultural areas; disfiguration of	X		The topography of project road is mainly plain. There is no

Screening questions	Yes	No	Remarks
landscape by road embankments, cuts, fills, and quarries?			encroachment of historical places. However community structure like temple, mosque, Schools, and Graveyards exists along the project road which may require relocation at certain locations. New bypasses at Pasakha, construction of land custom stations and widening of road from two lane to four lane would require additional land and change in land use which would need to change in land scale of these areas. Opening of new Quarries is not envisaged. Only operational and licensed quarry will be used for road construction. Earth material will be sourced from pre identified areas (located within 25 to 30 Km from the road) and with the consent of landowner. All borrow areas will be suitably rehabilitated.
Encroachment on precious ecology (e.g. Sensitive or protected areas)?	X		Improvement of the road and increase in traffic speed may lead to man and animal conflict in Jaldapara National park area and elephant reserve area, in absence of adequate mitigation measures Large number of road side trees cutting is involved. Attempts have been made to minimising the cutting of trees while finalising the road widening options.
Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?	X		The proposed alignment is crossing through various major rivers and drains. Some of these rivers are perennial in nature. However most of the bridge required repair and widening work except one where re-construction is proposed. The construction for widening activities are proposed in lean water flow period. Appropriate measures are proposed to prevent any contaminated to water resources.
Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used		X	Adequate sanitary facilities including sewage treatment facilities will be provided at construction camps, which will be

Screening questions	Yes	No	Remarks
in construction?			set-up away from habitat and water bodies. No harmful ingredients are likely to be used in the construction activities. As such, no impact on surface water quality is anticipated due to construction. Measures like embankment slop stabilisation, RCC retaining walls are proposed to prevent siltation of ponds located next to the road due to surface runoff.
Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?	X		Localised air pollution level is likely to increase for short duration during construction period due to construction vehicle movement and asphalt processing. The asphalt mixing plant (hot mix plant) will be located away from inhabitated areas with adequately high stack for effective dispersion of likely emissions. Dust separation measures like spraying of water on unpaved vehicle movement areas are proposed to minimise the dust generation.
Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?	X		Workers may get exposed to dust and noise during construction activities. However the exposure levels are likely to be short and insignificant. Workers will be provided requisite PPEs to minimise such exposure and associated harmful occupational health effects. Appropriate measures will be proposed to reduce exposure to noise to the occupants of sensitive locations like schools, hospitals located near the road corridors. As such, no other occupational health hazard is anticipated during operation phase.
Noise and vibration due to blasting and other civil works?		X	No Blasting is involved. No significant noise generation is expected during construction activities except normal construction equipment operational noise. These noise levels will be impulsive in nature and its impact

Screening questions	Yes	No	Remarks
			will be confined within few meters of either side of the road. All stationary noise making sources equipment like DG set, compressors will be installed with acoustic enclosures. There are few noise sensitive locations especially schools close to the alignment where noise level may increase due to increased traffic during operation stage. Provision of noise berries will be made wherever noise level is likely to increase beyond the prescribed ambient noise levels.
Dislocation or involuntary resettlement of people	X		The project affected persons are expected to be less. This aspect will be addressed as per Govt. rules and ADB's Social Safeguard Policies (SPS09) separately in a Resettlement Plan.
Dislocation and compulsory resettlement of people living in right-of-way?	X		Displacement of few persons may be involved. However This aspect will be addressed as per Govt. rules and ADB's Social Safeguard Policies (SPS09) separately in a Resettlement Plan.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	No such impact is anticipated.
Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?	X		No such social concern is expected. Concern may arise during construction stage due to increase in ambient air pollution levels, which is expected to be localised and temporary in nature. This aspect will be effectively controlled with the proposed dust suppression and other mitigation measures. As such people at large are supportive of project.
Hazardous driving conditions where construction interferes with existing roads?	X		Hazardous driving condition may arise around bridge/culvert widening / re-construction areas and at locations of road interface with non-project roads. To minimized the impact suitable traffic management plan will be designed and implement by the contractor to prevent any

Screening questions	Yes	No	Remarks
			hazardous driving condition in above situations.
Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?	X		Proper provisions for sanitation (sewage treatment), health care (drinking water supply and periodic health check-ups) and solid waste disposal (through composting) facilities will be made at each construction camp. Awareness will be created amongst the workers about hygiene and health protection.
Creation of temporary breeding habitats for mosquito vectors of disease?		X	No such condition is anticipated. Each borrow area will be rehabilitated as per pre agreed used and rehabilitation plan.
Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?	X		Adequate safety measures will be adopted to avoid accidents during construction and operation stages. Measures, like signage, speed, control, crash barriers will be taken close to sensitive locations such as schools, temple or hospitals.
Increased noise and air pollution resulting from traffic volume?	X		Increase in noise and air pollution is expected during construction phase but is likely to be confined within few meters of either side of the road. Adequate mitigation measures will be adopted to minimise the same. During operation phase, vehicular traffic will be the main source of air and noise pollution. Improved road conditions, plantation along the road and provision of noise barrier will reduce the noise and air pollution impact. Moreover, most of the road stretch passes through open agricultural land, which will provide adequate dispersion to vehicular emission.
Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?	X		This possibility is minimal but cannot be ruled out. Controlled construction activities and proper drainage system will reduce this possibility. Provision is made for adequate signage and crash barriers near water bodies, which will minimise

Screening questions	Yes	No	Remarks
			the possibilities of accidental water pollution.
Social conflicts if workers from other regions or countries are hired?		X	Most of the workers will be hired locally.
Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	Most of the workers will be hired locally. One construction camp is anticipated for every 50km stretch with expected workers population of only 50-60. This is unlikely to cause any significant burden on social infrastructure and services.
Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	The construction material (aggregate from approved quarries, borrow earth, bitumen) will be sourced from nearby and approved sources. No explosive or chemicals are likely to be used. Bitumen waste if any generated during construction will either recycled or disposed off in controlled manner.
Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.		X	No such impacts are anticipated. Adequate awareness will be created amongst people and workers through information disclosure, safety signage and public consultation about safety aspects.

Based on above assessment and the project is **categorized as 'A'**

Appendix 2.1 : Bridge Inventory – Nepal Bangladesh Road

Serial No.	River/Nala	Section	Latitude			Longitude			Water Flow	Bridge type	Length (m)	Span Arrangement	Carriageway Width (m)
			Deg	Min	Sec	Deg	Min	Sec					
1	Mechi River	*Kakarbhitta - Panitanki*	26	38	40	88	9	47	Yes	PSC T Beam	570.0	20 x 28.5	6.9
2	NA	*Panitanki- Bagdogra*	26	40	42	88	12	1	Yes	Slab	10.1	1 x 10.1	8.0
3	Khamchi Nala		26	40	53	88	12	22	Yes	Slab	20.0	2 x 10	7.5
4	Magurmari Bridge		26	41	11	88	13	13	Yes	Slab	20.4	2 x 10.2	7.5
5	Manza River		26	41	21	88	14	40	Yes	Slab + T-beam	60.0	10+2x20+10	7.5
6	Changa Bridge		26	41	27	88	15	15	Yes	Slab + T-beam	60.0	10+2x20+10	7.5
7	Deomani Bridge		26	41	31	88	15	48	Yes	Slab	18.0	2 x 9	7.5
8	Lalpha		26	41	35	88	16	21	Yes	Slab	40.4	4 x 10.1	7.5
9	Tepu		26	41	40	88	17	11	Yes	Slab	28.5	9.7 + 9.1 + 9.7	7.5
10	NA		26	41	42	88	17	38	Yes	Slab	9.9	1 x 9.9	7.5
11	NA		26	41	44	88	17	44	Yes	Slab	9.9	1 x 9.9	7.5
12	Halia	*Bagdogra - Shiv mandir*	26	42	4.7	88	19	49	Yes	RCC T-beam	38.0	13+12+13	7.2
13	Bwabalan		26	42	7.1	88	20	4.7	Yes	RCC T-beam	50.4	13+2x12.2+13	7.4
14	rail		26	42	10	88	20	28	No	RUB/Steel girder	57.5	5x11.5	
15	Laska		26	42	17	88	20	59	Yes	RCC T-beam	50.4	13+2x12.2+13	7.4
16	Maungarmari		26	42	27	88	21	30	Yes	Slab	19.9	5.4+9+5.4	7.5
17	Balason & Mahananda	*Medical Mor - Naukaghat*	26	41	13	88	24	20	Yes	PSC T Beam	479.8	4+10x40.1+3	7.5
18	Rnagapani NJP line	*Naukaghat - Fulbari*	26	40	40	88	25	3.3	No	Rob, Plate girder	12.5	1x12.5	7.2
19	Testa Canal		26	35	12	88	24	55	Yes	PSC T Beam	60.8	2 x 30.4	7.5

Appendix 3.1 : Bridge Inventory – (Additional Corridor VIA Rangapani)

Serial No.	River/Nala	Latitude			Longitude			Water Flow	Bridge type	Length (m)	Span Arrangement	Carriageway Width (m)
		Deg	Min	Sec	Deg	Min	Sec					
1	Lochaka	26	41	22.9	88	22	0.1	Yes	Slab	36.1	8.8+18.4+9.1	6.8
2	Ranidanga	26	41	3.4	88	21	54.1	No	Slab	14.0	2 x 7	5.9
3		26	39	58.4	88	22	11.2	No	Slab	6.1	1x6.1	5.6
4		26	39	34.6	88	22	10.4	Yes	Slab	8.9	1x 8.9	5.9
5	Teesta Canal	26	38	37.4	88	22	16.4	Yes	Slab	64.4	7 x 9.2	7.5
6	Mahananda	26	38	42.4	88	24	2.2	Yes	PSC T Beam	205.0	10 x 20.5	7.5

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Appendix 4.1 : Bridge Inventory – Bhutan Bangladesh Road

Serial No.	Name of River/Nala	Section	Latitude			Longitude			Water Flow	Bridge type	Length (m)	Span Arrangement	Carriageway Width (m)
			Deg	Min	Sec	Deg	Min	Sec					
1	NA	*Jaigaon - Hasimara*	26	51	6	89	22	56	Yes	3 cell Box	21.0	3x7	7.8
2	NA		26	50	46	89	22	60	Yes	1 cell Box	8.1	1x8.1	6.2
3	NA		26	50	37	89	23	8	Yes	Slab	8.1	1x8.1	6.2
4	NA		26	40	2	89	22	32	No	Slab	28.1	8.6+10.9+8.6	7.5
5	NA		26	43	38	89	21	17	Yes	Slab	8.1	1x8.1	6.0
6	NA	*Hasimara - Birpara*	26	43	41	89	19	52	Yes	RCC T beam	55.5	3x18.5	7.5
7	Torsa		26	43	44	89	19	33	Yes	PSC T-beam	430.0	10 x 43	7.3
8	Halong		26	43	46	89	17	52	Yes	Slab& PSC	30.9	9.7+31.5+9.7	7.3
9	NA		26	41	29	89	16	29	Yes	Slab	7.2	1x7.2	7.0
10	NA		26	41	19	89	14	32	Yes	Slab	8.8	1x8.8	7.0
11	Majhua		26	40	55	89	12	60	Yes	RCC T beam	62.5	21.6+19.3+21.6	7.3
12	Daldati		26	41	1	89	12	31	Yes	RCC T beam	55.3	18.1+18.3+18.9	7.5
13	Ekti		26	41	5	89	11	57	Yes	RCC T beam	80.0	4x20	7.4
14	Kurjee		26	41	24	89	10	47	Yes	Slab	30.0	3x10	7.3
15	Birpara Zora		26	42	3	89	9	42	Yes	RCC T beam	60.0	3x20	7.4
16	Birpara		26	42	14	89	8	39	Yes	Slab/skew 10deg	30.3	10.2+9.9+10.2	7.4
17	NA	*Birpara - Telipara*	26	42	15	89	7	45	Yes	RCC T beam	55.8	3x18.6	7.6
18	NA		26	42	17	89	6	37	Yes	Slab	8.0	1x8	7.0
19	Dimdima		26	42	16	89	5	54	Yes	RCC T beam	146.4	24+4x24.6+24	7.5
20	Kalua		26	42	23	89	3	55	Yes	RCC T beam	83.8	20.6+21.6+20.4+21.2	7.5
21	Kathajhora	*Telipara - Dhupguri*	26	42	17	89	3	13	Yes	Slab	9.7	1x9.7	7.5
22	Angrabhasa		26	42	1	89	1	41	Yes	Slab	20.4	2x10.2	7.1
23	Angrayasj		26	40	12	89	1	42	Yes	RCC T beam	26.8	2x 13.4	-
24	Dudua		26	39	30	89	1	42	Yes	Slab + T-beam	121.4	10.7+5x20+10.7	7.3
25	NA		26	38	39	89	1	39	Yes	RCC T beam	15.5	1x15.5	10.0
26	Madhka		26	38	25	89	1	41	Yes	RCC T beam	26.6	2x13.3	7.3
27	Deomali		26	38	0	89	1	41	Yes	Slab	10.2	1x10.2	7.4
28	Kasra		26	37	51	89	1	30	Yes	Slab	10.2	1x10.2	7.4
29	Thakurpat		26	37	25	89	1	1	Yes	Slab	10.0	1x10	7.4
30	Gilandi		26	37	3	89	0	38	Yes	Slab + T-beam	39.0	9.8+20+9.2	7.5
31	Bamni		26	35	60	89	0	29	Yes	Slab	30.6	10.3+10+10.3	7.2
32	Kumlai	*Dhupguri - Mainaguri*	26	35	16	89	0	20	Yes	RCC T beam	38.6	13.2+12.2+13.2	7.3
33	Kalijhora		26	34	60	89	0	8	Yes	Slab	7.1	1x7.1	8.0
34	Balasi		26	34	53	88	59	52	Yes	Slab	30.0	3x10	7.2
35	NA		26	34	33	88	58	53	No	ROB, Plate girder, Skew 45deg	13.0	1x13	7.5
36	Jhumar		26	34	36	88	58	10	Yes	RCC T beam	38.5	13.2+12.1+13.2	7.4
37	Jaldhaka		26	34	18	88	56	27	Yes	PSC Trapezoidal T-beam	420.2	11x38.2	7.5
38	Dharaikari		26	33	49	88	55	32	No	PSC T-beam	91.2	3x30.4	7.5
39	Husuldanga		26	33	29	88	54	54	Yes	Slab	7.2	1x7.2	7.3
40	Churabhandar		26	33	31	88	54	8	Yes	RCC T beam	26.6	2x13.2	7.3
41	Jhajhangi		26	33	40	88	53	32	Yes	RCC T beam	36.0	3x12	7.3
42	Halhali		26	33	44	88	52	27	Yes	RCC T beam	36.0	3x12	7.3
43	NA		26	33	53	88	50	27	Yes	Slab	17.2	2x8.6	7.5
44	Jarda		26	33	23	88	49	44	Yes	Slab + T-beam, Skew 20deg	80.0	10+3x20+10	7.3
45	NA	*Mainaguri - Changrabandha*	26	30	58	88	50	33	Yes	Slab	24.0	3x8	7.6
46	Dhallaberi		26	30	3	88	50	31	Yes	RCC T beam	64.2	3x21.4	7.5
47	NA		26	27	47	88	52	39	Yes	3 cell Box	40.0	8x5	7.5

Appendix 4.2: Ambient Air Quality and Noise Level Sampling Methodology

I. Sampling Methodology for PM2.5

A. Instrument Used

1. The Envirotech APM 550 instrument was used for sampling fine particles (PM2.5 fraction) which is based on impactor designs standardized by USEPA for ambient air quality monitoring.

2. Ambient air enters the APM 550 system through an omni-directional inlet designed to provide a clean aerodynamic cut-point for particles greater than 10 microns. Particles in the air stream finer than 10 microns proceed to a second impactor that has an aerodynamic cut point at 2.5 microns. The air sample and fine particulates exiting from the PM2.5 impactor is passed through a 47mm diameter Teflon filter membrane that retains the FPM. The instrument allows removal of the PM2.5 impactor from the sample stream so that the same system may be optionally used as a PM10 Sampler.

B. Principle

3. Air is drawn through a size selective inlet & through a filter. Particulates with diameter less than 2.5µm in ambient air are collected by the filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of PM 2.5 in the designated size range is calculated by dividing the weight gain of the filter by the volume of air sampled.

C. Procedure

4. After sampling place the exposed filters in controlled temperature & relative humidity environment (15°C to 27°C) for 24 hours prior to weighing & then takes the wt. on balance. Record it as the final wt. of filter.

D. Calculations

5. Calculation of volume of air sampled

$V = QT$

V = Volume of air sampled in m^3

Q = Average flow rate in m^3/minute

T = Total sampling time in minute

E. Calculation of PM 2.5 in Ambient air

$$PM\ 2.5 = \frac{(W_r - W_i) \times 10^6}{V}$$

Where:

PM 2.5 = Mass concentration of particulate matter less than 10 micron diameter in µg/m^3

W_i = Initial wt. of filter in g

W_f = Final wt. of filter in g
V = Volume of air sampled in m^3
10^6 = Conversion of g to µg

II. Sampling Methodology for SPM, RSPM, SO_2 and NO_X

A. Instrument Used

6. Air quality monitoring was undertaken using Respirable Dust Samplers (Envirotech Model APM 460) with thermoelectrically cooled impinger attachment for gaseous sampling. The APM 460 sampler uses an improved cyclone with sharper cut-off (D50 at 10 microns) to separate the coarser particulates from the air stream before filtering it on the glass microfiber filter. By using the APM 460, measurement of Respirable Particulate Matter can be done accurately and TSPM can also be assessed by collection of dust retained in the cyclone cup.

B. Principle

7. SPM and RSPM – Gravimetric Method using Respirable Dust Sampler
SO_2 – Absorption in dilute NaOH and then estimated calorimetrically with sulphanilamide and N (l-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (Central Pollution Control Board (CPCB) Method).
NO_X – Absorption in Potassium Tetra Chloromercurate followed by Chlorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS: 5182 Part - II).

C. Procedure

8. 24-hourly ambient air samples were collected for SPM, RSPM, SO_2 and NO_X. These samplers were operated at an average flow rate of 1.1 – 1.2 m^3/min. as per IS: 5182 Part II for sampling/collection of SPM and RSPM levels. The particulate matter is collected through high efficiency cyclone which retains the dust particles greater than 10 micron size and allow only fines (less than 10 micron particles) to reach the glass micro-fibre filter where these particles are retained. The instrument provides instantaneous flow rate and the period of operation (on-time) for calculation of air volume passed through the filter. Amount of particulates collected is determined by measuring the change in weight of the cyclone cup and filter paper. The passage of air entering in the cyclone is designed to prevent heavier settleable particles from reaching in the cyclone.

9. For SO_2, NO_X, ambient air samples were collected using above sampler with impinger attachment provided with specific absorbing solutions, which were operated at an average flow rate of 0.2-0.51 lit./min. as per IS: 5182, Parts IV & VI.

10. The impinger samples (containing SO_2, NO_X in specific absorbing solutions) were analyzed spectro-photometrically using UV-VIS Shimadzu Spectrophotometer (UV-265). The samples were tested as per standard methods prescribed by CPCB.

III. Methodology for Sound Monitoring

A. Instrument Used

11. Ambient Sound levels were measured using an Integrating sound level meter manufactured by Cygnet (Model No. 2031). It has an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in "A" weighting set the sound level meter was run for one hour time and Leq was measured at all locations.

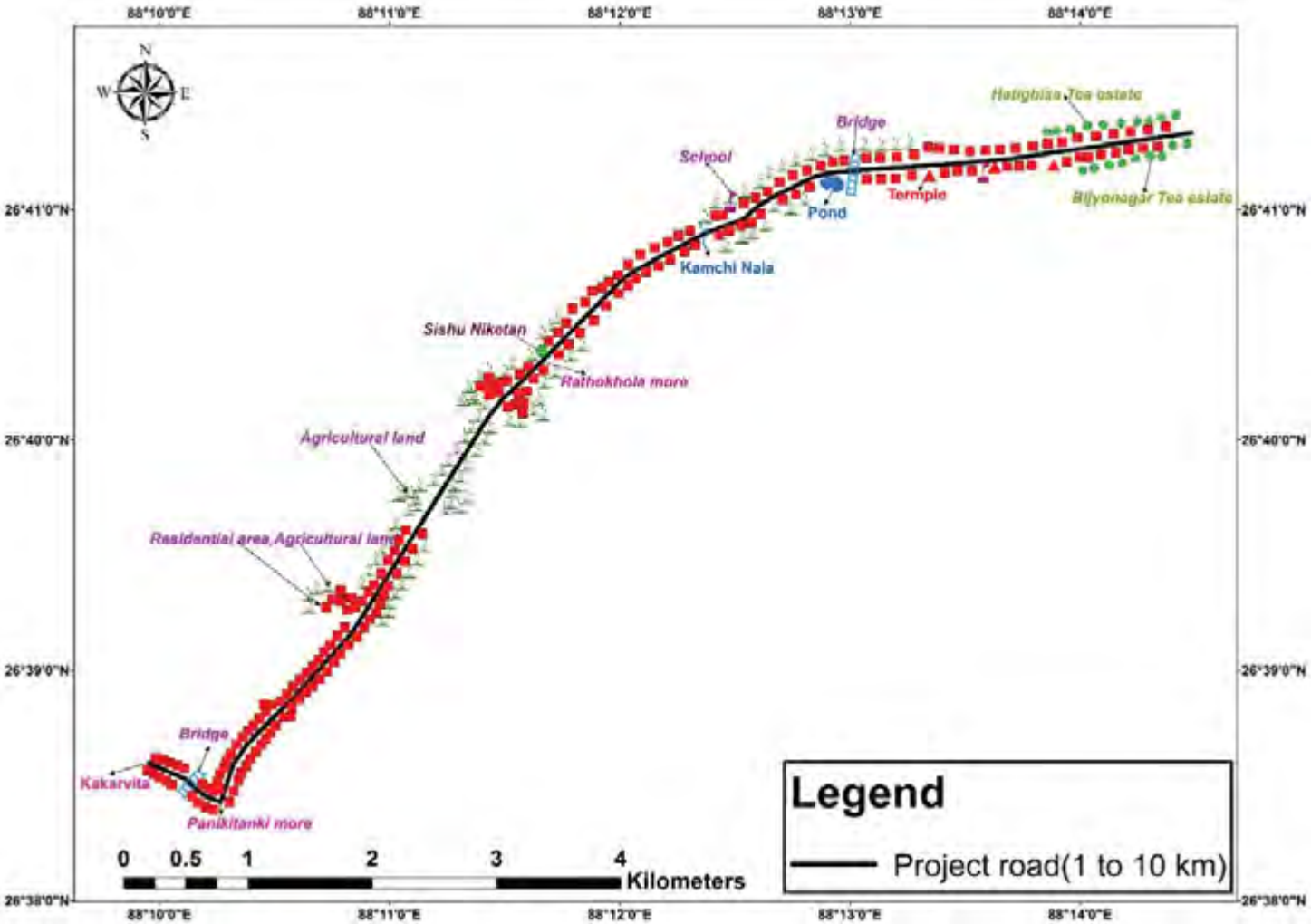
B. Principle

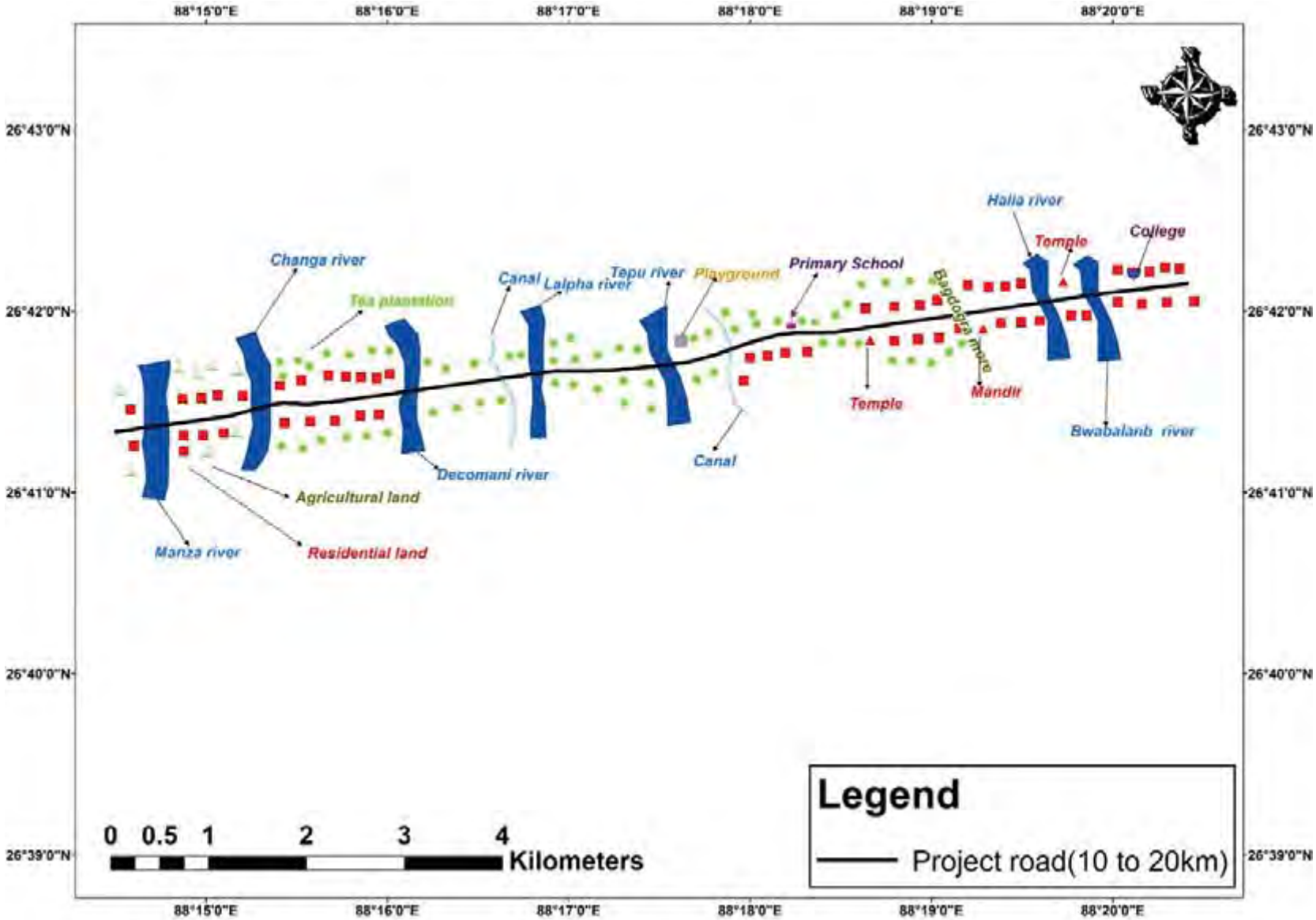
12. The intensity of sound energy in the environment is measured in a logarithmic scale and is expressed in a decibel, dB (A) scale. Ordinary sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB(A). In a sophisticated type of sound level meter, an additional circuit (filters) is provided, which modifies the received signal in such a way that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB (A). The sound levels are expressed in dB (A) scale for the purpose of comparison of noise levels, which is universally accepted by the international community.

C. Procedure

13. The day noise levels have been monitored during 6.00am to 10.00pm and night noise levels, during 10.00 pm to 6.00 am in the study area.

Appendix 5.1 : Strip Maps and Alignment Features (AH-2)

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26°39'0"N
Changa river
Tea plantation
Canal
Lalpha river
Tepu river
Playground
Primary School
Bagdogra more
Halia river
Temple
College
Temple
Mandir
Bwabalanb river
Canal
Decomani river
Agricultural land
Manza river
Residential land
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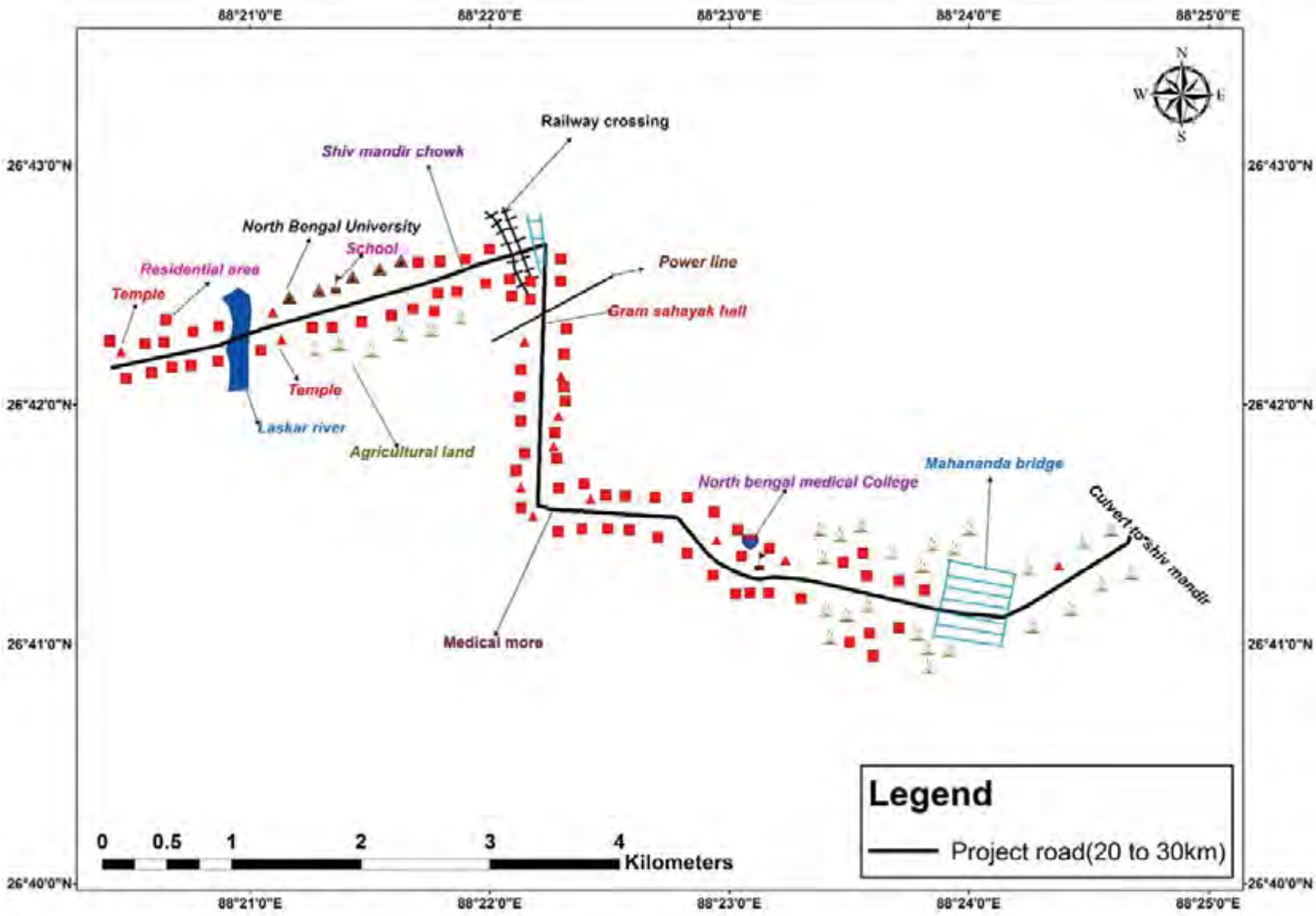
Kilometers
Legend
Project road(10 to 20km)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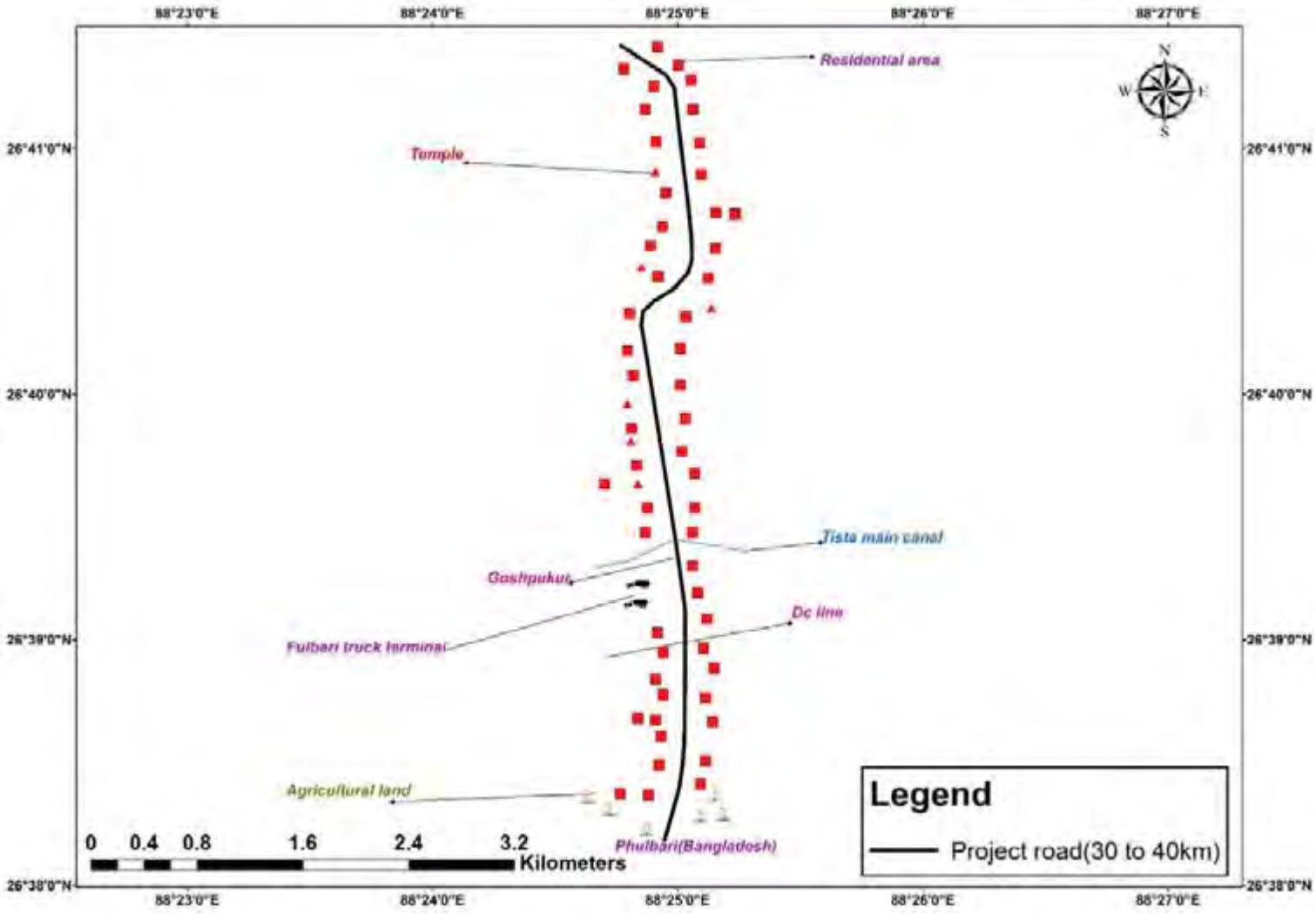
26°41'0"N
26°40'0"N
N
S
W
E
Railway crossing
Shiv mandir chowk
North Bengal University
School
Residential area
Temple
Power line
Gram sahayak hall
Temple
Laskar river
Agricultural land
Mahananda bridge
North bengal medical College
Culvert to shiv mandir
Medical more
0 0.5 1 2 3 4
Kilometers
Legend
Project road(20 to 30km)


88°23'0"E
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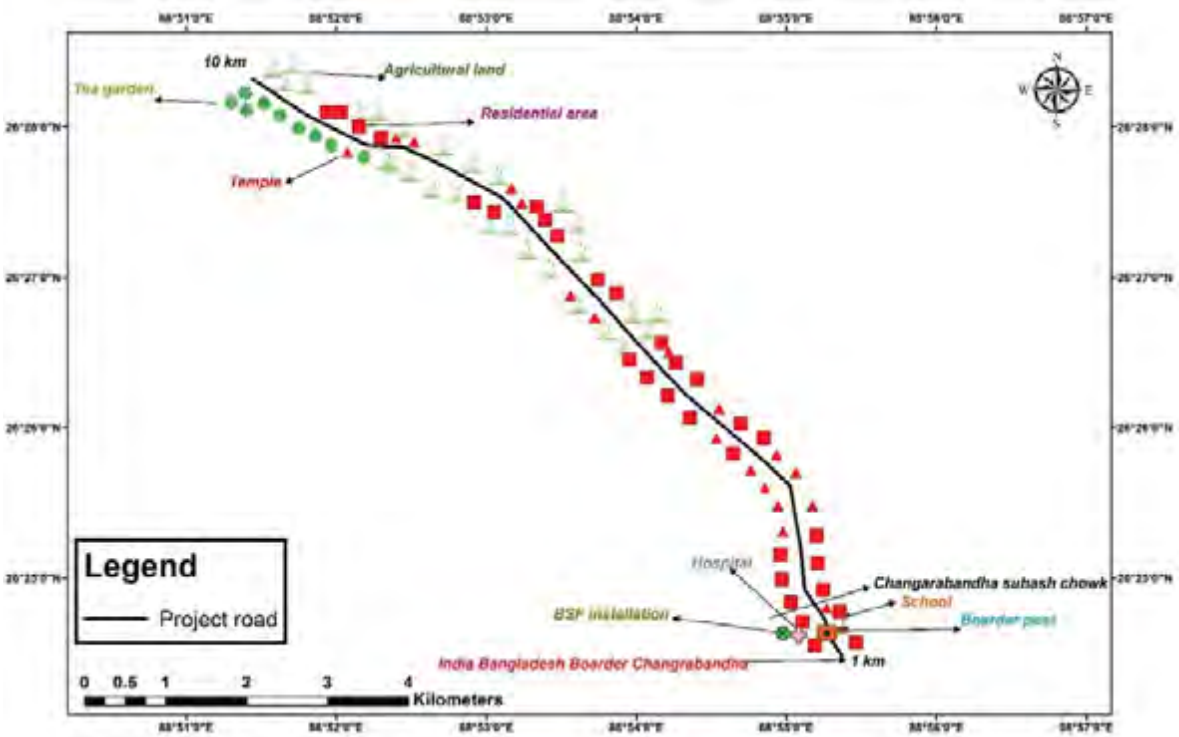
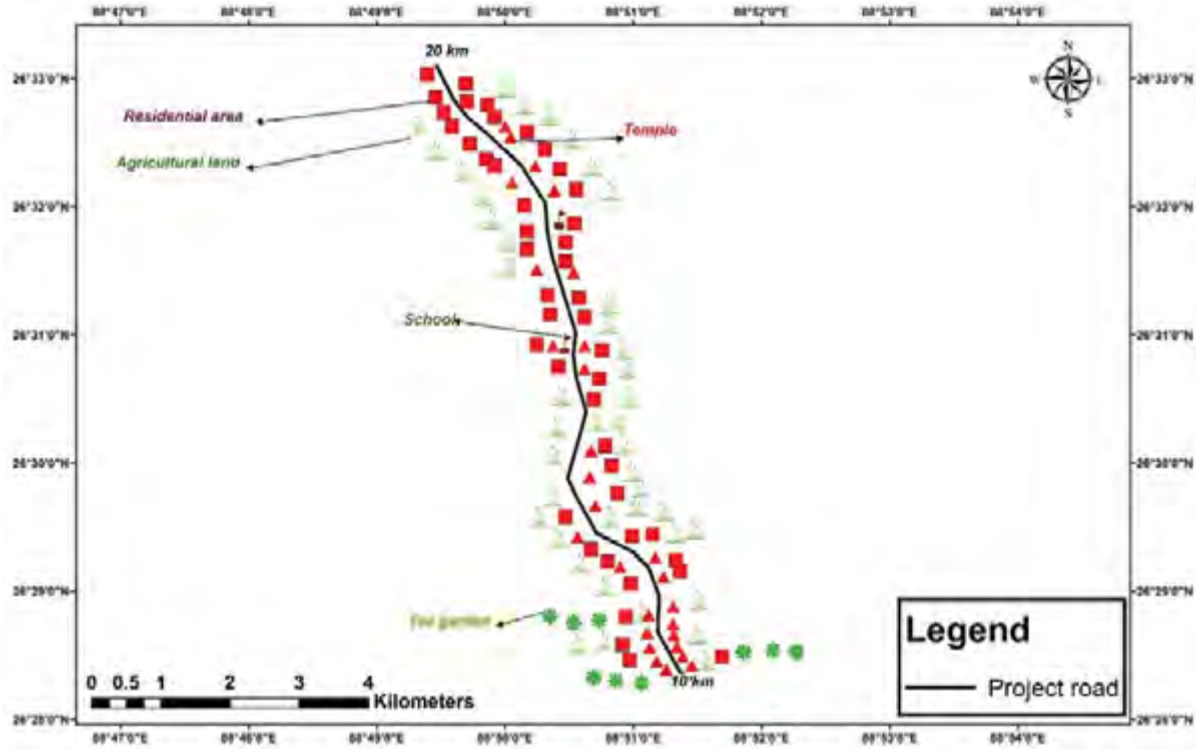
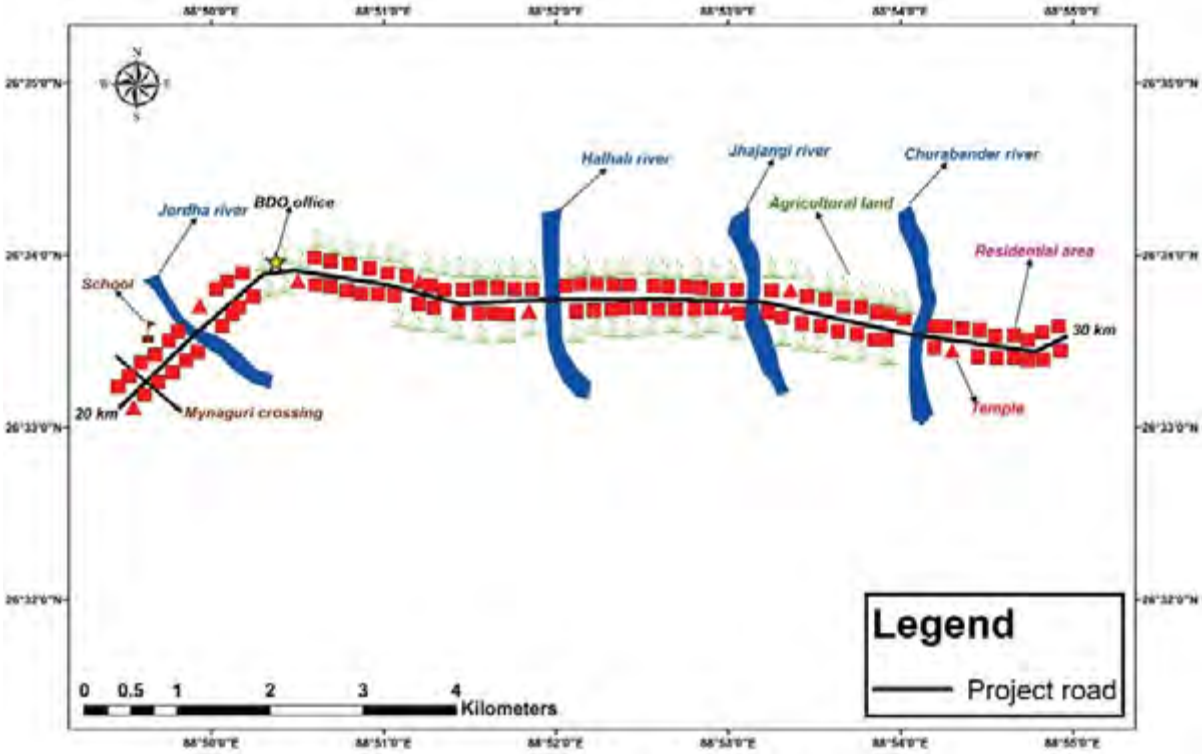
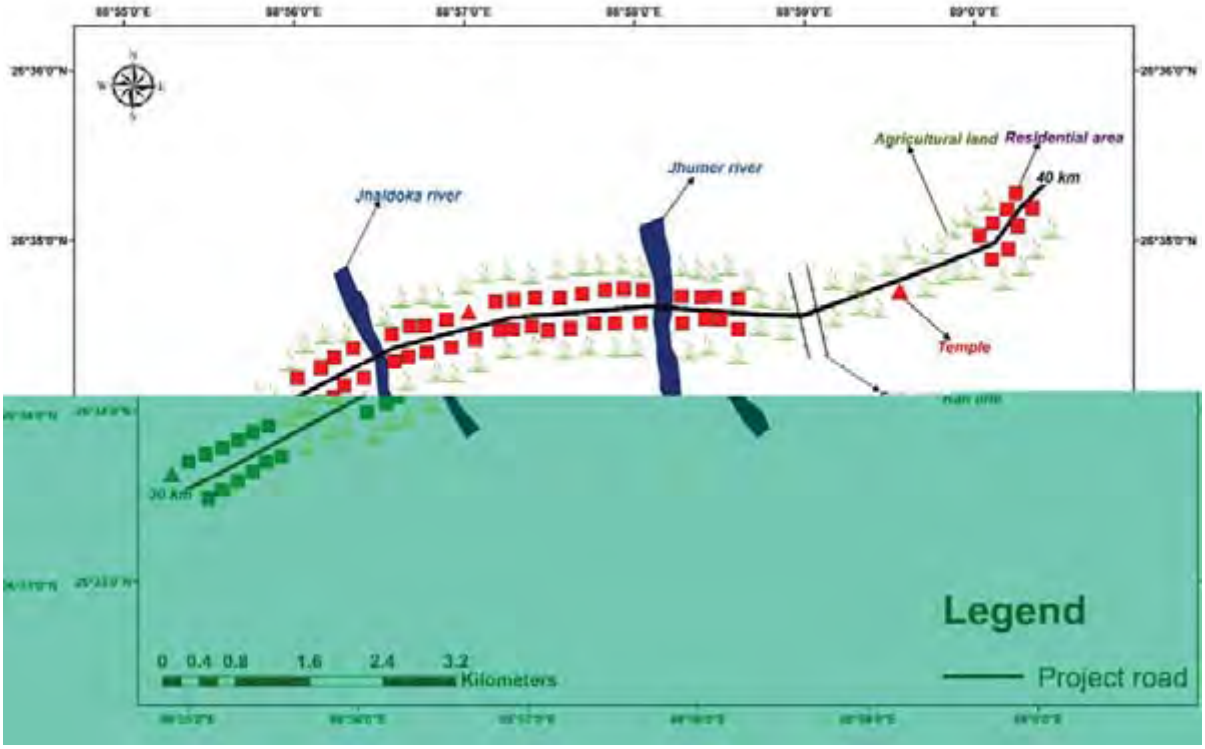
88°27'0"E
26°41'0"N
26°40'0"N
26°39'0"N
26°38'0"N
Residential area
Temple
Tista main canal
Goshpukur
Dc line
Fulbari truck terminal
Agricultural land
Phulbari(Bangladesh)
N
S
W
E
0 0.4 0.8 1.6 2.4 3.2
Kilometers
Legend
Project road(30 to 40km)

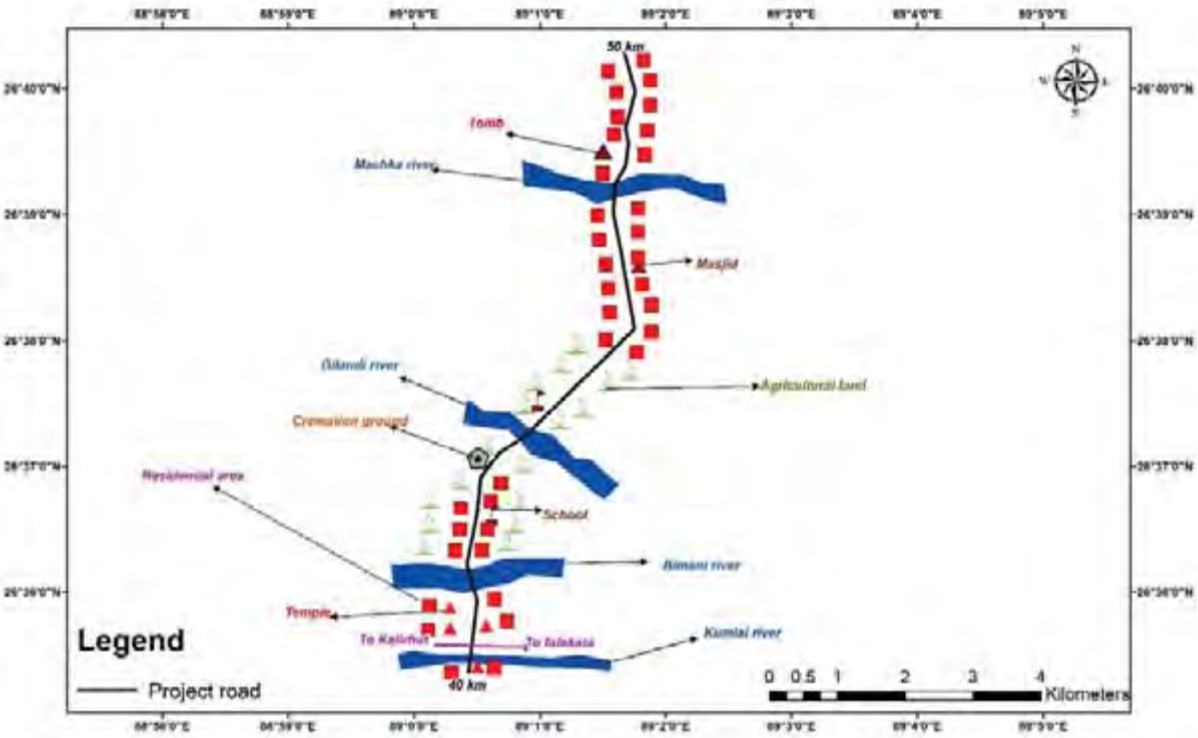
Appendix 6.1: Strip Maps and Alignment Features (AH-48)

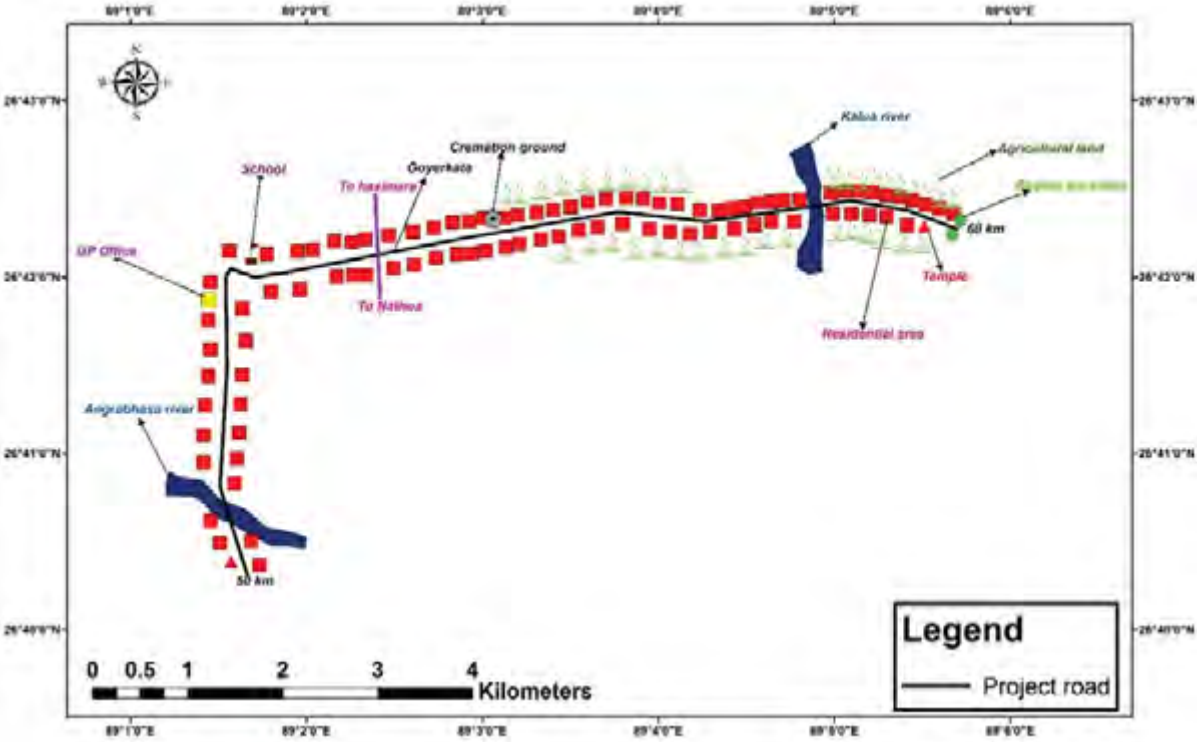


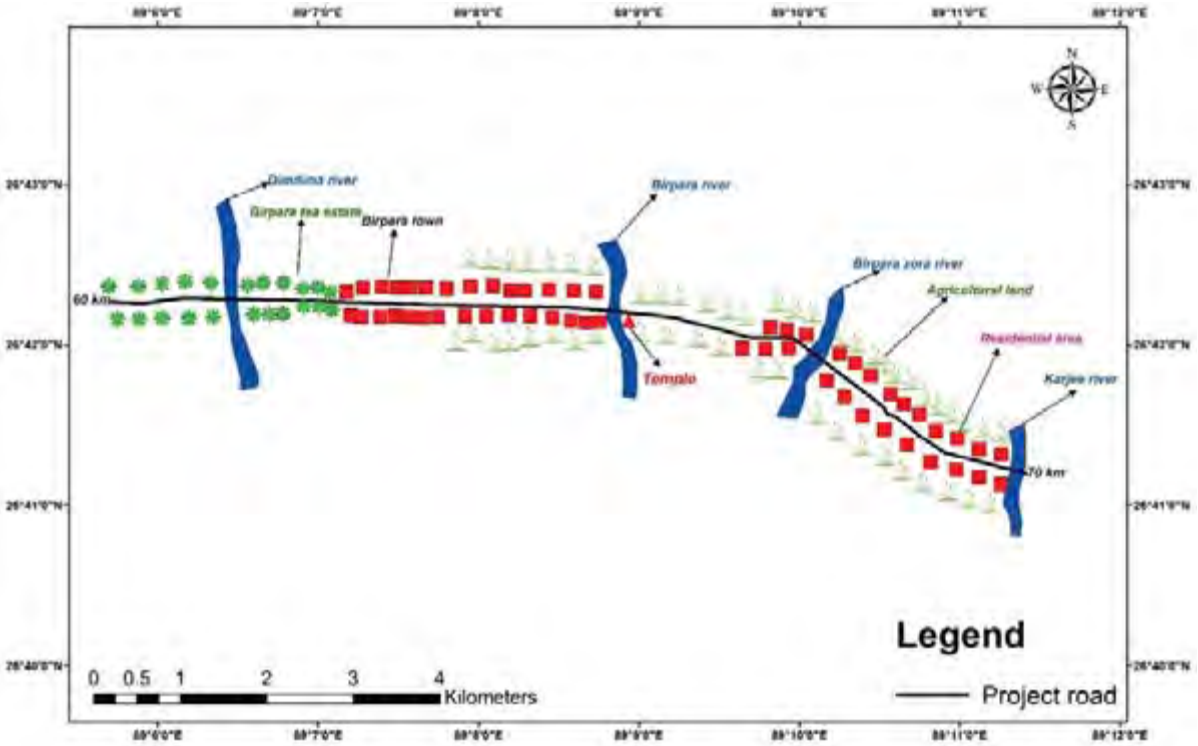


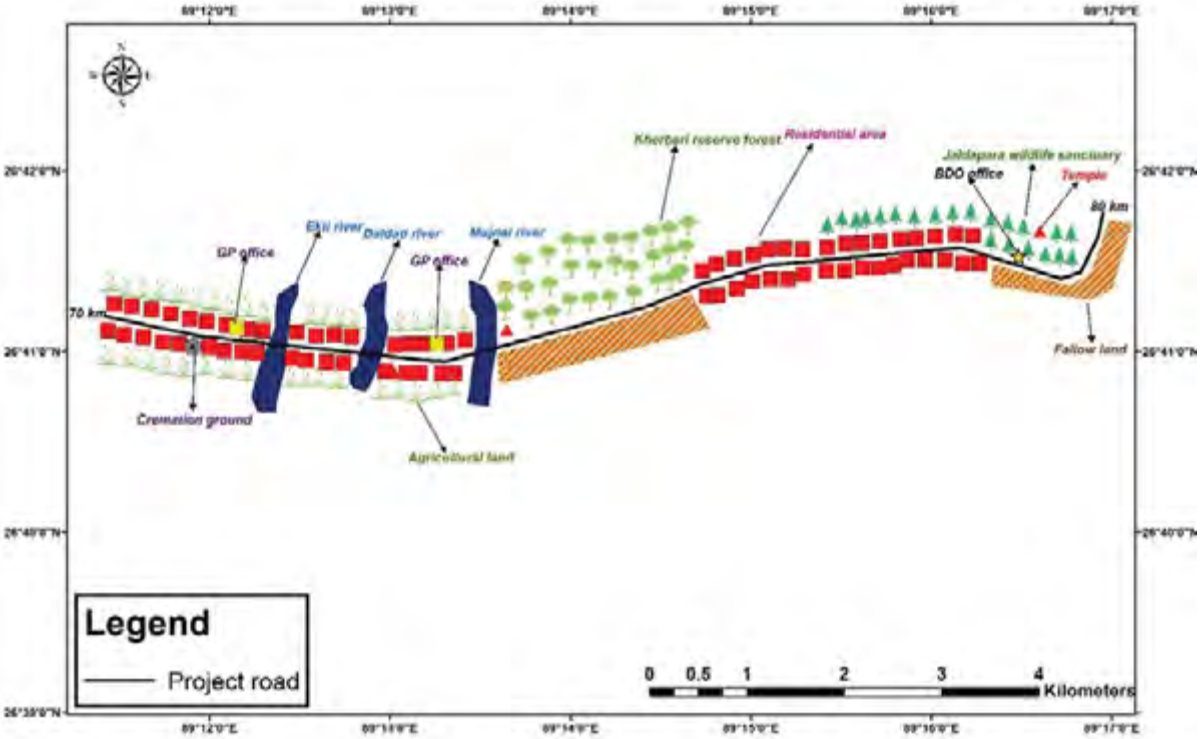

Jordha river
BDO office
School
20 km
Mynaguri crossing
Halhali river
Jhajangi river
Agricultural land
Churabander river
Residential area
30 km
Temple
Legend
Project road
0 0.5 1 2 3 4
Kilometers

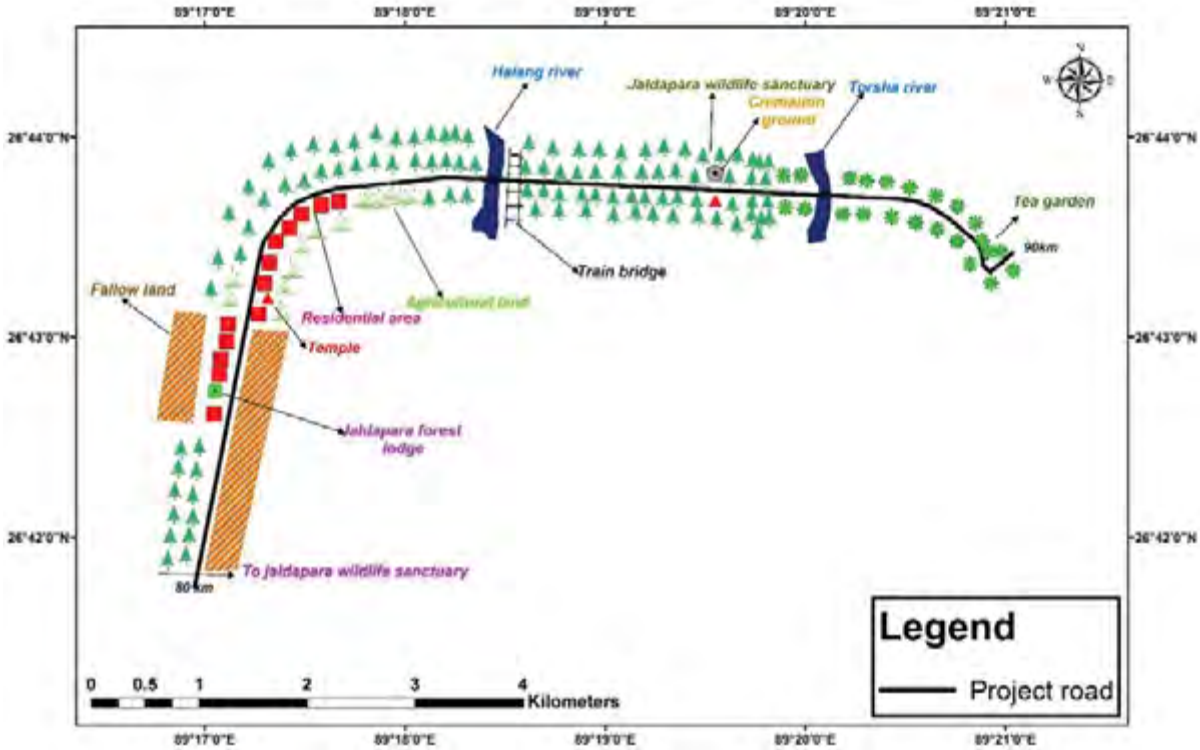

Jhaldoka river
Jhumer river
Agricultural land
Residential area
40 km
Temple
30 km
Legend
Project road
0 0.4 0.8 1.6 2.4 3.2
Kilometers

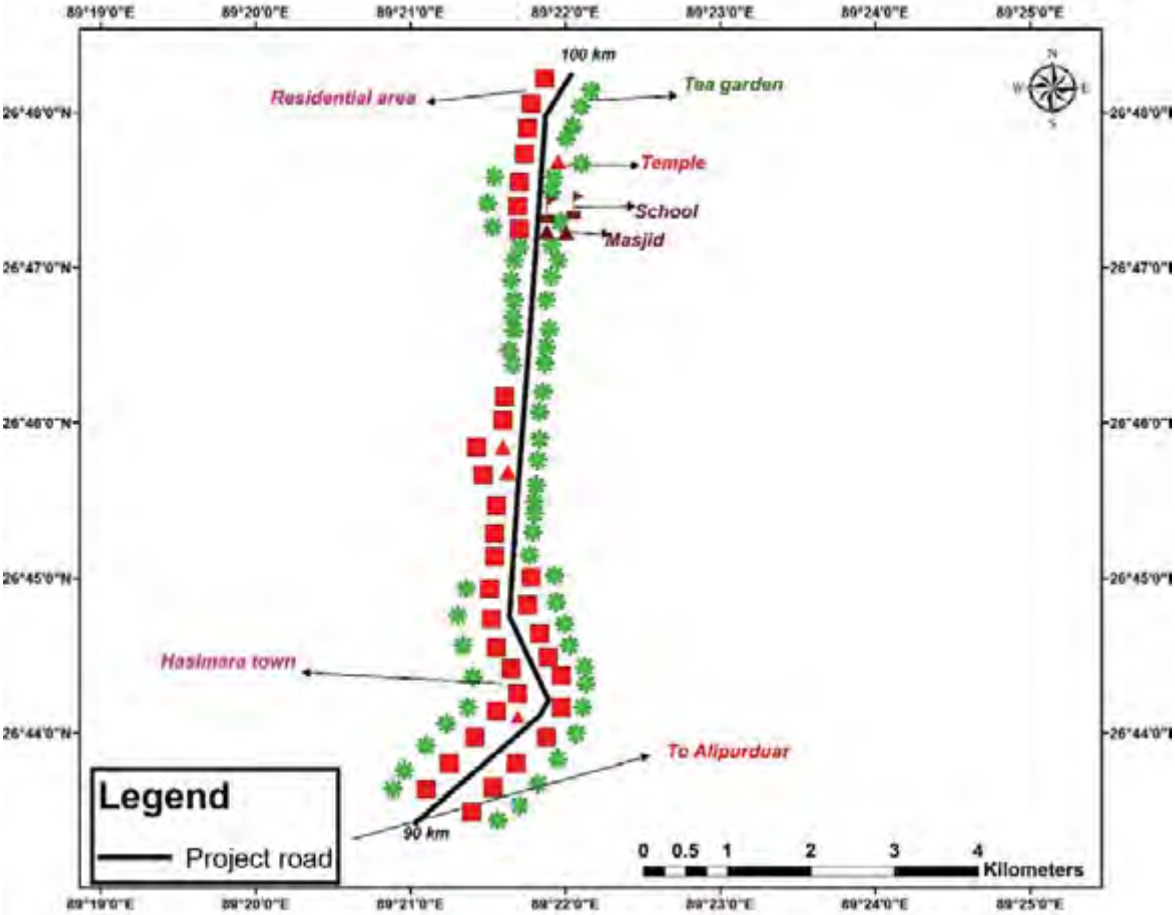

50 km
Tomb
Mashka river
Masjid
Gilandi river
Agricultural land
Cremation ground
Residential area
School
Bimani river
Temple
To Kalimur
To Islakata
Kumlai river
40 km
Legend
Project road
0 0.5 1 2 3 4
Kilometers

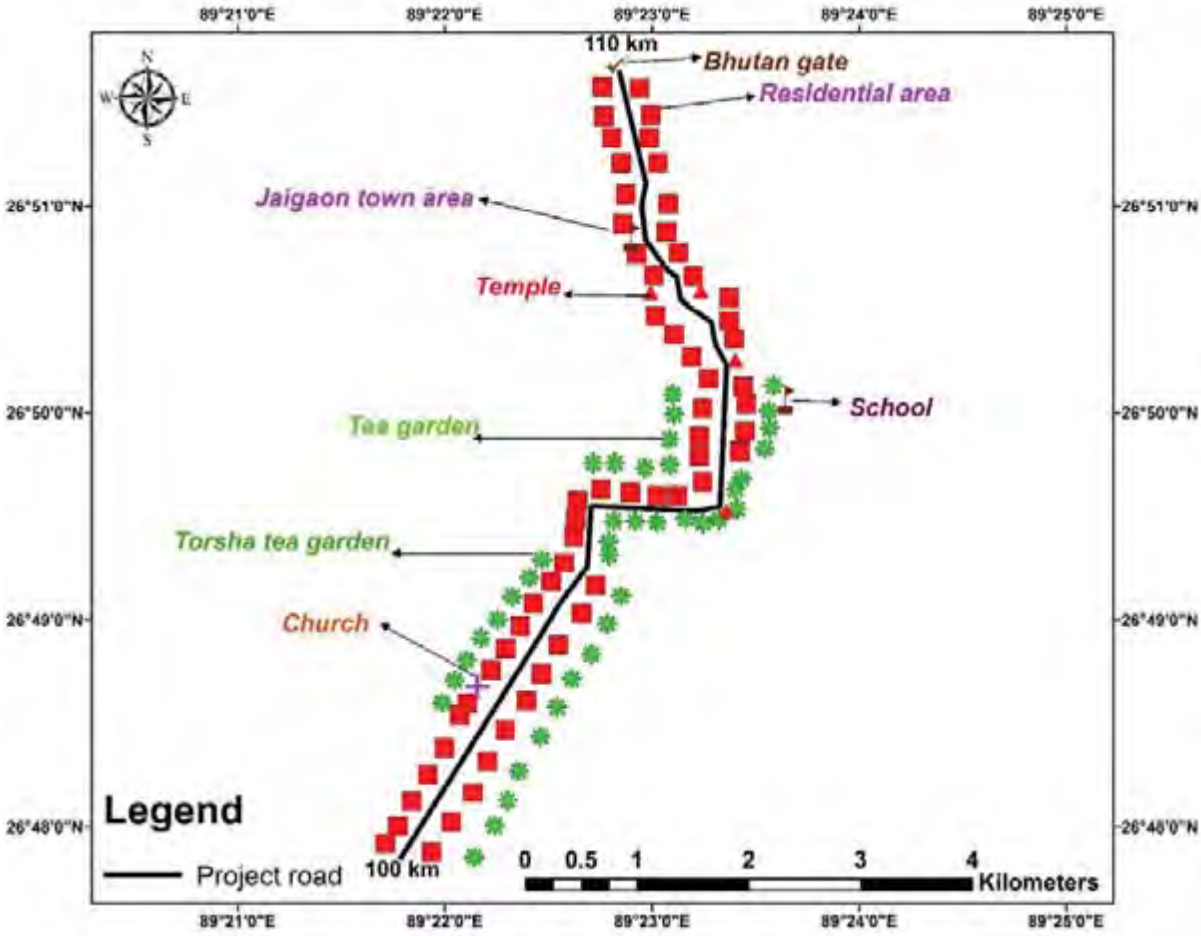

Kalua river
Agricultural land
Cremation ground
Goyerkata
School
To Haximara
UP Office
To Nalhua
60 km
Temple
Residential area
Angrabhasa river
50 km
Legend
Project road
0 0.5 1 2 3 4
Kilometers


Dimdima river
Birpara tea estate
Birpara town
Birpara river
Birpara zora river
Agricultural land
Residential area
Karjee river
Temple
60 km
70 km
Legend
Project road
0 0.5 1 2 3 4
Kilometers


Kherbari reserve forest
Residential area
Jaldapara wildlife sanctuary
BDO office
Temple
80 km
Ekli river
Daldad river
Mujnai river
GP office
GP office
70 km
Cremation ground
Agricultural land
Fallow land
Legend
Project road
0 0.5 1 2 3 4
Kilometers


Halang river
Jaldapara wildlife sanctuary
Cremation ground
Torsha river
Tea garden
90km
Train bridge
Fallow land
Agricultural land
Residential area
Temple
Jaldapara forest lodge
To jaldapara wildlife sanctuary
80 km
Legend
Project road
0 0.5 1 2 3 4 Kilometers


100 km
Residential area
Tea garden
Temple
School
Masjid
Hasimara town
To Alipurduar
90 km
Legend
Project road
0 0.5 1 2 3 4 Kilometers


89°21'0"E
89°22'0"E
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89°25'0"E
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26°50'0"N
26°49'0"N
26°48'0"N
N
S
E
W
110 km
Bhutan gate
Residential area
Jaigaon town area
Temple
School
Tea garden
Torsha tea garden
Church
100 km
Legend
Project road
0 0.5 1 2 3 4
Kilometers

Appendix 7.1: Environmental Management Plan (BEING REPLACED)

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
A. Design and Pre - Construction Stage						
1. Design Considerations						
Legislative approvals	Considering the proposed project activities the following legislative approvals shall be required in advance: **1.** Obtain Environmental Clarence for both the roads under EIA notification 2006. Prior to Start of construction 2. Obtain Forests Clearance for diversion of about 5 Ha of reserved forests land 3. Obtain Permission under Wild Life Protection Act the project and for the diversion of National Park Land for construction of underpass for the movement of elephant.- in AH-48 4. Obtain permission from forest as applicable for cutting of trees 5. Obtain concurrence from Gram Panchyats for shifting or demolition of community structure 6. Obtain permission from concerned authorities for shifting of utilities (like electric pole, telephone lines, hand pumps, water pipelines) 7. Obtain connect to establish Hot Mix plant, batching plant, quarry operation if new quarry to be opened, and setting up construction	Legislative requirements	Ah-2 and AH-48 Road project and	Part of Design costs	Design Consultant/ SEMU	PMU
Utility Relocation	Utilities relocation will be reasonably completed before construction starts and without affecting any essential supplies to habitat like water supply.	Design requirement	As per widening plan	Included in construction cost	Design Consultant	PMU
Shifting of Community Structure	Community structures, like, religious structures will be shifted appropriately, as required.	Design requirement	As per widening plan	Included in construction cost	Design Consultant	PMU
Climate Change and Removal of trees	Approximately 12500 trees may need to be cut within proposed ROW for up-gradation of the project road and bypasses before the commencement of construction with prior Clarence from the	Local Forest Rule	Within RoW or on Govt. /Panchayat Land	Rs 187.5 Mn (@ Rs 5000 per tree for 37,500 trees with three	Through Forest Department/Village Panchayats	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	Forest Department/District Authorities as applicable. Compensatory afforestation: 3 trees will be planted for each tree felled as per regulatory compliance. Geometric adjustment to reduce tree cutting.			years of maintenance)		
	Additional Tree plantation for climate change consideration of 1:5 basis considering woody trees of 34%	Local Forests Rule and Climate Change Considerations	-do-	Rs 42.5 Mn (@ Rs 5000 per tree for 8500 tree with three years of maintenance)	Through Forest Department/Village Panchayats	PMU
	Diversion of Forests Land for Non Forestry Purposes	Forests (Conservation) Act	Khairbari reserved Forests and Jaldapara National Park	12.8 Ha + NPV (16 Ha @Rs 8,00,000 per ha + Net present Value to be estimated by forests department on actual site assessment	SEMU/Design Consultant	EA/PMU
Ecology- Fauna	Some portion of AH-48 road passes through Jaldapara National Park and Elephant movement path. Provision of three underpasses is made to allow safe passage of the animal Elephant also crosses AH_2 road near Kiran Chand Tea Estate.and Near Hasimara and Pasakah a locations. Adequate signage would be fixed in the Elephant movement areas of AH-2 and AH-48.	Wild Life Protection Act -do-	Jaldapara National Park, Near Kiran Chand Tea estate of AH-2 and Near Hasimara and Pasahka bypass area.	Part of Design costs	SEMU/Contractor	Supervision Consultant/PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
Ecology Aquatic	Siltation of Water bodies may affect aquatic fauna of the river. No construction camp or material storage site shall be selected close to water bodies. Provision shall be made to release fish fries and fingerlings in perennial rivers to enhance local fishery with the help of fishery department as an enhancement measures Development fisheries and tree nurseries	-	Construction CAMP sites and close to river	Rs 8 Mn (Rs 5 Mn for Nurseries and Rs 3 Mn for fisheries)	Contractor/Supervision Consultant/SEMU	PMU/SEMU
Land Use and Land Cover	Land use may partially change at the borrow areas but the same will be done as per the agreement with land owner Identification of Borrow Areas shall be done before start of construction. Borrow earth shall be sourced as per this plan.	-	Through the Project Roads	Part of Construction costs.	Contractor	Supervision consultant/ SEMU//PMU
Land Acquisition and R & R	12 Ha (9 Ha government land and 3 ha private land) for AH-2 and 55 Ha (35 HA government land and 20 Ha private land) is required for the project About 120 PAH, 95 structures completely and 44 structures partially are likely to be affected in AH-02. Similarly about 310 PAH and 250 structures completely and 145 structures partially are likely to be affected in AH-48. Adequate provision for compensation as per	Land compensation Act 1898, National Highway Act 1956 and National R & R policy 2007 and ADB SPS09 provisions	As per Design requirement ,particularly at by Passes	Part of Land Acquisition and R & R costs	SEMU	SEMU/PMU
Social and Safety	Adequate provision shall be made in project design for safety near schools, hospitals and other sensitive locations. Provision of adequate caution signage near school, sensitive locations, shall be fixed at appropriate locations. These shall be preferably of PCC with Retro-reflective paints. Steel base signage shall be avoided to prevent theft of the same. Crash barrier shall also be installed at appropriate locations particularly near school to provide safety to school children. Provision of speed breakers shall also be made near schools and	-IRC Guidelines on Road Safety.	Sensitive locations, like school	Part of Design and construction costs.	Design Consultant,/ SEPMU/Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	religious places.					
Air Quality and Noise Pollution	No new Quarry is to be opened. All material to be transported under covered lorry. The increased traffic may increase Ambient Noise level of upto 2 dB(A) at 2025 predicted traffic level. Provision of noise barrier is made for those locations which may experience higher traffic noise level.	Design requirement	Sensitive receptor locations requiring noise barrier	Included in construction costs Rs 1.2 Mn Provision of 10 barrier in each road @ Rs 2000 per square meter for av 60 square meter per barrier	Design Consultant/Contractor	SEMU/Supervision consultant and PMU
Water Resources, Hydrology and Drainage, inadequate drainage provision in habitat area	Water flow should not be stopped fully. Continues flow of the water in a channel with a pond and puddle upstream (about 50 m) shall be maintained for aquatic flora and fauna. Elaborate drainage system shall be provided to drain the storm water from the roadway and embankment and to ensure minimum disturbance to natural drainage of surface and subsurface water of the area. Selection of widening option (left aligned, right aligned or centric widening) to be decided based on the least cutting of tree, minimum loss of structure and embankment design considerations. Raise road level as feasible, above the nearby areas with provision of adequate side drains to evacuate the rain water and domestic discharges (drained by habitats occasionally) to prevent damage to road and rain water entry to habitats' houses. Raise Road level in flood prone area of the road.	Design requirement	All habitat areas throughout the alignment	Included in construction cost	Design Consultant	PMU
Safety along the proposed alignment	Adequate safety provisions like crash barriers at accident prone areas, rumble strips in habitat areas to regulate speed,	Design requirement	Crash barriers are proposed at sensitive	Included in construction cost	Design Consultant	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	retro-reflective warning sign boards nears school, hospital, religious places (Preferably PCC boards with retro-reflective paints to avoid its theft) shall be made.		locations like school, medical centers, along the project corridor Rumble strips are proposed at the all the settlements and crossing points			
2. Natural Hazards						
Protection from damage from Earthquake	Adoption of relevant IS codes for design embankment/structures suitable to withstand earthquake of highest magnitude in high Damage risk zone Iv (Seismic Zone II level as per Indian classification).	IRC:34 Recommendations for road construction in waterlogged area and IRC: 75 and MoRSTH guidelines for Design of High Embankments	Throughout the stretch especially bridge structures	Project preparation and construction costs Cost	Design Consultant	PMU
B. Construction Stage						
3. Climate and Air Quality						
Local Weather conditions	Additional Plantation on river banks, borrow areas and sensitive locations to increase the green cover and improve the aesthetics	Kyoto Protocol, Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981 + IRC and MORSTH Specifications for Road and Bridge works Air (Prevention and Control of Pollution) Act 1974 and Central	Throughout project corridor, mainly at haulage roads, earthwork, construction sites, loading areas, storage areas, transport route.	Road Side Plantations in the ratio of 1:3	Design Consultant and Contractor	PMU
Poor air quality due to compromise in design	Road design and Pavement roughness as per IRC specifications. congestion free movement of traffic with provision of junctions improvement at major intersections			Included in construction costs	Design Consultant and Contractor	PMU
Dust Generation due to construction activities and transport, storage and handling of construction materials	Transport, of loose and fine materials through covered vehicles and paved roads to the extent feasible. Loading and unloading of construction materials shall be made at designated locations in project area with provisions of					CSC / PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	water fogging around these locations Storage areas to be located downwind of the habitation area. Water spraying on earthworks, unpaved haulage roads and other dust prone areas. Provision of PPEs to workers.	Motor and Vehicle Act 1988				
Emission from vehicle, equipment and machinery	Regular maintenance of machinery and equipment. Hot Mix Plant shall be located at least 1 km downwind of the human settlement. Batching plants and crushers at downwind (0.5km) direction from the nearest settlement. Hot mix plant to be fitted with adequate stack height. Obtain consent to establish (NOC) from PCB before setting up these plants. Only crushers licensed by the PCB shall be used DG sets with stacks of adequate height and use of low sulphur diesel as fuel. Use LPG as fuel at construction camps Undertake periodic ambient air quality monitoring as per EMOP		Asphalt mixing plants, crushers, DG sets locations	Included in construction costs Included in monitoring cost	Contractor	Supervision consultant (PMU)/PMU
4 . Noise						
Noise from construction vehicle, equipment and machinery.	Provision is made for installing need base noise barrier near sensitive locations like hospitals, schools. All equipment shall be fitted with silencers and will be properly maintained to minimize its operational noise. Stationary noise making equipment shall be placed along uninhabited stretches.	Legal requirement Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof + MoRSTH Specifications for	Throughout the road.	Cost for Plantation already indicated above. Rest part of construction costs	Contractor/Supervision Consultant	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	The timing for construction activities shall be regulated such that all noise generating construction activities happen after school hours. The provision of temporary noise barrier (Barricading) shall be made near identified sensitive locations or near the noise source during construction. Plantation along the boundary wall shall be made at start of construction itself. Protection devices (ear plugs or ear muffs) shall be provided to the workers operating near high noise generating machines Noise measurements as per EMoP should be carried out to ensure the effectiveness of mitigation measures and develop a mechanism to record and respond to complaints on noise Noise monitoring as per EMoP.	Road and Bridge works		Monitoring Cost as indicated In EMoP.		
5. Land and Soil						
Land use Change and Loss of productive/top soil	The top soil from the productive land shall be preserved and reused for plantation purposes as top cover of embankment slope for growing vegetation to protect soil erosion. The land taken on lease for access road and construction camp shall be is restored back to its original land use before handing it over back to land owner.	Project requirement	Throughout the project section and borrow areas	Included in construction cost	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
Slope protection and Soil erosion due to construction activities, earthwork, and cut and fill	Bank protection measures shall be taken at erosion prone areas. The protection measures may include use of geo-textiles matting, bio (vegetative) - turfing Side slopes of the embankment shall not be steeper than 2H:1V. Provision of side drain to guide the water to natural outfalls. In rural stretches, longitudinal side drains shall be intercepted by drains serving as outlet channels to reduce the erosion. Soil spread on slopes for permanent disposal shall be buttressed at the toe by retaining walls. Turfing of embankment slopes shall be done along the stretch. Stone pitching wherever necessary. Shrubs shall be planted in loose soil area. Soil erosion shall be visually checked on slopes and high embankment areas. In case soil erosion is found, suitable measures shall be taken to control the soil erosion further including bio-turfing While planning or executing excavations the Contractor will take all adequate precautions against soil erosion as per MoRSTH.	IRC: 56 -1974 recommended practice for treatment of embankment slopes for erosion control Clause No. 306 and 305.2.2 MoRSTH Specifications for Road and Bridge works Guidelines IX for Soil erosion	At high embankment area	Construction cost	Design consultant and Contractor,	/ PMU
Soil erosion at earth stockpiles	The earth stockpiles to be provided with gentle slopes to prevent soil erosion and stock piles to be located downwind.		At earth stockpiles	Construction cost	Contractor	PMU
Borrow areas	Non-productive, barren lands, wasteland shall be used for borrowing earth with the necessary permissions/ consents. Borrow areas should not be located on cultivable lands except in the situations where land owners desires to level the	IRC Guidelines (No. IRC:10-1961) on borrow areas selection and amount to be extracted	Borrow sites location.	Construction cost	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	land. The top soil shall be preserved and depth shall be restricted to the desired level and the slop shall not be steeper than 25%. Borrow areas shall be sited away from inhabited areas. To the extent possible, To the extent borrow areas shall be sited away from inhabited areas. 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 fishpond in consultation with fishery department and land owner/community. Rehabilitation of the borrow areas as per Guidelines for redevelopment of Borrow Areas.	For quarries (Environmental Protection Act and Rules, 1986; Water Act, Air Act) + Clause No. 305.2.2 MoRSTH Specifications for Road and Bridge works Guidelines V for Borrow Areas Management				
Quarry Operations	Aggregates will be sourced from existing licensed quarries. Copies of consent/ approval / rehabilitation plan for a new quarry or use of existing source will be submitted to EO, PIU. The contractor will develop a Quarry Redevelopment plan, as per the Mining Rules of the state and submit a copy of the approval to EA if new quarries are to be opened. .	MoRSTH Specifications for Road and Bridge works Guidelines VI for Quarry Areas Management				
Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	Construction vehicles, machinery, and equipment to be stationed in the designated ROW to avoid compaction. Approach roads/haulage roads shall be designed along the barren and hard soil area to reduce the compaction. Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear and	Design requirement	Parking areas, Haulage roads and construction yards.	Included in construction cost	Contractor	CSC / PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	tear to the village/minor roads. Land taken for construction camp and other temporary facility shall be restored to its original conditions.					
Contamination of soil and construction waste management	Fuel and lubricants shall be stored at the predefined storage location away from drainage channels. The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils Construction vehicles and equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not contaminate the soil. All efforts shall be made to minimize the waste generation. Unavoidable waste shall be stored at the designated place prior to disposal. To avoid soil contamination at the wash-down and re-fuelling areas, “oil interceptors” shall be provided. Oil and grease spill and oil soaked materials are to be collected and stored in labeled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized Waste Oil Recycler Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided at construction camp. Domestic solid waste at construction camp shall be segregated into biodegradable and non-biodegradable waste. The non-biodegradable and recyclable waste shall be sold off. Efforts shall be made that biodegradable waste shall be composted in the mechanized and movable composter by the contractor. Non bio-degradable and	Design requirement	Fuelling station, construction sites, and construction camps and disposal location.	Rs 1.2 Mn	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	non-salable waste shall be disposed off to authorized land fill site. All excavated materials from roadway, shoulders, drains, cross drainage should be used for backfilling embankments, filling pits, and landscaping. Unusable debris material should be suitably disposed off at pre designated disposal locations, with approval of the concerned authority. Unproductive/wastelands shall be selected for dumping sites. Away from residential areas and located at least 1KM downwind side of these locations, Dumping sites shall not be close to water body and contaminate any water sources, rivers. Dumping sites should have adequate capacity equal to the amount of debris generated. Public perception and consent from the village Panchayats about the location of debris disposal site shall be obtained before finalizing the location. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRSTH guidelines should be followed. Soil quality monitoring shall be carried out as per EMoP.					
6. Water Resources						
Construction water	Requisite permission as applicable shall be obtained for abstraction of groundwater. The contractor shall make arrangements for water required for construction without affecting the water availability and supply	MoRSTH Specifications for Road and Bridge works	Throughout the Project section	Included in construction cost	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	to nearby communities. Water intensive activities shall not be undertaken during summer season. Provisions shall be made to connect road side drains with exiting nearby ponds.					
Alteration in surface water hydrology due to embankment	Existing drainage system to be maintained and further enhanced. Adequate cross drainage structures shall be provided. Additional balancing culverts shall be provided in flood prone areas. The embankment height shall be designed consistent with the existing topography of the region and shall be higher than the HFL. Elaborate drainage system shall be provided to drain the storm water from the roadway and embankment and to ensure minimum disturbance to natural drainage of surface and subsurface water of the area. Surface runoff from the main road and embankment slopes shall be discharged through longitudinal drains, designed for adequate cross section, and the outfalls. No construction material will be stored or disposed near any water body except for reusing it for enhancement measures such as embankment raising.	MoRSTH Specifications for Road and Bridge. IRC SP 42 and 50 for design of surface and subsurface	Near all drainage channels, river crossings etc.	Included in construction cost	Contractor	PMU
Siltation in water bodies due to construction activities/earthwork	Embankment slopes to be modified suitably to restrict the soil debris entering water bodies. Provision of Silt fencing shall be made at water bodies. Silt/sediment should be collected and stockpiled for possible reuse as surfacing of slopes where they have to be re-	MoRSTH Specifications for Road and Bridge works and worldwide best practices	Near Mahanadi and Joke River bodies, embankment slopes.	Included in construction cost	Contractor	CSC / PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	vegetated. Earthworks and stone works to be prevented from impeding natural flow of rivers, streams and existing drainage system. Provision of retaining wall is made along the road for the ponds located next to the road to prevent soil erosion and siltation of pond					
Deterioration in Surface water quality due to leakage from vehicles and equipment.	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 on 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 cleanup. 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 periodically.	The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof.	Water bodies, refueling stations, construction camps.	Construction cost	Contractor	PMU
7. Flora and Fauna						
Terrestrial and Aquatic I Flora and Fauna	Requisite permission from Forest Department shall be obtained for cutting	Forest Conservation Act	Throughout project corridor	Indicated above	Contrcator/Super vision	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	of roadside trees. Tree cutting shall be well planned to avoid any kind of inconvenience to local people and traffic Minimization of any untoward incidence and probable harm due to poaching activities from immigrant labour population. Strict anti-poaching surveillance measures need to be implemented, especially during project construction phase in the areas of Jaldapara national park. Signage for no-noise zones, wildlife conservation boards should be installed at the required project sites. Noise generating equipments like DG set, compressors shall have acoustic enclosures. These should not be installed at least in one Km area of National Park or Reserved forests. Noise generating activities should not be permitted during night. Drivers should be warned to move slowly in the wild life movement areas. Provisions of signages as a precautionary measure to provide awareness about animal movement shall be made to avoid accidents The construction activities over rivers or near water, bodies shall be undertaken during summer season when most of rivers and water ponds are practically dry. Best construction practices shall be adopted to prevent increase in siltation level of the water. All precautionary efforts shall be taken as given under surface water section to prevent accidental	1980 + IRC SP: 21 and IRC SP:66			Consultant/SEMU	

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	damage of water quality					
8. Construction Camps						
Impact associated with location	All camps should maintain minimum distance from following: # 1000 m from habitation # 500 m from water bodies	Design Requirement	Both construction camps	1.2 Mn	Contractor	PMU
Worker's Health in construction camp	The location, layout and basic facility provision of each labor camp will be submitted to CSC prior to their construction. The construction shall commence only after approval of CSC concurrence The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as approved by the EA. Preventive medical care to be provided to workers. Disposal of solid waste on regular basis at identified locations. 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, sell, give, barter to the workers of host community. Provision of day crèche for children Limited recreation and sporting facilities for the staff and workers. Immunization to immigrant workers/local community against communicable and sexually transmitted diseases.	The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof	All construction camps	Part of the Contract	Contractor	PMU
9. Management of Construction Waste/Dismantled Debris						

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
Selection of Dumping Sites	Unproductive/wastelands shall be selected for dumping sites. Away from residential areas and water bodies Dumping sites have 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.	Design Requirement and MoRSTH guidelines	At all Dumping Sites	Part of the contract	Contractor.	PMU
Reuse and disposal of construction and dismantled waste	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. All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. Unusable debris material 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. For removal of debris, wastes and its disposal MORSTH guidelines should be followed. Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed off-site.					
10. Accessibility, Traffic Management, Accident and Safety Risks						
Design requirement and Traffic Planning During Construction Stage	Temporary traffic diversion shall be planned by the contractor and approved by PMU The traffic control plans shall contain details of diversions; traffic safety arrangements during construction; safety	Design requirement and IRC SP:55	Throughout the project corridor especially at intersections.	Project preparation and construction cost	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	measures for nighttime 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 is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. The contractor shall inform local community of changes to traffic routes, and pedestrian access arrangements with assistance from CSC and Nodal officer concerned Use of adequate signage to ensure traffic management and safety. Conduct of regular safety audit on safety measures.					
Pedestrians, animal and Vehicular movement,	All measures for the safety of traffic during construction viz. signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan/Drawings shall be taken. Temporary access and diversion, with proper drainage facilities. Access facility to the schools located adjacent to the highway.	Design requirement and IRC: SP: 27 -1984 Report Containing Recommendations of IRC Regional Workshops on Highway Safety IRC:SP: 32 -1988 Road Safety for Children (5-12 Years Old) IRC:SP: 44 -1994 Highway Safety Code IRC: SP: 55 -2001 Guidelines for Safety in Construction Zones	Near habitation on both sides of schools, temples, hospitals, construction sites, haulage roads, diversion sites.	Included in construction cost.	Contractor in consultation with Forest department and PMU	PMU
Accident risk from construction activities	Contractors to adopt and maintain safe working practices. Usage of fluorescent and retro-reflective signage, in local language at the construction sites Training to workers on safety procedures and precautions.		Construction sites	Included in construction cost	Obligation of Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	Provision of PPEs to workers. Provision of a readily available first aid unit including an adequate supply of dressing materials. Ensure ready access to ambulance, nursing staff, and doctor when needed. The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. Clear demarcation of areas for restricted accesses to avoid accidents.	The Building and other Construction workers Act 1996 and Cess Act of 1996 Factories Act 1948				
11. Common Property Resources and other Utilities						
Damage to Common Property Resources and Utilities	Ensure that no construction material dumped close to the such facilities and all precautions are taken such that no damage happen to any of common property resources and utilities.	Environment Protection Requirement	Throughout the corridor	Construction cost	Contractor	PMU
Access to common property resources	The area shall be barricaded for safety prospective. It shall be ensured that access to these area ensure for people to visit such places.	Environment Protection Requirement	Throughout the corridor	Construction cost	Contractor	PMU
12. Contractor Demobilization						
Clean-up Operations, Restoration and Rehabilitation	Contractor will prepare site restoration plans, which will be approved by the CSC. The cleanup 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, at the contractor's expense, to the satisfaction of the Environmental officer. All the opened borrow areas will be rehabilitated .and CSC will certify in this regard.	Project requirement	Throughout the Corridor and borrow areas	----	Contractor	PMU

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
B. Operation Stage						
1. Climate and Air quality						
Air pollution due to due to vehicular movement	Roadside tree plantations shall be maintained. Regular maintenance of the road will be done to ensure good surface condition Ambient air quality monitoring shall be carried out as per EMoP. If monitored parameters are above the prescribed limit, suitable control measures must be taken. Road signs shall be provided reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment.	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Throughout the Corridor	Indicated In EMoP costs	PMU	
2 Noise Environment						
Noise due to movement of traffic	Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch and speed limitation and honking restrictions may be enforced near sensitive locations. The effectiveness of the noise barrier shall be monitored.	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	In all settlement areas	Included in EMOP costs	PMU	
3. Land and Soil						
Soil erosion at embankment during heavy rain fall.	Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching, river training structures etc.	Project requirement	At bridge locations and embankment slopes and other probable soil erosion areas.	Included in Operation/ Maintenance cost	PMU	
Soil erosion at borrow areas	Visual monitoring and inspection of soil erosion at borrow areas, quarries (if closed and rehabilitated), embankments and other places expected to be affected, will be carried out once in every six months as suggested in monitoring plan.	Project requirement	At bridge locations and embankment slopes and other probable soil erosion areas.	Included in Operation/ Maintenance cost	PMU	
4. Water Resources						
Contamination of	Monitoring of surface water bodies		Near drains	Indicated in	PMU	

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
surface water quality due to leakage of oil			/natural streams	EMoP		
Siltation	Regular visual checks shall be made to observe any incidence of blockade of drains/culverts. Regular checks shall be made for soil erosion and turfing conditions of river training structures for its effective maintenance.					
5. Flora and Fauna						
Terrestrial and Aquatic Flora and Fauna	Arrangement shall be made to ensure survivability of the tree plantation. The tree survivability audit shall also be conducted at least once in a year to assess the effectiveness of the programme. It is proposed to carry periodic visual check of functionality of underpasses and other measures taken for the protection of animals. Periodic data shall be collected from wild life authorities regarding Man Animal conflicts and suitable corrective action shall be initiated in-case conflict level is found increasing. Periodic surveillance shall be conducted to check erosion and siltation in major water bodies.	Forest Conservation Act 1980	Throughout the corridor	Indicated in Monitoring cost in EMoP	PMU	
6. Flooding/ inundation						
Road inundation due to choking of drainage channels	Field Unit will ensure that all drains (side drains and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding.	Project operation requirement	In settlement area	Overall Operation cost	PMU	
7. Right-of-Way Maintenance						
Accident Risk due to uncontrolled growth of vegetation	The construction site shall be kept completely clear of vegetation. Regular maintenance of plantation Invasive plant not to be planted near the road. Controlled use of herbicide/pesticide	Project requirement	Throughout the Project route	Included in operation/ Maintenance cost	PMU	

Environmental Issue/ Component	Remedial Measure	Reference to Laws /Guidelines	Approximate Location	Mitigation Cost	Institutional Responsibility	
					Implementation	Supervision
	The designated ROW shall be maintained free of any encroachment.					
8. Accidents and Safety						
Accident risks associated with traffic movement.	Traffic control measures, including speed limits, will be enforced strictly. Further encroachment and squatting within the ROW will be prevented. Monitor/ensure that all safety provisions included in design and construction phase are properly maintained	IRC:SP:55	Throughout the Project route	Included in operation/ Maintenance cost	PMU	
Transport of Dangerous Goods	Preparation of spill prevention and control and emergency preparedness and responsive plans based on an analysis of hazards, implementation of presentation and control measures.		Throughout the project stretch	Included in operation/ Maintenance cost.	PMU	
9. Monitoring Operation Performance						
Monitoring Operation Performance	Monitor the operational performance of the mitigation/ enhancement measures carried out as a part of the project The indicators selected for monitoring include the survival rate of trees; utility of enhancement provision, status of rehabilitation of borrow areas, Air quality, water quality, noise levels, soil quality, drainage pattern. The monitoring and reporting to be carried out as per EMoP		Throughout the corridor	Included in EMoP	PMU	

Appendix 7.2 : Environmental Monitoring Plan (EMoP)

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Cost (Rs.)	Implementation	Supervision
Terrestrial and aquatic fauna	Construction Stage	Surveillance Audit for status of wild life their movement in project areas, Aquatic fauna in rivers	None specific	NearJaldaparaa National Park , Near Naxalbari and Hasimara. River next to Jaldapara National Park during construction of underpasses in this area	During construction stage)	24,00,000 (12 person days per audit *RS 25000 per person day * 2 times a year for three year + Rs 200000 for travel per year)	Independent subject Expert	PMU/SEMU
	Operation Stage	Surveillance Audit for status of wild life their movement if any project areas, , Aquatic fauna in rivers	None Specific	Above Locations	First years after construction	16,00,000 (12 person days per audit* Rs 25,000 per person day * twice a year in first year and once a year in next two year Rs 4,00,000 for travel in three year)	Independent subject Experts	PMU/SEMU
Air Quality	Construction Phase	PM 10 and PM2.5 SO2, NOx, CO	National Ambient Air Quality Standards	Within 100 m of Hot mix plant, construction camp, crusher and near sensitive locations/ settlement 6-8 locations	Continuous 24-hourly, twice a week, for two weeks once per half yearly	19,20,000 (@RS 10,000 per sample *twice a week*two week*8 locations per year * two time a year for three year)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU
	Operation Phase	PM 10 and PM2.5 SO2, NOx, CO	National Ambient Air Quality Standards	7-8 locations Near Jaldapara National Park, bypass roads, Naxalbari, near school and select urban and rural areas.	Continuous 24-hourly, twice a week, for one week, once in winter and Summer at 8 locations	9,60,000 ((@RS 10,000 per sample *twice a week* one week week* 8 locations per year * twice a year for three year)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Cost (Rs.)	Implementation	Supervision
Surface Water Quality	Construction Stage	pH, BOD, COD, TDS , TSS, DO, Oil & Grease	As per CPCB Water Quality Criteria	Rivers and canals (from all the water bodies where construction work is going in close vicinity)	Twice a year (about 12 locations)	4,32,000 (@ Rs 6000 per ample * 2 samples per year* 12 locations*3 year.)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU
	Operation Phase	pH, BOD, COD, TDS , TSS, DO, Oil & Grease	As per CPCB Water Quality Criteria	Rivers and canals	Once during the dry season after six month of construction	1,50,000 (@ Rs 6,000* 25 locations)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU
Ground water and Drinking Water Quality	Construction Stage	pH, BOD,DO, total coliform, As, Cd, Mn and Ground Water levels	As per IS 10500:1991	Construction site, service areas,	Once at the start of construction (5 locations)	90,000 (@Rs 6,000 per sample for five locations for three years)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU
	Operation Phase	pH, BOD, DO, total coliform, As, Cd, Mn and water levels	As per IS 10500:1991	Construction site, service areas,	Once after six month of completion of construction at construction camp site areas (about 5 locations)	30,000 (@Rs 6,000 per sample * 5 locations)	Independent Environmental Laboratories approved by SPCB/ MoEF	PMU/SEMU
Noise	Construction Phase	Noise level Level in dB (A)	As per National Standards for Noise	Near the construction sites and sensitive locations close to Road alignment	Dy and Night levels once in a quarter at sensitive locations and close construction activity areas (say 20 locations per quarter)	7,20,000 (Rs 3000 per sample*20 locations* four times a year for three year s)	Independent Monitoring Agency	PMU/SEMU
	Operation Phase	Noise Level in dB (A)	As per National Standards for Noise	Near the habitats close to protected area of Jaldapara and sensitive locations	once after six month of construction at about 20 locations.	60,000 (Rs 3000 per sample*once at 20 locations)	Independent monitoring agency	PMU/SEMU

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Cost (Rs.)	Implementation	Supervision
Soil Erosion and siltation	Construction Phase	Visual check for Soil erosion and siltation	--	Near the bridge approaches, borrow areas , embankment areas and near underpasses areas	After first precipitation	Part of routine action of Project Management Team	Design Team/ Environmental supervision consultant	PMU/SEMU
	Operation Phase	Study of Soil erosion and siltation	--	Near the bridge approaches, borrow areas , embankment areas and near underpasses areas	Once during operation of 1st year	Part of routine action of Project Management Team	Design Team/ Environmental supervision consultant	PMU/SEMU
Drainage Pattern and Water Logging	Construction Phase	Visual check	--	All along the road alignment	After first year of year of construction.	Part of routine action of Project Management Team	Design Team/ Environmental supervision consultant	PMU/SEMU
	Operation Phase	Visual check	--	All along the road alignment	Once during operation of 1st year	Part of routine action of Project Management Team	Design Team/ Environmental supervision consultant/CMU	PMU/SEMU
Tree Plantation	Construction Phase	Surveillance monitoring of trees felling	As laid out in the detailed design for project	Entire stretch of the road alignment	During site clearance in construction phase	14,00,000 (@ 6 person days per quarter *Rs 25000 per person * four times a year for two year + Rs 2,00,000 for travel)	Environmental supervision consultant or SEMU appointed consultants	PMU/SEMU
	Operation Phase	Survival rate of trees success of re-plantation	The survival rate should be at least 70% below which re-plantation shall be done.	Entire stretch of the road alignment	Every year for 5 years Once a year	20,00,000 (@ 12 person days*Rs 25,000 per person * once a year* 5 years + Rs 3,00,000 for travel)	Environmental supervision consultant or SEMU appointed consultants	PMU/SEMU
Total Costs of monitoring construction stage								**Rs 69,62,000**
Total Costs of monitoring operation Stage								**Rs48,00,000**

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Cost (Rs.)	Implementation	Supervision
Contingencies @ 10%						**Rs. 11,76,000**		
Total cost of monitoring						**Rs. 1,29,38,000** **Or say 12.93 million**		
Or Say US $ (! US $ = INR 55)						**Or Say US$ 0.235 Mn**		

Appendix 7.3 : EMP Implementation Schedule

Environmental Issue	EMP Component	Time line																					
		Construction Phase					Operation Phase																
		1	2	3	4	5/6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	~	25
Technical Support	Preparation of Environmental guidelines and development of EHS management System																						
Flora and Fauna	Minimization of Tree cutting and Compensatory afforestation (Minimum 1:3) (Plantation and maintenance for three year)																						
	Construction of Underpass																						
Drainage Pattern, Water logging , Soil Erosion and Borrow Area Management	Monitoring of water logging,																						
	Monitoring of Soil Erosion at bridge approaches, river embankments, corridor embankment, Siltation level in the river																						
	Borrow Area Rehabilitation																						
Land	Compensation against land acquisition																						
	Installation of grease traps at construction sites																						
Water & Drinking Water Supply	Construction of soak pits at construction sites & Rehabilitation sites																						
	Monitoring of Surface Water Quality																						
	Monitoring of Ground Water Quality																						
Air Quality & Dust Management	Water Spraying/ Watering																						
	Monitoring of Ambient Air Quality																						
Construction Safety	Provision of PPEs																						
Health Issues	Health Check-up Camps																						
Faunal Monitoring	Monitoring of Wild Life Movement, Functionality of Underpasses and effectiveness of warning sign boards																						
Tree & noise monitoring	Monitoring of Tree Felling & Plantation																						
	Maintenance of tree (Additional two years)																						
	Provision of additional tree plantation																						
	Monitoring of Noise																						
Establishments	Construction Stage, with requisite facilities for sanitation, solid waste management, prevention of soil contamination,																						
Training	Environmental training & Awareness																						
MIS	Establishment and operation																						

Legends

- Critical
- High priority
- Medium priority
- Low priority

Appendix 7.4 : Training and Awareness

Details of Proposed Training & Awareness Program with Budget

S. No.	Target group	Subject(s)	Method	Time Frame and Estimated Cost (INR or Rs)	Basis for Costs Estimation	
					Training Material Preparation	Training Delivery
1	All Project Staff of EA involved in implementation of the project	**Environmental Overview:** Environmental Regulations, sub-project related provisions of various Acts/ Guidelines, process and methodology for EIA EMPs	Lectures cum interaction	Before beginning of the implementation of the sub-project. Rs 0.624 Mn	@ Rs 0.2 Mn	Reproduction of Training Material Rs 24,000 (@ Rs. 400 per set for 60 sets) Training Delivery: Honorarium and travel cost of the faculty Rs 0.2 Mn (@ 1,00,000 per programme for 2 programmes) Venue and other facility costs Rs).2 Mn (@ Rs 1,00,000 per programme with 25 participants in each)
2	PMU staff at site responsible for implementation of EMP, Supervision Consultant's Environmental Specialists and Select NGOs	**Implementation of EMPs:** Basic features of an EMP, Planning, designing and execution of environmental mitigation and enhancement measures, monitoring and evaluation of environmental conditions – during construction and operation	Workshops and Seminars	Before the construction begins Rs 0.624 Mn	@ Rs 0.20 Mn	-do-
3	Environmental officers, design team, Supervision Consultant Construction Contractors' staff	**Environmentally Sound Construction Practices:** Clean construction technology, alternatives materials and techniques for	Workshops and Site visits	Before the construction Rs 0.624 Mn	@ Rs 0.3 Mn	-do-

		construction, Waste Management and minimization in construction, pollution control devices and methods for construction sites and equipment, Environmental clauses in contract documents and their implications, protection of flora and fauna, Environmental monitoring during construction				
4	SEMU designated officials and Supervision Consultant, NGOs and community representatives	**Monitoring Environmental Performance during Construction:** Air, Water, Soil and Noise, tree survival Monitoring requirement and techniques, Evaluation and Review of results, Performance indicators and their applicability, possible corrective actions, reporting requirements and mechanisms	Lectures, Workshop and site visits	During initial phases of construction Rs 0.5 Mn	@ Rs 0.15 Mn	Reproduction of Training Material Rs 24,000 (@ Rs. 400 per set for 60 persons) Training Delivery: Honorarium and travel cost of the faculty Rs 016 Mn (@ 8,000 per programme for 2 programmes) Venue and other facility costs Rs 0.16 Mn (@ Rs 80000 per programme with 25 participants in each)

5	-do-	**Long-term Environmental Issues in Project Management:** Designing and implementing environmental surveys for ambient air, noise, vibration, biological and water quality surveys, data storage, retrieval and analysis, contract documents and environmental clauses, risk assessment and management, contingency planning and management and value addition	Workshops and seminars	During implementation of the Sub-project Rs 0.50 Mn	@ RS 0.15 Mn	101 Do -
6	Public /contractors workers	**Awareness programmes** on environmental protection and measures being implemented by EA and their role in sustaining the measures taken including for noise pollution, air pollution, safety, soil conservation, and tree plantation, tree plantation and importance of tree loss prevention to minimise C-loss.	Workshops	During construction and initial phase say 4 years of operation Rs 0.13 Mn	@ Rs 0.3 Mn includes costs of designing of awareness booklets/material	Material reproduction costs 2.0 lac (RS 200 for 1000 sets) Faculty Lumpsum: Rs 0.2 Mn Delivery Lumpsum 6.0 (two hours workshops)

7	PMU project Staff, Supervision Consultant, Engineering Staff of Contractor. DFO	Restoration of sites viz borrow areas, construction Camps, Occupational health and safety, management systems, tree plantation, Faunal protection and sustainability, . tree plantation and importance of tree loss prevention to minimise C-loss Reporting Formats/procedure	Lecture/Presentations	before Contractor Demobilization Rs 0.43 Mn	@ Rs 0.10 Mn	Reproduction of Training Material Rs 10,000 (@ Rs. 200 per set for 50 persons) Training Delivery: Honorarium and travel cost of the faculty Rs 016 Mn (@ 80,000 per programme for 2 programmes) Venue and other facility costs Rs 0.16 Mn (@ Rs 80000 per programme with 25 participants in each)
			Total Training Costs	**Rs 4.60 Mn**		

Appendix 7.5 : Environmental Budget

Component	Item	Unit	Quantity	Rate	Amount (million Rs)
DESIGN AND CONSTRUCTION STAGE					
Technical Support	• Preparation of Environmental guidelines and performance indicators, code of practices	Lump sum	-	Rs 2.5 million	2.5
Flora	• Diversion of Forest land for Non forestry Purposes (Diversion of Reserved Forests and National Park land	Rs per ha	16 ha (Twice the total forest land diversion area)	Rs 8,00,000 per ha + Net present Value to be estimated by forst department on actual site assessment	12.8 + Net Present Value
	• Clearing of plantation	km		Covered in engineering costs	
	• Compensatory afforestation (Minimum 1:3) (Plantation and maintenance for five year)	No of tree	37,500	Rs. 5000[37] per tree with circular guard and maintenance for 3 years	187.5
	• Additional Tree plantation for climate change consideration of 1:5 basis considering woody trees of 34%	No of Trees	8500	Rs. 5000 per tree with circular guard and maintenance for 3 years	42.5
Floral	• Developing Floral nursery for facilitating tree plantation	Lump sum	Depending on site conditions	Lump sum	5
Faunal	• Developing Fisheries	Lump sum	Depending on site conditions	Lump sum	3
Drainage Congestion and disposal of accumulated water	• Provision of adequate surveillance	Covered in project design and engineering cost			
Erosion & Sedimentation	• Embankment, bridge approaches and River/canal Bank Protection Measures	Covered in project design and engineering cost			
Land	• Compensation against land acquisition and Rehabilitation	Covered in R&R Budget			
Soil	• Soil contamination protection (Septic tanks, grease taps etc) and rehabilitation of borrow areas	Covered in project design and engineering cost			

[37] Sapling cost + fencing material +labor cost = 1400, watering, pesticide = Rs. 100 per tree per month for 36 months. (1400+3600 = 5000)

Component	Item	Unit	Quantity	Rate	Amount (million Rs)
Noise	• Provision for Temporary Noise Barriers and thick tree plantation around sensitive receptors	10 barrier in each road @ Rs 2000 per square meter for av 60 square meter per barrier			1.2
Water and Water	• Installation of oil and grease traps at construction sites and Waste Water Collection & Disposal system	Estimated @ RS 2,00,000 per camp estimated six camp			1.2
	• Construction of soak pits at construction sites	Estimated @ RS 2,00,000 per camp estimated six camp			1.2
Dust Management during construction	• Water Sprayer / Watering	Covered in project design and engineering cost			
Safety	• Provision of Retro-Reflective signage Animal Movement Areas Near Naxalbari, Jaldapara National Park and Hasimara – Pasakha bypass area	16 Signage per site four sites @ Rs 15,000 per signage			0.96
	• Caution Signage, Speed Breaker and Crash Barrier	Covered in project design and engineering cost			
	• Accident risks in construction activity	Covered in project design and engineering and cost			
	• General Safety (provision of PPE like ear muffs, gloves etc.)	Average 300/labour/year for construction period or five years			To be part of contractors costs
Health	• Health checkup camps for construction workers	camps	1 camp /year	Rs 0.2 million/camp for five years one camp per road	2.00
Environmental Monitoring in the construction phase	• Terrestrial and Aquatic Fauna	Cost as mentioned in monitoring plan			7.66
	• Ambient Air Quality				
	• Surface Water Quality				
	• Ground Water /Drinking Water Quality				
	• Noise & Vibration				
	• Soil Erosion & Siltation				
	• Drainage Pattern and Water Logging				
	• Monitoring Tree Felling & Plantation				
		SUB TOTAL (CONSTRUCTION STAGE)			**267.52**

Component	Item	Unit	Quantity	Rate	Amount (million Rs)
OPERATION STAGE					
Erosion Control and landscaping	• Visual Check	Lump Sump	To be part of Regular maintenance and operation costs		-
Emergency Preparedness: Accident Response	Ambulance equipped with requisite emergency medical aid facility	Rs per Ambulance	5 Ambulances with One doctor and one Para medical staff and one driver. @ Rs 1.5 Mn per ambulance with 1.2 Mn per per ambulance operational costs for three year.		25.5
Monitoring of performance indicators	• Terrestrial and Aquatic Fauna including surveillance audit	Cost as mentioned in the Monitoring plan			5.28
	• Ambient Air Quality				
	• Surface Water Quality				
	• Ground Water /Drinking Water Quality				
	• Noise & Vibration				
	• Soil Erosion & Siltation				
	• Drainage Pattern and Water Logging				
	• Monitoring Tree Felling & Plantation				
		SUB TOTAL (OPERATION PHASE)			**30.78**
TRAINING and AWARENESS					
Training	• Environmental training & awareness	Lump sum	As per training details	-	4.6
ESTABLISHMENT AND SYSTEMS					
Establishment	• Supervision Consultant (environment and Social)	Lump sum	1	Lump sum	20
	• Construction Stage (Site Environmental officer)	Per son months	1 person for five years	Rs 75,000 per person month + plus need based subject expert support (lump sum Rs 1.0 Million)	5.5
	• Operation Stage	Per son Months	1 person for 1 year	Rs 75,000 per person month plus need based subject experts support(lump sum Rs 0.5 million)	1.4
Management Systems	• Adoption of EHS management systems	Lump sum	Project Director Office and site	-	4.0
	• Management Information and tracking system	Lump sum	-	-	2.0

Component	Item	Unit	Quantity	Rate	Amount (million Rs)
SUBTOTAL (ESTABLISHMENT & TRAINING and MANAGEMENT SYSTEM)					**37.5**
SUB TOTAL (Construction, and Operation and mobilization)					**335.80**
CONTINGENCIES @ 5 % on total Environmental Costs					**16.79**
GRAND TOTAL (in Rs)					**352.59**
GRAND TOTAL (in US$) (@ 1 US $ = Rs. 55)					**US $ 6.41 Million or say US $ 6.4 million**

Appendix 7.6 : Tree Plantation and Management Guidelines

A. Guidelines:

1. **Preparation of the Plantation Area:** For plantation in new areas it always economical and comfortable to plant trees in blocks. The open areas near the AH-2 and AH-48 road shall be identified and selected. During the selection of the block plantation sites, the availability of the water in nearby areas shall be taken into consideration as the survival of the tree saplings depends on the availability of water or watering facilities.

2. **Preparation of Pits and Sapling Transplantation:** The location of each plantation pit shall marked according to the design and distance of the plantation. The size of the plantation pit varies depending upon the species of the plants, height of the saplings. Trees shall be planted on the alternate rows in a straight line for the prevention of the horizontal dispersion of the pollutants. Hence the pit shall be dig accordingly. During the time of placing the tree saplings the roots shall be freed from plastic or any type of cover which is normally use for the transplantation of the tree saplings from the seed bed to the tree plantation pits. This exercise will help the root hairs to reach the soil.

3. **Spacing:** For the survivability of the tree species planted spacing between the saplings should be maintained. Spacing which are usually used for teak planting are 2 x 2 m^2, 3 x 1 m^2, 3 x 3 m^2, 4 x 2 m^2 and 4 x 4 m^2, depending on site condition. However, wider spacing of 6 x 1 m^2 can also be adopted sometimes where the survivability is high. Closer spacing is used for straight timber of good quality.

4. **Time of Plantation:** As per the normal practices followed under the silvicultural guidelines plantation of the tree sapling to be done only after the first shower during the rainy season. The best time for plantation is after 15 days from the day of first shower during rainy season.

5. **Protection of Tree saplings:** Circular tree guard should be placed after the plantation of the saplings for the protection of these young plants from the ravages of cattle, sheep and goat and other animals. If tree saplings died or damage occur after placing the circular tree guard, timely replacements of damaged plant and thereafter care is important.

6. **Selection of Tree Species:** The selection of the tree species to be planted plays a crucial role for higher survivability rate. This is always better to choose the local and Vulnerable, endemic species.

7. **Maintenance (include thinning) : Weeding:** Low pruning at 6 months**, Thinning:** Thinning shall start after the stand is 3-4 years old and repeated every 4 years until the stand is 15 years old. Between 15-25 years old, thinning should be conducted every 5 years and after 25 years old, thinning shall be done after every 10 years. When the canopy closes, at about 6 years, 30-40% of the stems shall be thinned to selectively remove suppressed, diseased and badly formed trees.

8. **Survivability:** Periodic assessment shall be carried for survivability of the trees. Minimum 70% survival rate shall be achieved.

B. Records:

9. The following records shall be maintained:

    1. Record of Tree plantation

2. Record of Survivability rate

C. Reporting:

10. The tree plantation and survivability report shall be sent to EA six monthly

D. Responsibility:

11. Prime Responsibility: PMU through contractor or Forest Department Contractor will be responsible for tree cutting or plantation.

12. Supervisory Responsibility: Supervision Consultant to check compliance of above guidelines.

Appendix 7.7: Guidelines for Borrow Earth Management

A. Guidelines

1. Selection and Rehabilitation of Borrow Pits: Guidelines for selection of borrow pits, amount that can be borrowed and its rehabilitation in line with The Indian Road Congress (IRC):10-1961 shall be followed and are as follows:

- Contractor must identify the borrow area before start of construction and submit these details with rehabilitation plan.
- Borrow areas shall not be located on cultivable lands. However, if it becomes necessary to borrow earth from temporarily acquired cultivated lands, their depth shall not exceed 45 cm. The topsoil to a depth of 15cm shall be stripped and set aside. Thereafter, soil may be dug out to a further depth not exceeding 30 cm and used in forming the embankment.
- A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).
- Ridges of not less than 8m widths will be left at intervals not exceeding 300m. Small drains will be cut through the ridges, if necessary, to facilitate drainage. The slope of the edges will be maintained not steeper than 1:4 (vertical: Horizontal).
- Borrow pit shall be selected from wasteland ;
- Priority shall be given to the borrowing from humps above the general ground level within the road land;
- Priority shall be given to the borrowing by excavating/enlarging existing tanks;
- Borrowing shall be from land acquired temporarily and located at least 500m away from the road;
- Borrowing shall be from mounds resulting from the digging of well and lowering of agricultural fields in vicinity of the road;
- Borrow area near to any surface water body will be at least at a distance of 15m from the toe of the bank or high flood level, whichever is maximum.
- In case of settlements, borrow pits shall not be selected within a distance 800 m from towns or villages. If unavoidable, earth excavation shall not exceed 30cm in depth;
- The haulage distance from site shall not be too far.
- Redevelopment plan shall be prepared by the contractor before the start of work which should be duly agreed upon by land owner.
- Borrow pits shall be backfilled with rejected construction wastes and covered with vegetation.
- Borrow areas might be used for aquaculture in case landowner wants such development.
- Borrow pits located near habitat areas will be re-developed immediately after borrowing is completed. If spoils are dumped, that will be covered with a layers of stockpiled topsoil in accordance with compliance requirements with respect MOEF/SPCB guidelines.

B. Records:

2. The following records shall be maintained:

1. List of Borrow areas identification with capacity and rehabilitation plan
2. Agreement with land owners

3. Details of Earth excavated
4. Closure report of rehabilitated borrow pits.

C. Reporting:

3. The Borrow area opening, earth borrowed and borrow area rehabilitation details shall form part of half yearly report to EA

D. Responsibility:

4. Prime Responsibility: Contractor will be responsible for waste management and reporting
5. Supervisory Responsibility: Supervision Consultant to check compliance of above guidelines.

Appendix 7.8 : Guidelines For On Site and Off Site Emergency Management

1. Many emergencies can occur on any construction site and need to be effectively handled. . The environmental and occupational health and safety aspects and related emergency can includes incidence such as Collapse / subsidence of soil / Fire / Explosion / Gas Leak, Collapse of Building / Equipment and other Occupational Accidents. On site and off site emergency management plan shall be developed to effectively handle them. The following guidelines can be used to develop these plans

A. Guidelines:

2. Availability of 'On-Site Emergency Plan'

   a. Every contractor shall have a written on-site emergency plan. The contractor should submit a copy of this plan to PMU and Supervision consultant before the start of the work.
   b. Contractor shall develop the onsite emergency plan considering the potential environmental, occupational health and safety emergency situation at site.
   c. Contractor shall include a list of these potential emergency situations in the onsite emergency preparedness & response plan.

3. Identification of Potential Environmental and Occupational Emergency Situations during construction, operation and maintenance stages

4. The potential emergency situations have been defined below for guidance purposes. The contractors can follow these for developing site specific on site emergency preparedness plan.

Emergency conditions/situations	Sources
Collapse / subsidence of soil	▪ Civil structures
Bulk spillage	▪ Hazardous substance / inflammable liquid storage ▪ Vehicular movement on highway
Fire and explosion	▪ Inflammable Storage Areas ▪ Gas Cylinder Storage Areas ▪ Electrical Circuits ▪ Isolated Gas Cylinders (LPG / DA) ▪ Welding / Gas Cutting Activity
Electrical Shock	▪ HT line ▪ LT distribution ▪ Electrically Operated Machines / Equipment / Hand Tools / Electrical Cables
Gaseous Leakage	▪ Gas Cylinder Storage Areas ▪ Gas Cylinder used in Gas Cutting / Welding Purposes
Accidents due to Vehicles	▪ Heavy Earth Moving Machinery ▪ Cranes ▪ Fork Lifts ▪ Trucks ▪ Workman Transport Vehicles (cars / scooters / motor cycles / cycles) ▪ Collapse, toppling or collision of transport equipment
Slips & Falls (Man & Material)	▪ Work at Height (Roof Work, Steel Erection, Scaffold, Repair & Maintenance, Erection of equipment, Excavation etc.) ▪ Slips (Watery surfaces due to rain) ▪ Lifting tools & Tackles (Electric Hoist & Forklifts)
Collision with stationary / moving objects	▪ Vehicular movement on highway

Other Hazards	▪ Cuts & Wounds ▪ Confined Space (under & inside machinery etc.) ▪ Hot Burns ▪ Pressure Impacts (Plant contains several Pressure Vessels & pipefitting containing CO2, Air, Water, product & Steam, which can cause accidents & injuries to person around.)

B. Design of 'On-Site Emergency Plan'

5. The 'On-site emergency plan' to be prepared by contractor for each railway line shall include minimum the following information :

- Name & Address of Contractor
- Updation sheet
- Project Location
- Name, Designation & Contact Numbers of the organization, nearby hospitals, fire agencies etc. and key personnel including their assigned responsibilities in case of an emergency.
- The roles and responsibilities of executing personnel
- Site Layout Diagram
- Identification of Potential Emergencies Situations/ preventive measures / control & response measures
- Location of Emergency Control Centre (or designated area for emergency control / coordination) with requisite facilities.
- Medical services / first aid
- List of emergency equipment including fire extinguishers, fire suits etc.

C. Emergency Control Centre

6. The emergency control centre shall be equipped with following facilities

- Copy of current on-site emergency plan
- Display of the name of site emergency controller
- Two numbers of artificial respiratory sets
- Two numbers of Stretchers
- Vehicle for 24 hours (for large construction sites)
- Inter personnel/section telephone (2 numbers)
- Site layout diagram with entry and exit routes / Assembly points
- Directory of internal / external emergency phone Numbers
- A set of fire extinguishers (DCP type / Foam Type / CO2)
- List of fire extinguishers installed in the construction site including maintenance record
- A set of personal protective equipment (PPE)
- Two numbers of first-aid boxes with prescribed first-aid medicines
- List of competent first-aiders
- List of fire trained personnel
- Two numbers of blankets
- Drinking water
- Two numbers of rescue ropes
- Two numbers of high beam torches
- Two numbers of gas leak detectors
- Life boat & jackets (if working in or near water course)

D. Records:

7. The following records shall be maintained:

1. Record of emergency preparedness plan with emergency contact numbers
2. Mock drill/emergency preparedness exercise records
3. Corrective preventive action record after emergency is occurred

E. Reporting:

8. The accident and incident records and emergency preparedness drill reports shall form part of quarterly report to EA

F. Responsibility:

9. Prime Responsibility: Contractor will be responsible for waste management and reporting

10. Supervisory Responsibility: Supervision Consultant to check compliance of above guidelines

Appendix 7.9 : Guidelines for Debris and Solid Waste Management

1. Management and disposal of construction waste is one of the major issues during construction work of railways. The following preparations are suggested for disposal of waste material.

A. Guidelines:

i. The debris disposal site should be identified which are preferably barren or low-lying areas away from habitat. The same shall be notified to EA and Supervision consultant
ii. Prior concurrence shall be taken from concerned Govt. Authorities or land owner
iii. Due care should be taken during site clearance and disposal of debris so that public/ private properties are not damage or effected, no traffic are interrupted.
iv. All efforts should be made to use debris in road construction or any other public utilities.
v. The debris should be stored at site ensuring that existing water bodies and drains within or adjacent to the site are kept safe and free and no blocking of drains occurs.
vi. All dust prone material should be transported in a covered truck.
vii. All liquid waste like oils and paint waste should be stored at identified locations and preferably on a cemented floor. Provision of spill collection pit shall be made in the floor to collect the spilled oil or paint. These should be sold off to authorized recyclers.
viii. All domestic waste generated at construction camp preferably be composted in portable mechanized composter. The composted material shall be used as manure. In case composting is not feasible, the material shall either be disposed off though municipal waste disposal system or disposed of through land burial. The dump site must be covered up with at least six inch thick layer of soil.
ix. All efforts should be made that no chemical/ oily waste spill over to ground or water bodies.
x. All precautions should be followed for emergency preparedness and occupational health & safety during construction and handling a waste.
xi. Provision of fire extinguishers shall be made at the storage area
xii. Adequate traffic control signals and barriers should be used in case traffic is to be diverted during debris disposal. All efforts should be made to ensure avoidance of traffic jam, which otherwise results in air pollution, noise pollution and public unrest.

B. Records:

2. The following records shall be maintained:

a) Generation and disposal quantity with location of disposal
b) Recyclables waste generation and disposal
c) Domestic waste disposal locations details

C. Reporting:

3. The waste generation and disposal details shall form part of quarterly report to EA

D. Responsibility:

4. Prime Responsibility: Contractor will be responsible for waste management and reporting

5. Supervisory Responsibility: Supervision Consultant to check compliance of above guidelines.

Appendix 8.1 : Summary of Public Consultation

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
Government Departments				
April 2012 and May 2012,	Kakarbita Custom Office, Mr. T.K. Misir, Custom Superintendent Mr. Uttam Gurung, Custom Superintendent Mr. Ravinder	Traffic congestion, air and water pollution, movement of hazardous material and flood, bypass alignment	No issue of flood, water is available easily however groundwater has high iron content. Market is congested, needs to be bypass or alternate engineering solutions to prevent vehicle idling and air pollution. The current trucks movement is of the order of more than 100 per day from India to Nepal and 50 to 60 per day from Nepal to India which is on the rise but no hazardous material movement and no accidents scenario.	Bypass to Exiting alignment is proposed
April 2012	NTP Forest Division, Siliguri. Mr. D. K. Dutta, Additional District Forest Officer,	Tree cutting and Forest conservation, animal movement,	The cutting of trees should be avoided. Tree should be planted for a minimum of 1:3. Tree cutting require permissions of forest department even if tree is located in a non-forest land. The road side plantation is not classified as protected forest except in the forest land area as per the West Bengal Tree Protection and Preservation Act, 2008-09.	Provision is made to undertake compensatory tree plantation on minimum 1:3 ratio.
April 2012 and May 2012	West Bengal State Pollution Control Board, Regional Office, Siliguri Parivesh Bhawan, Paribhan Nagar, Matigara, Siliguri. Mr. Subrito Ghosh, Chief Engineer Mr. Gautan Kumar Pal,	Environmental Issues been faced in the area and issue associated with the improvement of the road corridor	There is no issue of river water quality or air, noise and soil pollution in the project district areas. No water logging. However, vehicular pollution is a concern in urban areas. The road design and maintenance should be such that idling of the vehicle could be prevented and tree cutting could be avoided.	Provision of bypasses is proposed with improved road design. The area of traffic jams are either being bypasses, or provision of ROB, grade separation and junction improvement is proposed. System of regular maintenance is proposed to be enhanced.
May 2012	Office of the Wildlife (North)	Animal movement and	The road development is a welcome step,	Enhancement measures are

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	West Bengal, Govt. Saw Mill Complex, Mahananda Para, Siliguri, Dist Darjeeling, West Bengal., Dr. Brij Raj Sharma, Chief Conservator of Forests	road development	however, it is not desirable or feasible to widen the road in Jaldapara Sanctuary area. The development has fragmented the home area of elephants which love to move long distances in a group. Elephants in this area moves from East to West (Nepal to Baxua Tiger Reserve and back). Elephants do cross the road in Jaldapara Sanctuary Area. To protect animals migratory routes "Eastern Dooars Elephant Reserve" which covers the core area of Jaldapara and Baxa Tiger Reserve and other forest areas. Following suggested cautions shall be considered for road improvement aspects: 1. Elephant specific improvements like creation of water bodies, bamboo plantations can be created in core areas to restrict their movement towards urban / rural areas for search of water. 2. Electric fencing can be consider along the both side of the road as well as creating of animal trench to guide the elephant for the specific crossing route.	proposed to plant more Bamboo tree and water bodies in conservation areas
May 2012,	Office of the Wildlife Division –II, Jalpaiguri. Mrs. Sumita Ghatak, Divisional Forest Officer	Animal movement and road development	Accidental deaths of elephants with respect to road is nil. No forest or other animal issue in AH-2 road segment (Kakarbhita to Phulwari). Only elephant crossing is confined to Naxalbari Tea Estate area. The elephant moves from Nepal to Assam and Assam to Nepal between May to June for maize crop season and September to December for wheat crop season which result in conflict with people. About 40 person killed in last few years by elephant and about 800 people injured in last 5 to 7 years. Tree felling in non-forest areas also is a	Measures are proposed to for adequate signage, speed control and undivided road carriageway.

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
			matter of concern. Following suggestions are made: 1. Adequate signage shall be placed in the elephant area cautioning elephant movement zone with pictures. 2. Under pass may or may not serve the purpose of ensuring animal movements through the underpass for road crossing. However, it is still a preferred option if its height is kept for more than 10 ft. and with wider opening. 3. Speed breakers and signage is preferred option additional as this will help to protect animals accidents with vehicles. 4. No divider shall be provided in the road as it hinders the fast movement of animals. 5. No fluorescent lights shall be installed in the animal crossing area of the road since animal gets distracted from the light because the reflected light give a fire feeling to the animals. 6. Maximum possible tree plantation shall be made.	
April,2012 and May 2012,	Field Directors Office, Alipur Duar, Jalpaiguri. Mr. R.P.Saini, Field Director, Buxa Tiger Reserve. Mr. V. Salimath, IFS, Deputy Field Director, Buxa Tiger Reserve (West) Mr. Bhaskar J.V. IFS, Deputy Field Director (East)	Animal movement and road development	The undisturbed elephant movement has to be ensured while any development takes place with the fast moving vehicle, elephant gets scared and comes and stand on the road. For elephant crossing in the Jaldapara National park, four under passes at identified crossing areas is desired with the trench on either side to divert elephant to the under pass locations. No separate data is available on the accident of Bison. In addition to the bypass,	Provision of Underpass in Jaldapara National made. Alternative alignment is suggested to to shift the bypass somehow away from Hashimara town to minimise the Man-Animal conflict. Measures are proposed to regulate traffic in the event of elephant movement. Official were inclined to the proposed measures

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
			speed should be limited to 25km / hr. in the elephant movement area. The proposed Pasaka bypass and road close to Hasimara is elephant conservation area. It is desirable to have an elevated road in this area provided it is technically feasible.	
NGOs				
April 2012,	Himalayan Nature and Adventure Foundation, Nivedita Market, Siliguri. (It's a leading NGO dealing in Animal Protection, Environmental Awareness. Mr Bose HNAF Siliguri	Effect on Wild Animal particularly on Elephants Movement due to the proposed project, Bio- Diversity of the area, effect of pollution on bio-diversity	There is no safe corridor for elephant movement. The Sanctuary and forest area is frequently traversed by Asian Elephant. Their population is about 500 Nos in this area. The man and animal conflict is maximum and there are many persons death due to this conflict. The elephants comes in urban area in search of water and food. The road development is welcomed, but all type of widening should be done in one go but not in Phases like 2 lane now and 4 lane later. Wherever animal crossing is there and four lane development takes place then provision of under pass or flyover should be made. To prevent man and animal conflict, create grasslands, plant food bearing trees, create water bodies, and create more fodder availability for elephants in the forest area. No banana tree shall be planted along the houses located close to its movement areas. Create more awareness about animal protection, create provision of reflective signage.	Provision of Underpass is proposed in the Jaldapara National Park Area and installation of Caution Signage is made. Road development will take place as per traffic density and road viability.
April 2012,	Naxalbari Science and Adventure association (formally Naxalbari vigyan club). Mr. Dhruba Jyoti Rao	The animal movement, water availability, sanitation, tree plantation and	No concern for widening of the road including tree cutting since Panitanki to Bagdogra has enough RoW. There is a small no. of tree plantation in this stretch.	Provision of providing caution signage for elephant movement with adequate lighting shall be made in the

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	(Secretary) and Mr. Pran Govinda Nag. (It's a leading NGO dealing in afforestation and sanitation)	afforestation	To increase the tree density should be increased through social forestry. Only local variety of trees shall only be grown. The tree like eucalyptus shall be avoided. The afforestation shall be carried out on 1:3 basis and each tree plantation shall be protected with iron wire mesh. The elephant crosses the road near Kiran Chand Tea Estate between Panitanki and Naxalbari in the month of October to November and May to June. The elephant enters the agriculture field for eating the rice crop. They come from Tukari Range Reserve Forest and go upto Bagdogra Forest Range. The water is available. The ground water table is at 20 to 25 feet below the ground level and as such water and sanitation is not an issue in the area.	elephant movement area. Provision is made for compensatory tree plantation on 1:3 basis.
April 2012	Naxalbari Integrated Development Society, Village Satbhya, Naxalbari. Mr. Pradeep Prasad, General Secretary and founder. Ms. Manjula Begum, founder member Mr. Sanjay Prasad, Advisor.	The animal movement, water availability, sanitation, tree plantation and afforestation.	The road development is a long awaited demand and the road widening should happen at the earliest. The bad condition of the road is also responsible for high air pollution near the road. Due to bad conditions of the road there is substantial instances of road accidents, bus over topping. There is no issue of flood or animal accident however quality of drinking water is an issue due to presence of arsenic and iron presence. Elephant crosses the road between Satbhiya to Sanasi Tea Estate. The movement of animal is very limited is once	-do-

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
			or twice in summer and winter.	
April 2012,	Jalpaiguri Science and Nature Club, Nivadita Marg, Naya Basti, Jalpaiguri. Mr. Raja Routh, Joint Secretary. (Its an NGO focusing on Natural Conservation, Wildlife conservation and creating awareness among the people.)	Proposed Road Development, Wildlife Protection and Conservation of Natural resources.	The organization always support infrastructure development provided adequate safeguards are incorporated in the project design for the protection of animals. The development of road increases the possibilities of Man and Animal conflict particularly of Bison, Elephant, Leopard in Jaldapara Range area. Suggestion made by them includes : 1. Creating awareness among various stakeholders (Students, Forest native people, villagers and drivers) on nature and animal protection. 2. Create adequate safe animal crossing passages, either in the form of under passes or speed limits.	Provision of Underpass is made in the Jaldapara National Park area. Provision of awareness is made.
May 2012,	Science & Nature Group, Jalpaiguri, Mr. Kunal Banergee, Mr. Raja Rao Mr. Nihar Ranjan Ghosh And Mr. Pran Dapinder	Environmental Impact of the road development with its emphasis on Air Pollution, Water Pollution, Flora and Fauna	No major impact is expected on Air, Water Noise or Fauna from this road development except in the animal road crossing locations in Jaldapara National park Areas where adequate provision for safe passes of animals shall be made. No migration of birds are seen in project road area. No spawning or breeding ground in both the road alignment areas.	-do-
May , 2012	Mr. Nehar Rajan Bose, Social Worker and Environmental Activists cum Reporter, Uttar Banga Sangbad, Jalpaiguri	Environmental Impact of the road development with its emphasis on Air Pollution, Water Pollution, Flora and Fauna	Road development will improve air quality due to reduction in dust generation after road improvement. No much impact is anticipated due to cutting of roadside trees. No impact is anticipated on wild life. No Wildlife death/ damage reported in recent past excepting rare cases of Deer death/ damage (4-5) cases seen within Tursa river to Madarihat area (7 Km. Stretch).	Adequate signage will placed. Compensatort Tree plantation is proposed on 1:3 ratio itself.

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
			Elephant and Bison accidental death is frequent with railways but leopard death is rare (2-3 case in last 10 years). Main migratory period of elephant is June to September from 6 P.M to 4- 5 A.M. Very few cases of Rhino and Bison movement above road. Snake death/ damage in both Railway and road occur. Alert zone should be identified and notified to prevent man – animal conflict. Speed limit shall be fixed between Tursa river to Madarihat area (7 Km. Stretch) to minimise animal accident. Tree of religious importance shall be cut in consultation with communities concerned. Compensatory tree shall be undertaken on minimum 1:3 ratio. Plantations shall be selected with less canopy cover and small leaf species like Debdaru, Gulmohor. No impact is anticipated on noise and water resources.	
May 2012	Social Worker and Environmental Activists, Sur Natya Sangathan & Part Time Lecturer, Jaigaon College, Jaigaon	Environmental Impact of the road development with its emphasis on Air Pollution, Water Pollution, Flora and Fauna	Elephants move within Hasimara to Madarihat area for fodder mainly due to grown crops. Exceptionally, Samber, deer, bison comes outside the park for sufficient Fodder from agriculture land. No road animal accident occurred in this region in last few years. No large canopy plants should be planted. No plants of aromatic and fodder plants should be planted to invite wild animals towards road. Fodder plants should be planted inside park	Enhancement measures are proposed for availability of fodder inside the park.

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
			for reimbursement of plant cuttings. Water facility inside the park should also be improved. Religious tree shall be cut with concurrence from the community.	
Village Panchayat (Village Administration and Public)				
April 2012, and May 2012	Naxalbari Panchayat, Mr. Anil Burgani, President, Male (3) female (10) villagers and Panchayat members. (Names of villagers not given)	Impact on various components of environmental quality and water and tree plantation issue.	No environmental issue particularly with respect to air quality, noise levels and soil quality. No issue of flood from Mecchy river due to high embankment barriers on Indian side of the river. No issue of water logging since rain water easily drained out. They suggest to take adequate signage and speed control measures for preventing Man – Animal conflict. The road has many instances of soil erosion and subsidence. Therefore road embankment should be well strengthened and well stabilized. Village Panchayat shall be ready to plant extra trees for compensatory afforestation purposes on the extra land available under its control. They are also ready to provide workers for plantation purposes.	Road Embankment will be strengthened through slope stabilisation techniques and required design measures. Wild life protection measures suggested under EMP Larger participation of Panchayat is proposed for tree plantation
April' 2012	Raniganj Gram Panchayat, Village Panchayat Office. Mr. Handru Oraom, Pradhan (President) Mrs. Bina Mandal, Vice Pradhan Mr. Narendra Nath Sinha, Executive Assistant, Mr. Abhijeet Chaudhary,	Impact on various components of environmental quality and water and tree plantation issue.	Members welcome the initiative of widening the road. No issue of water, air, noise or soil pollution. Concern with tree cutting and congestion at railway line crossing. Suggested the following : 1. The road alignment may be taken from inner road to bypass railway crossing and Naxalbari Market area, otherwise	ROB is proposed at railway crossing to avoid congestion. Bypass to Pantitanki is proposed on the Northern Side of the existing alignment. Design measures are being

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	G.P. Assistant Mr. Madhusudan Sarkar, G.P. Member and 3 females villagers (Name of village female not given)		ROB shall be constructed to avoid traffic congestion at railway crossing. 2. Culverts shall be provided close to the road at various locations depending on drainage flow and ensure periodic maintenance to prevent its siltation. 3. Trees should be saved to the maximum possible and temples can be shifted close to tree line areas. 4. Surveillance posts shall be created at a distance of 200m each for 1km stretch of elephant movement to prevent man and animal conflict. 5. The Panchayat is ready to plant compensatory trees through various government schemes along the road and PMGSY road.	taken to avoid tree cutting as much as possible. Larger participation of Panchayat is proposed for tree plantation
May-2012	GP office, Paschim, Khairwadi, Rangalibazana, Jalpaiguri Mr. Pulok Roy, Mr. Uttam Dey, Ms. Modhumita	Environmental Impact of Road development with respect to Air pollution, Noise pollution, water availability and pollution, loss of trees, shifting of community structure, animal movement, soil erosion, flood, safety and acceptability to the road development project	In favour of the project, no environmental concern due the project development. Ready to cooperate for tree plantation. Water availability is not a concern. Suggested to minimize tree cutting as much as possible. Also suggested to stabilize road embankment and exercise cautioned for hazardous traffic situations during construction.	Measures are proposed to minimize tree cutting through design measures. Measures are also proposed for embankment slope stabilization and traffic control during construction stage.
AH-48				
May-2012	Opposite Railway Station and near temple and hospital, Changlabandh, Nekliganj, Cooch Behar, Ms. Nandita, Mr. Tapan Dam, Mr. Rajib Sorkar, Mr. Laxman Saha, Ms. Laboni,	-do-	Very much in favour of the road improvement. Impact with respect to Air and noise pollution may be there but of lesser magnitude and have very little concern for the same. Suggested to plan more no. of trees. The temple may be impacted however, they are ready to shift the temple.	Provision of more tree plantation is proposed.

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	Mr. Sanjib Bose, Mr. Arun Sarkar, Trinayan			
April-2012	Temple, Kalasibandha, Nekliganj, Cooch Behar Mr. Nirmal Roy, Vrishti	-do-	In favour of the project consider little impact due to the project.	-
April-2012	Club, Ghoskadanga, Mayanaguri, Jalpaiguri Mr. Govind Barman, Mr. Parimal Roy, Mr. Madhab Roy, Mr. Ratan Roy, Mr. Doram Roy, Mr. Uttam Roy, Bandana	-do-	In favour of the project, no environmental concern due the project development. Suggested to have good mechanism for period road maintenance.	Measures are proposed for sustenance of environmental measures during operation stage.
April-2012	School, Ghoskadanga, Mayanaguri, Jalpaiguri Mr. Tapan Das, Mr.Jayanto Roy, Mr. Alok Roy, Shila Das	-do-	In favour of the project, no environmental concern due the project development. Suggested to take measures for the safety of students	-
May-2012	Temple, Madhudanga, Mayanaguri, Jalpaiguri Mr. Gonesh Saha, Mr. Paridosh Roy, Lata Saha, Mr. Bisnudeb Nath, Mr. Chanan Deb Nath Mr.Anashav Roy, Sagarika	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Bateshwar, Madhudanga, Mayanaguri, Jalpaiguri Mr. Hirondas, Mr. Chandon Das, Mr. Prakash Roy, Pinki Roy, Indrayani	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	BDO Office, Mayanaguri, Mayanaguri, Jalpaiguri Mr. Samrat Chakroborty BDO, Mr. Rajiv Dutta Choudhari Asst. BDO,	-do-	In favour of the project, no environmental concern due the project development. Suggested to have a development upto 4 lane not itself	-
May-2012	BDO Office, Mayanaguri, Mayanaguri, Jalpaiguri New BDO Mr. Kalyan Baruah, Mr. An.N. Raichur	-do-	In favour of the project, no environmental concern due the project development	-

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	Office Supertindentent,			
May-2012	Club, Takatuli, Mayanaguri, Jalpaiguri Mr. Dipakar Sarkar, Mr. Gokul Das, Mr. Deepal Pandal, Mr. Gopal Sen, Mr. Amit Dutta, Mr. Dilip Paul, Ms Rachana Roy	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Jaldhaka bridge, Jaldhaka, Dhupguri, Jalpaiguri Mr. Bipil Roy, Mr. Bikram Singh, Ms. Dhurjati Das	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	- Convent, Magurmari, Dhupguri, Jalpaiguri Mr. Fr. Alberto, Ms. Brinda,	-do-	In favour of the project, no environmental concern due the project development. Concerned for road safety and suggested to provide signal, passes for cycle.	Measure for safety are proposed under EMP
May-2012	Cremation, Galandimor, Dhupguri, Jalpaiguri Mr. Chinta Adhikari, Mr. Krishna Das, Ms. Bijoya Das	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	School, Mallik Sova – Gosairhat, Dhupguri, Jalpaiguri Mr. Abel Tirki, Mr.Bimal Roy, Mr. Jia Ul Haque, Mr. Purbi Roy, Mr. Tapaskumar Bhadra Principal,	-do-	In favour of the project, no environmental concern due the project development. Little concern for air and noise impacts. Considered this area as an accident spot as few accidents has happened in the past, suggested to provide safe passes for the students and cyclists.	Measure for safety are proposed under EMP
May-2012	Mazar Sharif, Sonakhali, Dhupguri, Jalpaiguri Mr. Samsul Alam, Mr. Mushtaq, Ms. Rehana	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Shakovajhora, Dangiapara, Dhupguri, Jalpaiguri Ms. Gitarani Ghosh,	-do-	In favour of the project, no environmental concern due the project development	-

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	Mr.Nikhil Pal, Mr. Ranjit Roy, Mr. Bimal Pal, Ms. Mita Pal			
May-2012	School, Gairkata, Dhupguri, Jalpaiguri Mr. Priyalal Debnath, Mr. Shantanu Dey, Ms. Radharani, Ms. Tara Dey	-do-	In favour of the project, no environmental concern due the project development. Concerned for student safety and suggested for speed breakers	Measure for safety are proposed under EMP
May-2012	PHC, Paschim Khairwadi, Rangalibazana, Jalpaiguri Pulok Roy, Uttam Dey, Kajoli, Usha, Uttara	-do-	In favour of the project, no environmental concern due the project development. Suggested for measures for air and noise pollution due to the projects.	Measures for noise and air pollution control are proposed under EMP.
May-2012	High School, Madarihat, Madarihat, Jalpaiguri Mr. Bidyutkr Sarkar, Mr. Ranjit Das, Mr. Saban Das, Mr. Raju Roy, Mohd. Rahim, Mr. Samar Saha, Ms. Indrani, Ms. Joyeeta	-do-	In favour of the project, no environmental concern due the project development. Concern for the safety and suggested for signalling system.	Measure for safety are proposed under EMP
May-2012	BDO Office, Madarihat, Madarihat, Jalpaiguri Mr. Hiruk Mandal, BDO,	-do-	In favour of the project, no environmental concern due the project development. Concern for the safety and suggested for signalling system.	Measure for safety are proposed under EMP
May-2012	PHC, Madarihat, Madarihat, Jalpaiguri Mr. Sushant Bhattacharya Mr. Ranjan Chakraborty, Ms. Bharani Sarkar	-do-	In favour of the project, no environmental concern due the project development. Concern for the safety and suggested for signalling system.	Measure for safety are proposed under EMP
May-2012	- Cremation Temple, Hasimora Farmalangi, Kalchini, Jalpaiguri Mr. Gopal Khetri, Mr. Bimal Chakraborty,	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Temple, Hasimora, Kalchini, Jalpaiguri Mr. Dilip Muzumdar, Mr. Iswardas Aggarwal	-do-	In favour of the project, no environmental concern due the project development	-

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
May-2012	Masjid, Dalsingpara, Kalchini, Jalpaiguri Mohd. Wasi Aktha, Shaikh Abdulla,	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	School, Dalsingpara, Kalchini, Jalpaiguri Mr. Ranjeet Jaiswal, Mr Thomas Principal, Ms. Arudra Dey	-do-	In favour of the project, no environmental concern due the project development.	-
May-2012	High School, Dalsingpara, Kalchini, Jalpaiguri Mr. Kansal Kishori Head Master, Mr. Chandrabhanu Sharma, Mr. Rajkumar, Mr. Sambhu Jaiswal, Mr. Pradhan Dalsingpara,	-do-	In favour of the project, no environmental concern due the project development. Concerned for likely increase in Noise and Air pollution and safety of students. Also, is in favour of one time development of upto 4 lane highway.	Measures for noise and air pollution control and safety are proposed under EMP.
May-2012	Masjid, Dalsingpara, Kalchini, Jalpaiguri Mohd Emamul Haque, Mohd. Akram Haque, Janab Pir Mohemmed,	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Primary School, Khokla, Kalchini, Jalpaiguri Mr. Bharat Sharma, Mr. Vikram Lama, Mr.Sipnal Saha, Ms. Ashlesha Roy, Mr. Atish Gurum, Mr. Gopal Khatri, Mr. Santosh Lama, Mr. Rajesh Pradhan, Ms. Magha Dey, Mr. Robin Lama, Mr. Pritam Sewa, Ms. Bimla Darjee, Sujata Darjee, P.Phalguni	-do-	In favour of the project, no environmental concern due the project development. Concerned for likely increase in Noise and Air pollution and safety of students.	Measures for noise and air pollution control and safety are proposed under EMP
May-2012	Convent School, Mangalbari, Kalchini, Jalpaiguri Mr. Purna Subba, Mr. Amar Bahadur, Mr. Lal Bahadur	-do-	In favour of the project, no environmental concern due the project development. However, is concerned about the safety of students.	-

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	Bishwa, Mr. Ram Bahadur. Ms. U.Phalguni			
May-2012	Market Jaigaon, Jaigaon, Jalpaiguri Mr. Ganesh Bahadur Pradhan, Mr. Pawan Rayamajhi, Ms. Hastha	-do-	In favour of the project, no environmental concern due the project development	-
AH-02				
May-2012	Kakarbhita, Nepal O point, Kharibari, Darjeeling		In favour of the project, no environmental concern due the project development. Ready to cooperate for tree plantation. Water availability is not a concern. Suggested to minimize tree cutting as much as possible. Also suggested to stabilize road embankment and exercise cautioned for hazardous traffic situations during construction.	Measures are proposed to minimize tree cutting through design measures. Measures are also proposed for embankment slope stabilization and traffic control during construction stage.
May-2012	Check Post India, Panitanki, Kharibari, Darjeeling, Mr. Amal Singh, Mr. Mantu Mandal, Pradhan, Mr. Handur Orao, Shonalika, tumpa, shriti, monali, Mr. Ranjit Basak, Mr. Prabin Chhetri, Rajan PO Bahundangi, Dist Chapa Nepal, Ms. Neerajana, Ms. Sneha,	-do-	In favour of the project, no environmental concern due the project development. Suggested to carryout all kind of development one time only. If road is to be widened to four lane, the same shall be carried out this time only. Traffic congestions problem shall be resolved.	Design Measures are proposed under EMP for minimising the problem of congestion.
May-2012	Railway crossing, Naxalbari, Naxalbari, Darjeeling Mr. D.K. Mishra, Principal, Mr. Anil Barman Pradhan	-do-	In favour of the project, no environmental concern due the project development. Suggested to construct flyover at railway crossing to minimise traffic congestion.	Provision of ROB is made in the project design
May-2012	School / Temple, Borojhoro, Naxalbari, Darjeeling Mr. Mangal Singh, Mr.	-do-	In favour of the project, no environmental concern due the project development. Concern for likely increase of Noise level if	Safety measures proposed in the EMP. Provision of Noise barrier made based on

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
	Phulan Singh,		increase in traffic is high. Suggested to regulate speed around school and temple	predicted noise level for such situation in the EMP
May-2012	Primary School, Hatighisa, Naxalbari, Darjeeling Mr. Rajesh Kindo Mr. ienius Kindo, Ms. Baijayanti;	-do-	In favour of the project, no environmental concern due the project development. Safety measures shall be taken for students safety	Safety measures are proposed under EMP
May-2012	- Godadhar Puli, Upper Bagdogra, Naxalbari, Darjeeling Mr. Fr. Gorge Mathews, Mr. Fr. Monnen Joseph Director Ms. Drishti	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Market, Bagdogra BAlika Vidyalaya, Upper Bagdogra, Naxalbari, Darjeeling Mrs.Smriti Roy, Mrs. Durba Roy, Ms. Panchali Roy, Ms. Samali	-do-	In favour of the project, no environmental concern due the project development. Concerned for safety of Students. Suggested to make provision of Flyover for the safety of students and minimise congestion.	Safety measures are proposed under EMP
May-2012	University, Bagdogara, Naxalbari, Darjeeling Prof. Dr. A. P. Das Dept. of Botany NBU,	-do-	In favour of the project, no environmental concern due the project development	-
April-2012	Budiwalason, Naxalbari, Darjeeling Mr. Narayan Das, Ms. Darpana Das	-do-	In favour of the project, no environmental concern due the project development	-
May-2012	Shushrutanagar, Kadamtala, Matigara, Darjeeling, North Bengal Medical College Dr. Sabyasachi Das Med. Superintendent, Dr. Tapas Pal Asst. Superintendent, Mr. Chandan Dhar HC,Ms. Taneesha Banerjee, Ms. Mausami Dey	-do-	In favour of the project, no environmental concern due the project development. Suggested to take measures for minimise the noise and air pollution around Hospital area. Regulate the traffic especially during construction stage	Measures for pollution control and traffic regulations are proposed under EMP

Date	Location, Name and Address of the person/ agency met	Issues discussed	Comments/Recommendations of Persons Met	Actions of Comments/ Recommendations
April-2012	Kawakhali, Matigara, Darjeeling, Jr High School Dr. Mandal, Krishna Barma, Mr. Dhiraj Shah, Mr. Deepesh Roy, Mr. Asid Barma, Mr. Tapeshkr. Mr. Mandal, Ms. Nilima, Ms.Sudipta Roy. Ms. Geetanjali Roy	-do-	In favour of the project, no environmental concern due the project development. Concern for safety of student	Safety measures are proposed under EMP
April-2012	Naukaghat cros, Kamagaguri, Siliguri MC, Jalpaiguri Mr. Amit Sarkar, Ms. Ekantika Roy, Ms. Himani Chatterjee	-do-	In favour of the project, no environmental concern due the project development	-
April-2012	Teesta Canal, Naxalbari, Darjeeling Mr. Sidam Sarkar, Ms. Shomili	-do-	In favour of the project, no environmental concern due the project development	-
April-2012	Ranidanga, Naxalbari, Darjeeling, Mr. P.C. Mandal, Ms. Tuhina Roy, Mr. Mishti Dey,	-do-	In favour of the project, no environmental concern due the project development. Concern for tree loss. Suggested to minimise tree cutting. Suggested to take adequate measures for safety.	Measures for minimising and compensatory tree plantation as well safety proposed under EMP
May-2012	Ranidanga, Naxalbari, Darjeeling Mr. Jugal Kishor Saha, Mohammad Muslim, Mr. Mahindranath Adhikari, Mr. Naresh Singh, Mr. Amritlal Sarkar, Ms. Shubhangi, Ms. Falguni Roy	-do-	In favour of the project, no environmental concern due the project development. Suggested to make provision of divider for regulating the traffic and smooth flow of traffic.	-

Appendix 8.1A : Public Consultation Photographs

Public Consultation Stage-I: with NGOs, Village Panchayats, and Public

Public consultation at Naxalbari, Village Panchayat Office

Public consultation at Naxalbari, Village Panchayat Office

Discussion with Leading NGO at Siliguri

Interaction With Leading NGO at Naxalbari

Public Consultation with villagers

Public Consultation Stage-II Disclosure at Naxalbari United, North Bengal

Public consultation at Naxalbari, United Club

Presentation of EIA Findings

Presentation of EIA Findings

View of Active Women Participation

Respondents Extending Support in Favour of the Project

View of Interaction Session

Public Consultation Stage-II Disclosure meetings at Maynaguri, North Bengal

Presentation of EIA Finding

Respondents Extending Support in Favour of the Project

View of Interaction Session

View of Active Women Participation

Public Consultation Stage-II : Workshop held at Siliguri on 27th July, 2013

Presentation by Mr. S.K.Jain PPTA Environmental Safeguard Specialist

View of Active Participation of Participants

Experts and Team Members and Participants Interaction

Appendix 8.1B: List of Participants with Signature of Public consultation

Public Consultation (Stage II)
Environmental Impact Assessment: Findings & recommendation
SASEC Road Connectivity sector project
Organised through: Naxalbari Integrated Development society

Attendance Sheet

Date: 23/07/2013

Location: AH-2 Naxalbari, United Club

Sl. No.	Name	Designation, Address with contact number	Signature	Remark
1	Mamta Das	Housewife 9851347703 Naxalbari, Rathkhola	Mamta Das	W
2	Chouki Sonar	Housewife 9332218001 Naxalbari Rathkhola	Chouki Sonar	W
3	Sarita chetri	Housewife (Srijana S.H.G) 7872802421	Sarita Chetri	W
4	Bibha Chhetri	Housewife (Ankur Samaniswa)	Bibha Chhetri	W
5	Smita Dahal	Housewife (Diya S.H.G)	Smita Dahal.	W
6	Birjina Ekka	Tea Estate labour Premani S.H.G Belgachi	Birjinia Ekka	

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ublic Consultation (Stage II)
nvironmental Impact Assessment: Findings & recommendations
SASEC Road Connectivity Sector project
Organised through: Naxalbari Integrated Development Sector

Attendance Sheet

Date: 23/07/2013

Location: AH-2 Naxalbari, United Club

Sl. No.	Name	Designation, Address with contact number	Signature	
7	Dhiren Barai	Belgachi T.E	[signature]	M
8	Chandan Kr. Goswami	Naxalbari (Bazarpara) Ph no. 9933480184	[signature]	M
9	Renuka Munda	Belgachi	[signature]	W
10	Bhola Roy	Bhagilkam jot	[signature] 20/7/13	M
11	गणेश साह	ग्राम तोताशमजोत	गणेश साह 23/07/2013	M
12	Shatrughan Sahani	Uttar station para Naxalbari	[signature] 23/7/13	M

ublic Consultation (Stage II)
Environmental Impact Assessment: Findings & recommendation
SASEC Road Connectivity sector project
Organised through: Naxalbari Integrated Development Society

Attendance Sheet

Date: 23/07/2013 **Location:** AH-2 Naxalbari, United Club

Sl. No.	Name	Designation, Address with contact number	Signature
13	Arina Ekka	Tea State Labour Premoni S.H.G Belgachi	[illegible]
14	Agnesia Toppo	" Diplka S.H.G. Belgachi	[illegible]
15	Magita Beck	" Shan S.H.G Belgachi	manpritha [illegible]
16	Shib Rai	Nurse of GUP	23/07/13
17	Binni Roy (DAD)	Counsellor of GUP	[illegible] (DAD) 23/7/2013
18	Debashree Pawl	N.R.W.C.D.S (NGO) President. Naxalbari Rath Khola. 01985140212 3	Debash. P.

Public Consultation (Stage II)
Environmental Impact Assessment: Findings & recommendations
SASEC Road Connectivity sector project
Organised through: Naxalbari Integrated Development society

Attendance Sheet

Date: 23/07/2013

Location: AH-2 Naxalbari, United Club

Sl. No.	Name	Designation, Address with contact number	Signature	
19	Sampa Ghosh.	NRWCDS (NGO) J. SEC 9851273913.	23.7.2013	W
20	Jagshree Chowdhury	NRWCDS (NGO) Member 8906564266	J. Chowdhury 23.7.2013	W
21	Jhirmait Munda	Mayna SHG Belgachi	झिरमैत मुण्डा	W
22	Manika Sarkar	Bhaglisam Jote 9851970341	Manika Sarkar 23/7/13	W
23	Fulmani Sarkar	Bhaglisam Jote 8972247813	Fulmani Sarkar 23/7/2013	W
24	Reba Gosawmi	Bhaglisam Jote 9775801975	Reba Gosawmi 23/7/2013	W

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...lic Consultation (Stage II)
...ronmental Impact Assessment: Findings & recommendation
SASEC Road Connectivity sector project
Organised through: Naxalbari Integrated Development society

Attendance Sheet

Date: 23/07/2013

Location: AH-2, Naxalbari United Club

Sl. No.	Name	Designation, Address with contact number	Signature	
25	Mamani Roy	8759303663 Bhagliram Jote	Mamani Roy	W
26	Riya Sarkar	8759303663 Bhagliram Jote	Riya Sarkar	W
27	Sabtri Singh	8759303663 Bhagliram Jote	sabtrisingh	W
28	Purnima Sarkar	8759756588 Bhagliram Jote	Purnima Sarkar	W
29	Gita Oraon	Punitanki Bagan mahela Dal 9002871566 Satish Chanina T.E	G. Oraon	W
30	Krishna Barman	Janiti saw nivan Dal 8972742949 Gaursing Jote	Barman 23.7.13	W

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lic Consultation (Stage-II)
ironmental Impact Assessment: Findings & recommendation
SASEC Road Connectivity Sector project
Organised through: Naxalbari Integrated Development society

Attendance Sheet

Date: 23.07.2013

Location: Naxalbari, United club

Sl. No.	Name	Designation, Address with contact number	Signature	
31	Ibi Barman	7620113311 Megs S.H.S Gourshingjote	Ibi Barman 23-7-13	W
32	Shibani Roy	Paultanki Rural Dev. Edu Society (PRDES)(NGO) 9733458199	S Roy 23/7/13	W
33	Apsara Nirola.	PRDES (NGO) 8768951939	[signature] 23/7/2013	W
34	Biren Kamakar	9851546446.	[signature] 23.7.13	M
35	Chandan Bagh	9232685332	[signature] 23/7	M
36	Nanda Lohar	LIC OF INDIA AGENT 9641091995	[signature] 23/7/2013	M

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Public Consultation (Stage-II)
Environmental Impact Assessment: Findings & recommendations
SASEC Road Connectivity Sector project
Organised through: Naxalbari Integrated Development society

Attendance Sheet

Date: 23.07.2013

Location: Naxalbari United Club

Sl. No.	Name	Designation, Address with contact number	Signature	
37	Ram Chandra Prasad	President, Sarbajanik Jana Kalyan Samity 9733062848	[signature]	M
38	Piter Oraon	Tea Estate leabour	[signature]	M
39	Filsita Kujur	"	[signature]	M
40	Sabina Bike	Udaya S.H.G Belgachi	[signature]	W
41	Sabitra Munda	Dipika S.H.G Belgachi	[signature]	W
	Parbati Roy	(Sukhi S.H.G) 9800480300 Vill-Panitanki)	Parbati Roy	W

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Public Consultation (Stage II)
Environmental Impact assessment: Findings & recommendations
SASEC Road Connectivity Sector project
Attendance Sheet
Organised through: Naxalbari Integrated Development Society

Date: 23.07.2013

Location: Naxalbari, United Club

Sl. No.	Name	Designation, Address with contact number	Signature	
43	Sajal Barman	Labour, Belgachi	[illegible]	M
44	Amrita Minz	Ujjala S.H.G Tea Estate labour Belgachi	अमृता मिंज	W
45.	[illegible]	Social Service 9733294127,	[illegible]	M
46.	Manjula Prasad.	G.S. NRWCDS (NGO) 9531[illegible]747193	[illegible]	W
47.	Pradip Prasad	Founder cum General Secretary (NIDS) Naxalbari Ph. 97332-56221	[illegible] 23/07/13	M
48.	DR-M-A-Khalid	CEO, Biodiv & CC Div. EQMS India Pvt Ltd. New Delhi 9818425530	MKhalid	
49	S. K. JAIN	ADB-PPTA Environment Safeguard Specialist Director-Technical EQMS INDIA PVT. LTD. Ph: 9810292612	[illegible]	
50.	Subhashree Adhikary	Environmental Scientist, EQMS India Pvt Ltd Ph: 9811404229	[illegible]	

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Workshop on Environmental Impact Assessment of SASEC Road Connectivity Sector project : Two sampleroads

Attendance Sheet

Date: 27.07.2013

Location: Cindrella Siliguri

Sl. No.	Name	Designation, Address with contact number	Signature
1.	Nirmal Mondal	Acting Project Director SASEC Project 9434013065	[signature]
2.	Jitendra Kumar Patel	Assistant Project Manager PIU, Siliguri SASEC Project 9434422689	[signature]
3.	Pradip Prasad	Naxalbari Integrate Dev. Society Naxalbari. General Secretary 9733256221	[signature]
4.	Manjula Prasad.	Naxal Bari Rural Women & Child Development Society G.S. Cont. 7501413370.	[signature]
5.	Tapas Karmakar	Programme Manager CONC'RN 48, N.S. Bose Road East Bhakti Nagar Jalpaiguri	[signature] 9332351044 e-mail: Karmalapas@yahoo.com
6.	Ramakrishna Sahu	Naxalbari Integrate Development Society Naxalbari. 9614223593	[signature]

Workshop on Environmental Impact Assessment of SASEC Road Connecturty sector project: Two sample roads

Attendance Sheet

Date: 27.07.2013 **Location:** Cindrella Hotel Siliguri

Sl. No.	Name	Designation, Address with contact number	Signature
7	RAJ NAIR	Team Leader ADB TA 8116	[signature]
8.	Lisa Prasanna Ray	ACH, SJDA 9735918645	[signature]
9	SASMITA GHOSH	DCPO - Jalpaiguri 9832061136	[signature]
10	Debasish Sam	CONCIRN 9832093701	[signature]
11	A. R. Modak	S.E. NHC - III 8509505520	[signature] 27.7.13
12.	S. Biswas	SSOLVE Member. 9531744600	[signature]
13.	D.K. Singh	E.E / Jalpaiguri Hwy division - 94343-49866	[signature]

Workshop on Environmental Impact Assessment of SASEC Road Connectivity Sector project: Two sample roads

Attendance Sheet

Date: 27·07·2013 **Location:** Cindrella Hotel, Siliguri

Sl. No.	Name	Designation, Address with contact number	Signature
14	Basana Das	ICSRS Staff 8389844467	B. Das
15	Kakita yadav	Ideal center for Social 8509557833	Kakita yadav
16	Nanda Lohar	Naxalbari Rural & Child Dev. Socity (NRWCDS)	[illegible]
17.	Atanu Karmakar	Accountant, District Child Protection Society, Darjeeling, 9832423195	[illegible] 27/7/13
18.	Dr-M-A-Khalid	CEO, Biodiv & CC EQMS India Pvt Ltd New Delhi 9818425530	[illegible]
19.	S.k Jain	Director, EQMS India Pvt ltd; Delhi 9810297612	[illegible]
20	Subhashree Adhikary	Environmental Scientist EQMS India Pvt Ltd, 011-30003206	S Adhikary

Workshop on Environmental Impact Assessment of SASEC Road Connectivity sector project : Two sample roads.

Attendance Sheet

Date: 26/7/2013 **Location:** Maynaguri Dist: Jalpaiguri

at Maynaguri Sparsha welfare Society

Sl. No.	Name	Designation, Address with contact number	Signature	
1	Gayatri Ray	Group: Dream 'P' Vill+P.O. Bhotepatty P.S. Maynaguri Dt. Jalpaiguri	Gayatri Ray Ph. 9531625190	W
2.	Pampa Ray	Phone No - 9749578996 Group - Dream 'P' Vill + P.O - Bhotepatty, P.S - Maynaguri, D.S - Jalpaiguri.	Pampa Ray	W
3.	Dipali Roy	~~Gp~~ Group - Dream 'P' Vill+P.O - Bhotepatty. P.S - Maynaguri, D.S - Jalpaiguri	Dipali Roy	W
4.	~~chandana Roychoudhury~~	Group - Dream 'P' Vill+P.O - Bhotepatty. P.S - Maynaguri, D.S - Jalpaiguri	chandana Roy choudhury	W
5.	Dipali Roy	Group - ~~Dream~~ Radhagobinda' S.H.G Vill+P - Madhyakhagrabari P.S - Maynaguri D.S - Jalpaiguri	Dipali Roy. 9547219187	W
6.	Bina Roy	Group - Aparajita (S.H.G) vill - Uttar Khagrabari P.O - Maynaguri P.S - Maynaguri Dist - Jalpaiguri	Mob. 8116209762 Bina Roy	W

Workshop on Environmental Impact Assessment of SASEC Road Connectivity sector project : Two sample.

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
7.	Jharna Roy	Group- Aparajita (S.H.G) vill- uttar Khagra bari P.O+P.S- mayna guri Dist - Jalpai guri	mob-7602895493 Jharna Roy	W
8.	Chabi munda	Group- Aparajita (S.H.G) vill- uttar Khagra bari P.O+P.S- mayna guri Dist - Jalpai guri	chabi munda	W
9.	Arachana Roy	Group- Aparajita (S.H.G) vill- uttar Khagra bari P.O+P.S- mayna guri Dist - Jalpai guri	Arachana Roy	W
10.	Basanti Roy	"	Basanti Roy	W
11.	mitali Roy	"	mitali Roy	W
12.	Malati Sarkar	Tulshi S.H.G. vill+P.O, chuna Bhandar P.S. Maynaguri + Jal	Malati Sarkar 8513023958	W

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
13.	Chitrabi Mandal	"	Chitrabi Mandal	W
14.	Mausumi Roy	Group – Radha Gobinda S.H.G Vill – Madhy Khagrabari PS – Mayna guri Dis – Jalpai guri	Mausumi Roy 9641214778	W
15.	goshada Roy	Group Radha Gobinda S.H.G.	goshada Roy	W
16.	Suno Roy.	Radha Gobinda S. H.G.	Suno Roy.	W
17.	Dharitri Roy	Radha Gobinda S.H.G	Dharitri Roy	W
18.	Lalita Roy	Radhagobinda S.H.G.	Lalita Roy	W

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
19.	দিশালীরায়	তুষার		W
20	~~Baby Roy~~ Babi Roy.	"		W
21	মেজুনরায়	"		W
22.	Mousumi Sarkar	T. S. H. G. Ananda nagar.	8101468847	W
23.	[illegible] Saraswati Mallick	Janani S. H. G. viii - Anandanagar Mangnagari + Jal.	[illegible]	W
24.	Saraswati mattik	Janani S. H. G. viii + [illegible]	Saraswati mattik	W

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature
25.	Anita Suthridan	Jonani S.H.G. Fo+Po. Anandanagar. Maynaguri + Jal	[illegible]
26.	Mina Roy.	Jonani S.H.G. Ni:- Anandanagar. Po. Maynaguri + Jal	Mina Roy.
27.			
28.			
29.			
30.			

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
33	Prabir Kumar Ray		Ray	M
34	[illegible]	[illegible] S. H. G	[illegible]	W
35.	Sumana Sankar	Bhala Baba S.H.G.	Sumana Sankar	W
36.	Purnima Chakraborty	Baba LOKNath.	Purnima Chakraborty	W
37.	Sima Karmakar	[illegible] S.H.G	Sima Karmakar	W
38.	[illegible]	"	[illegible]	W

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
27	অরুণ চক্রবর্তী	বাবা লোকনাথ S.H.G	অরুণ চক্রবর্তী	W,
28	Shantha Panchanam	Jay Ganesh	Shantana Panchan	W,
29	বেণুকা রায়	শ্রাবণী S.H.G 7872820964	বেণুকা রায়	W,
30	ভারতী রায়	সোনালি S.H.G	ভারতী রায়	W,
31	যুথিকা রায়	শ্রাবণী S.H.G	যুথিকা রায়	W,
32	অনতারায়	সোনালি S.H.G	অনতারায়	W,

Attendance Sheet

Date: **Location:**

Sl. No.	Name	Designation, Address with contact number	Signature	
39.	Rahul Barua.	President Maynaguri Sparsha welfar society	Rahul Barua	M
40.	Subrata Das.	S.C. Maynaguri Sparsh Welfare Society.	[signature]	M
41.	Bisnanath Munda	Maynaguri sparsh (MOS) welfare society	[signature]	M
42.	Partha Pratim Sen	Maynaguri Sparsha welfare Society	[signature]	M
43.	Pradip Prasad	Nasalbari Integrated Development Society (NIDS) Nasalbari.	[signature]	M
44.	Dr M.A. Khalid	CEO, Birdiv & CC EQMC India Pvt Ltd New Delhi 9818425530 makhalid2007@gmail.com	[signature]	M

Appendix 8.2: Public Consultation Questionare

Road Corridor:
Sr. No. ……Date:……Time:……
Name of Enumerator:……

1. **Location**

Section (Km)		Name of Village/ Urban Ward	
Chainage in m		City / urban area	
Taluka		District	
Block		Landmark	
Location (Distance in M from centre of road)		GPS Coordinates	
Left side	Right Side	Lat	Lon
Noise Level	Time	Reading	

2. **Particulars of Community Infrastructure**
   Title ……
   Running length along the road ……
3. **Utility / Purpose**
   ……..……
4. **Usage**: Daily timing ..……..
Seasonal – months ……..
Annual functions ……...
5. **Owner** ……..
6. **Type of User** …….

Public Consultation

Date …….. Time …….

Attendance Total number Men Women
(Please note name of the participants)

Venue……..
Facilitators ……..

Nature of Impacts Conveyed

Sr. No.	Particulars	Response
01	Air Pollution	
02	Noise Pollution	
03	Water Pollution	
04	Willingness to give soil for borrow earth	

05	Loss of Trees	
06	Accident or Safety	
07	Movements of Animals	
08	Movement of Wild Animals	
09	Suggestions for the Concerns	

Overall Public Opinion captured during public consultation

……..

……

Specific Opinions and suggestions captured during public consultations if any

……..

Signature of the Enumerator

Appendix 8.3 : Inventory of Community Infrastructure and Public Consultation

AH 2 Nepal Bangladesh: List of villages / urban areas

Sr. No.	Chainage	Location		Name of village urban area	Tahsil	District	Particulars of Infrastructure				
		Distance from road					Type / title	Running length along the road	Utility :Purpose		
		L Side	R side						Purpose	Usage	Owner
1	0	0	0	Nepal O point	Kharibari	Darjeeling	Kakarbhita	0	Custom		Govt
2	0.5			Panitanki	Kharibari	Darjeeling	India check post		Custom		Govt
3	1		5	Panitanki	Naxalbari	Darjeeling	Market place - Panitanki	100	School	100	Committee
4	4.8	10		Rathkhola	Naxalbari	Darjeeling	Shishu Niketan		School		Private
5	7.2	5	--	Naxalbari	Naxalbari	Darjeeling	Hindi Higher Secondary School	100	School	600	Committee
6		10		Borojhoro	Naxalbari	Darjeeling	School - Durga Temple Mangal.	20	School	100	Committee
7				Hatighisa	Naxalbari	Darjeeling	Hatighisa TE		Factory		Private
8			5	Hatighisa	Naxalbari	Darjeeling	Shishu Shiksha Kendra	50	School	100	Committee
9				Bijaynagar TE	Naxalbari	Darjeeling	Bijoynagar TE		Factory		Private
10		0	0	Atal	Naxalbari	Darjeeling	Village Atal - Tea Estate Paharguri		Factory		Private
11		0	0	Sanyasi	Naxalbari	Darjeeling	Playgorund		Recreation		Private
12		10	--	Upper Bagdogra	Naxalbari	Darjeeling	Hebron High School	100	School	1750	Private
13	16.8	-	2	Upper Bagdogra	Naxalbari	Darjeeling	Bagdogra Balika Vidyalaya	50	School	900	Govt
14	17	0	--	Upper Bagdogra	Naxalbari	Darjeeling	Market		Market		Committee
15	17.8	5		Bagdogara	Naxalbari	Darjeeling	Gate No. 1 NBU	10	University	5000	Govt
16		10	--	Bagdogara	Naxalbari	Darjeeling	North Bengal University Dep. Law	100	College	500	Govt
17		50	--	Budiwalason	Naxalbari	Darjeeling	College Kalipad Vidyalaya	100	College	1000	Society
18	22.7	0	0	Shivmandir	Matigara	Darjeeling	St Paul	20	School	200	Private
19		--	100	Kadamtala	Matigara	Darjeeling	International Lapers Rehabilitation	100	Hospital	100	Committee
20		20	--	Kadamtala	Matigara	Darjeeling	Durga Mandir	100	Temple	100	Committee
21		--	5	Kadamtala	Matigara	Darjeeling	Sanyasi Baba Mandir	10	Temple	80	Committee

Sr. No.	Chainage	Location		Name of village urban area	Tahsil	District	Particulars of Infrastructure				
		Distance from road					Type / title	Running length along the road	Utility :Purpose		
		L Side	R side						Purpose	Usage	Owner
22		--	2	Kadamtala	Matigara	Darjeeling	Kali Temple	5	Temple	50	Committee
23		100	--	Kadamtala	Matigara	Darjeeling	North Bengal Medical College	300	Hospital	2000	Govt
24		10	--	Kadamtala	Matigara	Darjeeling	Kadam. Gram Sahayak Hall	20	GP	100	GP
25	25.3	2	--	Kawakhali	Matigara	Darjeeling	Jr.High School	100	School	250	Govt
26	30.8	--	10	Kamagaguri	Siliguri MC	Jalpaiguri	Mata Maya Kali Mandir	20	Temple	100	Committee
27		0	0	Fulbari	Siliguri MC	Jalpaiguri	Canal Teesta	10	Canal		Govt
28		--	100	Fulbari	Siliguri MC	Jalpaiguri	Truck Terminal	300	Transport		Govt
29	39	0	0	Bangladesh O pt	Naxalbari	Darjeeling	Bangladesh Zero Point		Custom		Govt
31		0	0	Canal Barrage	Naxalbari	Darjeeling	Teesta Canal Barrage		Canal		Govt
32		0	100	Teesta Canal	Naxalbari	Darjeeling	Basil Fund World	300	Recreation	100	Private
33	44	--	40	Rangapani	Naxalbari	Darjeeling	Nimtala Smashan - cremation		Cremation		Committee
34		--	25	Boropathar	Naxalbari	Darjeeling	NRL - Petrol Supply Depot	300	Company	100	Private
35		5	--	Ranidanga	Naxalbari	Darjeeling	Ranidanga Kalaram High School	200	School	2000	Society
36	49	5	--	Ranidanga	Naxalbari	Darjeeling	Ranidanga Jr. Girls High School	100	School	450	Govt

AH-48 Bhutan – Bangladesh Inventory of PCRs

Chai-nage	Location		Running length m	Name of Village urban area	Tahsil	District	Nature of Infrastructure	Utility :Purpose		
	Distance from road							Purpose	Usage	Owner
	L Side	R side					Type / title			
1	--	0	1.5	Changlabandh	Mekhliganj	Cooch Behar	Temple (Shani)		August	Union
1		35	30	Changlabandh	Mekhliganj	Cooch Behar	Jr. Girls HighSchool	School	8 months	Govt
1	5	0	40	Changlabd	Mekhliganj	CoohBeha	Shoppig Mal	Mall	Yet to open	Govt
1	5	0	300	Changlabandh	Mekhliganj	Cooch Behar	Parking Place	Parking	Truckers	Govt
1	--	40	100	Changlabandh	Mekhliganj	Cooch Behar	Primary HealthCentre	Dispensary	110 patients	Govt
1	--	0	1.5	Changlabandh	Mekhliganj	Cooch Behar	Temple (Shani)	Temple	Few	Public
1.8	5	--	10	Changlabandh	Mekhliganj	Cooch Behar	School St Johns	School	100	Private
2.4	--	2	5	Kalasibandha	Mekhliganj	Cooch Behar	Temple	Temple	Few	Committee
12.6	--	10	100	Ghoskadanga	Mayanaguri	Jalpaiguri	School	School	300	Govt

Chai-nage	Location Distance from road		Running length m	Name of Village urban area	Tahsil	District	Nature of Infrastructure	Utility :Purpose		
	L Side	R side					Type / title	Purpose	Usage	Owner
13.5	--	15	20	Ghoskadanga	Mayanaguri	Jalpaiguri	Sports Club	Sports	34	Committee
14.6	--	100	100	Ghoskadanga	Mayanaguri	Jalpaiguri	Bholanath H/S	School	650	Govt
17.5	--	20	50	Madhudanga	Mayanaguri	Jalpaiguri	Temple (Kalibari)	Temple	Few	Private
18	--	10	50	Madhudanga	Mayanaguri	Jalpaiguri	Temple -Bateswar	Temple	Few	Private
18	--	20	50	Madhudanga	Mayanaguri	Jalpaiguri	Jr. Basic School	School	80	ZP
20.6	40	--	100	Govindhanagar	Mayanaguri	Jalpaiguri	SP PrimarySchool	School	100	ZP
22.3	--	5	200	Mayanaguri	Mayanaguri	Jalpaiguri	BDO Office	Govt Office	Public	Govt.
	--	5	100	Mayanaguri	Mayanaguri	Jalpaiguri	BDO Office	Govt. Off.	200	Govt
	--	5	100	Mayanaguri	Mayanaguri	Jalpaiguri	BDO Office	Govt. Off.	200	Govt
23.6	40	--	20	Takatuli	Mayanaguri	Jalpaiguri	Temple, JubaClub	Sports	165	Committee
32.6	--	30	300	Jaldhaka	Dhupguri	Jalpaiguri	Pulic Par	Park	Public	ZP
40.6	--	50	30	Dhupguri	Dhupguri	Jalpaiguri	Temple	Temple	Public	Committee
43	--	200	200	Magurmari	Dhupguri	Jalpaiguri	School	School	440	Committee
43.7	20	--	10	Galandimor	Dhupguri	Jalpaiguri	Cremation Ground	Public	Public	Govt
45.8	5	--	200	Mallik Sova - Gosairhat	Dhupguri	Jalpaiguri	Raj Mohan h.School	School	2200	Govt
47.5	--	40	100	Sonakhali	Dhupguri	Jalpaiguri	Mazar Sharif	Masjid	Public	Committee
50.5	10		10	Dangiapara	Dhupguri	Jalpaiguri	PHC	PHC	Public	ZP
53.8	--	5	10	Gairkata	Dhupguri	Jalpaiguri	Gram Panchayat Office	GP	Public	ZP
54.5	10	--	30	Gairkata	Dhupguri	Jalpaiguri	jay Ghosh PSchool	School	188	ZP
87	5	--	100	Kasiyajhora	Dhupguri	Jalpaiguri	Cremation Ground	Cremation	Public	GP
66.4	10	--	200	Birpara	Birpara	Jalpaiguri	Play Ground	Sports	Public	Club
66.2	20		200	Birpara	Birpara	Jalpaiguri	Forest Park	Park	Public	Govt
66.4	--	2	1	Birpara	Birpara	Jalpaiguri	Shiv Mandir	Temple	Public	Private
72.1	10	--	10	Shishibadi	Birpara	Jalpaiguri	Temple	Temple	Public	Govt
72.2	20	--	80	Madhya RengaliBajana	Rangalibazana	Jalpaiguri	GP Office	GP	Public	ZP
73.4	--	10	10	Rengali Bajana	Rangalibazana	Jalpaiguri	Mahakali Temple	Temple	Public	Committee
75.2	--	40	30	Paschim Khairwadi	Rangalibazana	Jalpaiguri	GP Office	GP	Public	ZP
75.2	--	15	15	Paschim Khairwadi	Rangalibazana	Jalpaiguri	PHC (New)	PHC	Public	ZP
80.4	30	--	20	Madari Hat	Birpara	Jalpaiguri	BDO Office	Govt Office	Public	ZP
80.7		40	10	Shishibadi	Birpara	Jalpaiguri	Cremation Ground	Cremation	Public	Govt
80.9	10	--	50	Madari Hat	Birpara	Jalpaiguri	PHC	PHC	Public	Govt
	5		200	Madarihat	Madarihat	Jalpaiguri	Mad. Hat H.S.School	School	1100	Govt

Chai-nage	Location		Running length m	Name of Village urban area	Tahsil	District	Nature of Infrastructure	Utility :Purpose		
	Distance from road							Purpose	Usage	Owner
	L Side	R side					Type / title			
	5		100	Madarihat	Madarihat	Jalpaiguri	BDO Office	Govt. Off.	200	Govt
	40		100	Madarihat	Madarihat	Jalpaiguri	PHC	Govt. Office	300	Govt
			100	HasimoraFarmalangi	Kalchini	Jalpaiguri	Toorsa SmashanKali Tem.	Temple	100	Committee
93				Hasimori	Kalchini	Jalpaiguri	Cremation Ground	Cremation		Committee
93				Hasimori	Kalchini	Jalpaguri	Kali temple	Temple	50	Committee
			50	Hasimora	Kalchini	Jalpaiguri	Laxmi NarayanTemple	Temple	100	Committee
93				Hasimori	Kalchini	Jalpaiguri	Old HasimoriMarket	Public	200	Govt
94				Dalsingpara	Kalchini	Jalpaiguri	High School/club		100	Committee
	5	0	50	Dalsingpara	Kalchini	Jalpaiguri	Masjid-e-Mohammadi	Masjid	30	Committee
			50	Dalsingpara	Kalchini	Jalpaiguri	DalsingparaPublic Schoo	School	120	Private
	5		100	Dalsingpara	Kalchini	Jalpaiguri	Sri Ganesh H/S	Committee	2621	Committee
	5	0	50	Dalsingpara	Kalchini	Jalpaiguri	Bahrut-Ul-ShameGhousia	Masjid	150	Committee
99				Dalsingpara	Kalchini	Jalpaiguri	Church	Church	100	Committee
103				Jaigaon	Kalchini	Jalpaiguri	Temple	Temple	50	Committee
Bypass	5		200	Khokla	Kalchini	Jalpaiguri	Sarswati PrimarySch.	School	200	Govt
Bypass	0		300	Khokla	Kalchini	Jalpaigur	Sarswati NepaliPri.Sc.	School	500	Govt
Bypass	0		300	Khokla	Kalchini	Jalpaigur	Sarswati NepaliPri.Sc	School	500	Govt
Bypass	25		50	Mangalbari	Kalchini	Jalpaiguri	St Pauls Scool	School	300	Private
107		5	50	Dargaon	Kalchini	Jalpaiguri	New Ero HighSchool	Closed	---	Private
108	5	0	100	Jaigaon	Jaigaon	Jalpaiguri	Jaigaon VedvyasH/S	School	1200	Committee
108		0	50	Jaigaon	Jaigaon	Jalpaiguri	Kali Mandir	Temple	100	Committee
109		0	0	Bhutan Gate	Kalchini	Jalpaiguri	Gate	Gate		Govt

Appendix 9.1: Biological Environment

Proposed Alignment AH-2

List-I: Mammals

Sl. No.	Common Name	Species Name	WPA 1972 status	IUCN Status
A. Apes, Monkeys, Lemurs				
1	Rhesus Macaque	*Macaca mulatta* (Zinunerman) C		Least Concern
B. Elephant				
2	The Indian Elephant	*Elephas maximus* (Linnaeus)	I	Endangered A2c
C. Civet				
3	The large Indian civet	*Viverra zibetha* (Linnaeus) R		Near Threatened
4	The small India civet	*ViverricuLa indica* (Desmarest)		Least concern
5	Common palm civet	*Paradoxurus hermaphroditus* (Pallas)		
6	Himalaya palm civet	*Paguma larvata* (Hamilton-smith)		
D. Mongoose				
7	Common mongoose	*Herpestes edwasdsi* (Geoffroy)		
8	Small Indian mongoose	*Herpestes javanicus* (Hoggson)		
E. Dog				
9	Indian fox	*Vulpes bengalensis* (Shaw)		Least concern
F. Bats				
10	Fulvous Fruit bat	*Rousettus lescheneulu* (Dosmarest)		Least concern
11	Indian flying fox	*Pteropus giganteus* (Brunnich)		Least concern
12	Shortnosed fruit bat	*Cynopterus sphinx* (Vahl)		Least concern

List-II: Reptiles

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
Turtle/tortoise				
1	Red crowned roof turtle	*Kachuga kachuga*		
2	Indian tent Turtle	*Kachuga tecta*	Schedule I	Vulnerable
3	Narrow-headed softshell turtle	*Chitra indica* (Gray)	Schedule IV	
4	Indian Peacock soft-shell Turtle	*Aspideretes hurum* (Gray)	Schedule I	Vulnerable
Lizard				
7	Khasi Hills bent-toed gecko	*Cyrtodactylus khasiensis* (Jerdon)		
8	Gecko	*Gekko verticillatus*		
9	House gecko	*Hemidactylus brooki* Gray		
10	Yellow -green house Gecko	*Hemidactylus flaviviridis* Ruppell		
11	South Asian house Gecko	*Hemidactylus frenatus* Schlegel		
12	Indian garden lizard	*Calotes versicolor* (Daudin)		
13	Indian Chameleon	*Chamaeleon zeylanicus* (Laurenti)		
14	Bengal monitor Lizard	*Varanus bengalensis* (Daudin)	Schedule II	Endangered
15	Water monitor	*Varanus salvator* Laurenti	Schedule II	Endangered
Snake				

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
16	Beaked worm snake	*Typhlops acutus*	Schedule IV	
17	Wall's worm snake	*Typhlops oligolepis* Wall	Schedule IV	
18	Indian rock Python	*Python molurus* Linnaeus	Schedule IV	Endangered
19	Buff-striped keelback.	*Amphiesma stolata* (Linnaeus)	Schedule IV	
20	Common smooth water Snake	*Enhydris enhydris* (Schneider)	Schedule IV	
21	Common Wolf Snake	*Lycodon aulicus* (Linnaeus)	Schedule IV	
22	Checked keelback water snake	*Xenochrophis piscator*	Schedule IV	
23	Himalayan krait	*Bungarus bungaroides* (Cantor)	Schedule IV	
24	Banded Krait	*Bungarus fasciatus* (Schneider)	Schedule IV	
25	Monocled Cobra	*Naja naja kaoutchia* (Linnaeus)	Schedule II	
26	King Kobra	*Ophiophagus hannah* (Cantor)	Schedule II	
27	Russell's viper	*Vipera russelli* (Shaw)	Schedule II	

List-III: Amphibians

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
Amphibians				
1	Common Indian Toad	*Duttaphrynus melanostictus*	Schedule IV	
3	Indian Bull Frog	*Hoplobatrachus tigerinus*	Schedule IV	
4	Jerdon's Bull Frog	*Hoplobatrachus crassus*	Schedule IV	
5	Skittering Frog	*Euphlyctis cyanophlyctis*	Schedule IV	
6	Long-tongued Frog	*Sylvirana leptoglossa*	Schedule IV	
7	Terai Tree Frog	*Polypedates teraiensis*	Schedule IV	

List-IV: Birds

Family	Common Name	Scientific Name
PHALACROCORACIDAE		
1	Little Cormorant	*Phalacrocorax niger*
ARDEIDAE		
2	Large Egret	*Ardea alba*
3	Intermediate Egret	*Egretta intermedia*
4	Little Egret	*Egretta garzetta*
5	Cattle Egret	*Bubulcus ibis*
6	Indian Pond Heron	*Ardeola grayii*
ANATIDAE		
7	Lesser Whistling Teal	*Dendrocygna javanica*
8	Common Teal	*Anas crecca*
9	Mallard	*Anas platyrhynchos*
10	Northern Pintail	*Anas acuta*
11	Northern Shoveler	*Anas clypeata*

Family	Common Name	Scientific Name
12	Garganey	*Anas querquedula*
13	Common Pochard	*Aythya ferina*
ACCPITRIDAE		
14	Pied Harrier	*Circus melanoleucos*
15	Black Kite	*Milvus migrans govinda*
16	Pied Harrier	*Circus melanoleucos*
PHASIANIDAE		
17	Indian Peafowl	*Pavo cristatus*
18	Red Jungle Fowl	*Gallus gallus*
CHARADRIIDAE		
19	Red-wattled Lapwing	*Vanellus indicus*
20	Pacific Golden Plover	*Pluvialis fulva*
21	River Lapwing	*Vanellus duvaucelii*
22	Little Ringed Plover	*Charadrius dubius*
23	Greater Sand Plover	*Charadrius leschenaultia*
COLUMBIDAE		
24	Oriental Turtle Dove	*Streptopelia orientalis*
25	Spotted Dove	*Streptopilia chinensis*
26	Eurasian Collared dove	*Streptopelia decaocto*
27	Yellow-footed Green Pigeon	*Treron phoenicoptera*
PSITTACIDAE		
28	Red-breasted Parakeet	*Psittacula alexandri*
CUCULIDAE		
29	Common Hawk Cuckoo	*Hierococcyx varius*
CICONIIDAE		
30	Open Bill Stork	*Anastomus oscitans*
JACANIDAE		
31	Bronze-winged Jacana	*Metopidius indicus*
RECURVIROSTRIDAE		
32	Pied Avocet	*Recurvirostra avosetta*
PODICIPEDIDAE		
33	Little Grebe	*Tachybaptus ruficollis*
34	Great Crested Grebe	*Podiceps cristatus*
RALLIDAE		
35	Common Coot	*Fulica atra*
36	Purple Swamphen	*Porphyrio porphyrio*
ALCEDINIDAE		
37	Common Kingfisher	*Alcedo atthis*
38	Ruddy Kingfisher	*Halcyon coromanda*
MOTACILLIDAE		
39	Yellow Wagtail	*Motacilla flava*
40	White Wagtail	*Motacilla alba*
41	Citrine Wagtail	*Motacilla citreola*
42	Grey Wagtail	*Motacilla cinerea*
LARIDAE		

Family	Common Name	Scientific Name
43	Black-headed Gull	*Larus ridibundus*
44	Whiskered Tern	*Chlidonias hybridus*
HIRUNDINIDAE		
45	Barn Swallow	*Hirundo rustica*
FALCONIDAE		
46	Common Kestrel	*Falco tinnunculus*
MEROPIDAE		
47	Green Bee-eater	*Merops orientalis*
CORACIDAE		
48	Indian Roller	*Coracias bengalensis*
CAPITONIDAE		
49	Blue-throated Barbet	*Megalaima asiatica*
50	Lineated Barbet	*Megalaima lineata*
PICIDAE		
51	Black-rumped Flameback	*Dinopium benghalense*
LANIIDAE		
52	Long-tailed Shrike	*Lanius schach*
53	Grey-backed Shrike	*Lanius tephronotus*
ORIOLIDAE		
54	Black-hooded oriole	*Oriolus xanthornus*
DICRURIDAE		
55	Ashy Drongo	*Dicrurus leocucephalus*
56	Bronzed Drongo	*Dicrurus aeneus*
57	Crow-billed Drongo	*Dicrurus annectans*
STURNIDAE		
58	Common Myna	*Acridotheres tristis*
59	Asian Pied Starling	*Sturnus contra*
CAMPEPHAGIDAE		
60	Long-tailed Minivet	*Pericrocotus ethologus*
SYLVINAE		
61	Yellow-browed Warbler	*Phylloscopus inornatus*
62	Plain Prinia	*Prinia subflava*
63	Jungle warbler	*Turdoides striatus*
64	Striated Grassbird	*Megalurus palustris*
65	Golden-spectacled Warbler	*Seicercus burkii*
MUSCICAPINAE		
66	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*
67	Little Pied Flycatcher	*Ficedula westermanni*
CORVIDAE		
68	Rufous Tree Pie	*Dendrocitta vagabunda*
69	Large-billed crow	*Corvus macrorhynchos*
PYCNONOTIDAE		
70	Red-vented Bulbul	*Pycnonotus cafer*
TURDINAE		
71	White rumped Shama	*Copsychus malabaricus*

Family	Common Name	Scientific Name
72	White-capped Water Redstart	*Chaimarrornis leucocephalus*
PLOCEIDAE		
73	Eurasian Tree Sparrow	*Passer montanus*
74	Scaly-breasted Munia	*Lonchura punctulata*
SCOLOPACIDAE		
75	Jack Snipe	*Lymnocryptes minimus*
76	Common Snipe	*Gallinago gallinago*
77	Marsh Sandpiper	*Tringa stagnatilis*
78	Green Sandpiper	*Tringa ochropus*
79	Wood Sandpiper	*Tringa glareola*
80	Common Sandpiper	*Actitis hypoleucos*
81	Common Green Shank	*Tringa nebularia*
82	Little Stint	*Calidris minuta*

List-V: Butterfly

Sl. No.	Common Name	*Scientific Name*	Distribution Status
Family: Papillonidae			
1	Common Bluebottle	*Graphium sarpendon (Linnaeus)*	common
2	Common Jay	*Graphium doson*	common
3	Tailed Jay	*Graphium ararmemnon*	common
4	Yellow Helen	*Papilio nephelus*	common
5	Spangle	*Papilio protenor*	common
6	Commom Batwing	*Troides helena*	common
7	Lime Butterfly	*Papilio demoleus*	common
8	Common Rose	*Atrophaneura aristolochiae*	common
9	Great Mormon	*Papilio memnon*	common
Family: Pieridae			
10	Common Grass Yellow	*Eurema hecabe*	common
11	Common Emigrant	*Catopsilia Pomona*	common
12	Mottled Emigrant	*Catopsilia pyranthe*	common
13	Great Orange Tip	*Hebomoia glaucippe*	common
14	Chocolate Albatross	*Appias lyncida*	common
15	Common Gull	*Cepora nerissa*	common
16	Psyche	*Leptosia nine*	common
17	Indian cabbage White	*Pieris canidie*	common
18	Yellow Orange Tip	*Ixias pyrene*	common
FAMILY: Lycaenidae			
19	Large Oakblue	*Arhopala arnantes*	Common
20	Yarnfly	*Loxura atymnus*	common
21	Common Imperial	*Chentra freja*	common
22	Common Tit	*Hypolycaena erylus*	common
23	Fluffy Tit	*Zeltus arnasa*	common
24	Slate Flash	*Rapala manea*	common

Sl. No.	Common Name	*Scientific Name*	Distribution Status
25	Common Silverline	*Spindasis valcanus*	common
26	Common Ciliate Blue	*Anthene emolus*	common
27	Common Lineblue	*Prosotas nora*	common
28	Purple Sapphire	*Heliophorus epicles*	common
29	Common hedge Blue	*Acytolepsis puspa*	common
30	Angled Sunbeam	*Curetis acuta*	common
Family: Nymphalidae			
31	Dark Blue Tiger	*Tirumala septentrionis*	common
32	Blue Tiger	*Tirumala limniace*	common
33	Striped Tiger	*Danaus genutia*	common
34	Glassy Tiger	*Parantica aglea*	common
35	Plain Tiger	*Danaus chrysippus*	common
36	Common Nawab	*Polyura athamas*	common
37	Tawny Rajah	*Charaxes bernadus*	common
38	Banded Treebrown	*Lethe confusa*	common
39	Common Palmfly	*Elymnias hypermnestra*	common
40	Common Leopard	*Phalanta phalanta*	common
41	Commander	*Moduza procris*	common
42	Common Lascar	*Pantoporia hordonia*	common
43	Common Baron	*Euthalia aconthea*	common
44	Grey Count	*Tanaecia lepidea*	common
45	Common Map	*Cyrestis thyodamas*	common
46	Chocolate pansy	*Junonia lphita*	common
47	Grey pansy	*Junonia atlites*	common
48	Lemon Pansy	*Junonia lemonias*	common
49	Peacock Pansy	*Junonia almana*	common
50	Great Eggfly	*Hypolimnas bolina*	common
51	Indian Skipper	*Spialia galba*	common
52	Common Small Flat	*Sarangesa dasahara*	common
53	Rice Swift	*Borbo cinnara*	common
54	Dark Palm Dart	*Telicota ancilla*	common
55	Grass Demon	*Udapspes folus*	common
56	Restricted Demon	*Notocrypya curvi fascia*	common

Proposed alignment AH-48

List - VI: Mammals (Source-Primary Field Visit)

S. No.	Common Name	Species Name	WPA 1972 status	IUCN Status
A. APES MONKEYS, LEMURS				
1	Capped Langur	*Presby tis pileatus* (Blyth) C		Near Threatened
2	Rhesus Macaque	*Macaca mulatta* (Zinunerman) C		Least Concern
B. CAT				
4	Tiger	*Panthers tigris* (Linnaeus) R	I	Endangered
5	Leopard	*Panthera pardus* (Linnaeus)R	I	Near threatened
6	Fishing cat	*Prionailurus viverrinus* (Bennett) R	I	Endangered
7	Leopard cat	*Prionailurus bengalensis*	I	Least concern
8	Jungle Cat	*Felis chaus* (Giildenstaedi) R		Least concern
C. CIVET				
9	The large Indian civet	*Viverra zibetha* (Linnaeus) R		Near Threatened
10	The small India civet	*ViverricuLa indica* (Desmarest)		Least concern
11	Common palm civet	*Paradoxurus hermaphroditus* (Pallas)		
12	Himalaya palm civet	*Paguma larvata* (Hamilton-smith)		
13	Binturung or Bear-cat*	*Arctictis binturung (Raffles)*	I	Least concern
D. MONGOOSE				
14	Common mongoose	*Herpestes edwasdsi* (Geoffroy)		
15	Small Indian mongoose	*Herpestes javanicus* (Hoggson)		
E. DOG				
16	Jackal	*Canis aureus* (Linnaeus)		Least concern
17	Dhole*	*Cuon alpinus* (pallas)		Endangered
18	Indian fox	*Vulpes bengalensis* (Shaw)		Least concern
F. BEARS				
19	Himalayan black bear*	*Selenarctos thibetanus* (G. Cuvie)		Vulnerable
20	Sloth bear*	*Melursus ursinus* (Shaw)	I	Vulnerable
G. WEASEL				
21	Smooth Indian otter	*Lutra perspicillata* (1. Geoffroy)		Vulnerable
22	Yellow throated* Martens	*Martes flavigula* (Boddaert)		Least concern
23	Yellow bellied weasel*	*Mustela Kathiah* (Hodgson)		Lest Concern
H. PANGOLIN				
24	Indian Pangolin	*Manis crassicaudata*(Gray)	I	Near Threatened
I.BATS				
25	Fulvous Fruit bat	*Rousettus lescheneulu* (Dosmarest)		Least concern
26	Indian flying fox	*Pteropus giganteus* (Brunnich)		Least concern
27	Shortnosed fruit bat	*Cynopterus sphinx* (Vahl)		Least concern
J. RODENTS				
28	Malayan giant squirrel*	*Ratufa bicolour* (Sparrnano)		
29	Indian Crested Porcupine	*Hystrix Indica* (Kerr)		Least concern
K. ELEPHANT				

30	The Indian Elephant	*Elephas maximus* (Linnaeus)	I	Endangered A2c
L. RHINOCEROS				
31	The Great Indian one rhinoceros	*Rhinoceros unicornis* (Linnaeus)	I	Vulnerable B1ab (iii)
M. WILD OX, SHEEP, GOATS				
32	The Gaur or Indian Bison	*Bos gaurus*		Vulnerable A2cd+ 3cd+4cd
N. DEER				
33	Sambar	*Cervus unioclor* (Kerr)		Vulnerable A2cd+ 3cd+4cd
34	Hog deer	*Axis porcinus* (Zimmerman)		Endangered A2bcd
35	Spotted deer	*Axis axis*		Least concern
36	Muntjak or Barking deer	*Muntiacus muntjak* (Zimmerman)		Least concern
P. PIG, ETC.				
37	Wild boar	*Sus scrofa* (Linnaeus)		Least concern
*Data were collected based on secondary information provided by the local people near the JWLS.				

List VII-Reptiles

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
Turtle/tortoise				
1	Red crowned roof turtle	*Kachuga kachuga*		
2	Indian tent Turtle	*Kachuga tecta*	Schedule I	Vulnearble
3	Tricarinate hill turtle	*Melanochelys tricarinata*	Schedule I	
4	Elongated tortoise	*Geochelone elongata* (Blyth)		
5	Narrow-headed softshell turtle	*Chitra indica* (Gray)	Schedule IV	
6	Indian Peacock soft-shell Turtle	*Aspideretes hurum* (Gray)	Schedule I	Vulnearble
Lizard				
7	Khasi Hills bent-toed gecko.	*Cyrtodactylus khasiensis* (Jerdon)		
8	Gecko	*Gekko verticillatus*		
9	House gecko	*Hemidactylus brooki* Gray		
10	Yellow -green house Gecko	*Hemidactylus flaviviridis* Ruppell		
11	South Asian house Gecko	*Hemidactylus frenatus* Schlegel		
12	Indian garden lizard	*Calotes versicolor* (Daudin)		
13	Indian Chameleon	*Chamaeleon zeylanicus* (Laurenti)		
14	Bengal monitor Lizard	*Varanus bengalensis* (Daudin)	Schedule II	Endangered
15	Water monitor	*Varanus salvator* Laurenti	Schedule II	Endangered
Snake				
16	Beaked worm snake	*Typhlops acutus*	Schedule IV	
17	Wall's worm snake	*Typhlops oligolepis* Wall	Schedule IV	
18	Indian rock Python	*Python molurus* Linnaeus	Schedule IV	Endangered
19	Buff-striped keelback	*Amphiesma stolata* (Linnaeus)	Schedule IV	
20	Copper-headed trinket snake.	*Elaphae radiata* (Schegel)	Schedule IV	
21	Common smooth water Snake	*Enhydris enhydris* (Schneider)	Schedule IV	
22	Common Wolf Snake	*Lycodon aulicus* (Linnaeus)	Schedule IV	

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
23	Western rat Snake	*Ptyas mucosus* (Linnaeus)	Schedule IV	
24	Himalayan keelback	*Rhabdophis himalayana* Gunther	Schedule IV	
25	Checked keelback water snake	*Xenochrophis piscator*	Schedule IV	
26	Himalayan krait	*Bungarus bungaroides* (Cantor)	Schedule IV	
27	Banded Krait	*Bungarus fasciatus* (Schneider)	Schedule IV	
28	Monocled Cobra	*Naja naja kaoutchia* (Linnaeus)	Schedule II	
29	King Kobra	*Ophiophagus hannah* (Cantor)	Schedule II	
30	Russell's viper	*Vipera russelli* (Shaw)	Schedule II	

List VIII - Amphibian

Sl. No.	Common Name	Scientific Name	WPA Status	IUCN Status
Amphibians				
1	Common Indian Toad	*Duttaphrynus melanostictus*	Schedule IV	
2	Ornate Narrow-mouthed Frog	*Microhyla ornata*	Schedule IV	
3	Painted Frog	*Kaloula taprobanica*	Schedule IV	
4	Balloon Frog	*Uperodon globulosus*	Schedule IV	
5	Indian Bull Frog	*Hoplobatrachus tigerinus*	Schedule IV	
6	Jerdon's Bull Frog	*Hoplobatrachus crassus*	Schedule IV	
7	Skittering Frog	*Euphlyctis cyanophlyctis*	Schedule IV	
8	Long-tongued Frog	*Sylvirana leptoglossa*	Schedule IV	
9	Bright Frog	*Sylvirana humeralis*	Schedule IV	
10	Reed Frog	*Hylarana tytleri*	Schedule IV	
11	Terai Cricket Frog	*Fejervarya teraiensis*	Schedule IV	
12	Small Cricket Frog	*Fejervarya pierrei*	Schedule IV	
13	Terai Tree Frog	*Polypedates teraiensis*	Schedule IV	

List IX- Aves

Family –	Common Name	Scientific Name
PHALACROCORACIDAE		
1	Little Cormorant	*Phalacrocorax niger*
ARDEIDAE		
2	Large Egret	*Ardea alba*
3	Intermediate Egret	*Egretta intermedia*
4	Little Egret	*Egretta garzetta*
5	Cattle Egret	*Bubulcus ibis*
6	Grey Heron	*Ardea cinerea*
7	Indian Pond Heron	*Ardeola grayii*
CICONIIDAE		
8	Lesser Adjutant Stork	*Leptoptilos javanicus*
9	Asian Openbill	*Anastomus oscitans*

Family –	Common Name	Scientific Name
ANATIDAE		
10	Gadwall	*Anas strepera*
11	Lesser Whistling Teal	*Dendrocygna javanica*
12	Eurasian Wigeon	*Anas penelope*
13	Baer's Pochard	*Aythya baeri*
14	Common Teal	*Anas crecca*
15	Mallard	*Anas platyrhynchos*
16	Northern Pintail	*Anas acuta*
17	Northern Shoveler	*Anas clypeata*
18	Red-crested Pochard	*Netta rufina*
19	Ferruginous Duck	*Aythya nyroca*
20	Garganey	*Anas querquedula*
21	Common Pochard	*Aythya ferina*
22	Tufted Duck	*Aythya fuligula*
ACCPITRIDAE		
23	Pied Harrier	*Circus melanoleucos*
24	Eastern Marsh Harrier	*Circus spilonotus*
25	Osprey	*Pandion haliaetus*
26	Eurasian Sparrowhawk	*Accipiter nisus*
27	Greater Spotted Eagle	*Aquila clanga*
28	Black Kite	*Milvus migrans govinda*
29	Red-headed vulture	*Sarcogyps calvus*
30	Pied Harrier	*Circus melanoleucos*
PHASIANIDAE		
31	Indian Peafowl	*Pavo cristatus*
32	Red Jungle Fowl	*Gallus gallus*
CHARADRIIDAE		
33	Northern Lapwing	*Vanellus vanellus*
34	Grey-headed Lapwing	*Vanellus cinereus*
35	Red-wattled Lapwing	*Vanellus indicus*
36	Pacific Golden Plover	*Pluvialis fulva*
37	River Lapwing	*Vanellus duvaucelii*
38	Little Ringed Plover	*Charadrius dubius*
39	Greater Sand Plover	*Charadrius leschenaultia*
COLUMBIDAE		
40	Yellow-footed green pigeon	*Treron phoenicoptera*
41	Oriental Turtle Dove	*Streptopelia orientalis*
42	Spotted Dove	*Streptopilia chinensis*
43	Eurasian Collared dove	*Streptopelia decaocto*
44	Yellow-footed Green Pigeon	*Treron phoenicoptera*
PSITTACIDAE		
45	Red-breasted Parakeet	*Psittacula alexandri*
CUCULIDAE		
46	Common Hawk Cuckoo	*Hierococcyx varius*
JACANIDAE		

Family –	Common Name	Scientific Name
47	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
48	Bronze-winged Jacana	*Metopidius indicus*
RECURVIROSTRIDAE		
49	Pied Avocet	*Recurvirostra avosetta*
PODICIPEDIDAE		
50	Little Grebe	*Tachybaptus ruficollis*
51	Great Crested Grebe	*Podiceps cristatus*
RALLIDAE		
52	Common Coot	*Fulica atra*
53	Purple Swamphen	*Porphyrio porphyrio*
ALCEDINIDAE		
54	White-throated Kingfisher	*Halcyon smyrnensis*
55	Common Kingfisher	*Alcedo atthis*
56	Lesser Pied Kingfisher	*Ceryle rudis*
57	Ruddy Kingfisher	*Halcyon coromanda*
MOTACILLIDAE		
58	Yellow Wagtail	*Motacilla flava*
59	White Wagtail	*Motacilla alba*
60	Citrine Wagtail	*Motacilla citreola*
61	Grey Wagtail	*Motacilla cinerea*
LARIDAE		
62	Black-headed Gull	*Larus ridibundus*
63	Whiskered Tern	*Chlidonias hybridus*
HIRUNDINIDAE		
64	Barn Swallow	*Hirundo rustica*
FALCONIDAE		
65	Common Kestrel	*Falco tinnunculus*
MEROPIDAE		
66	Green Bee-eater	*Merops orientalis*
67		
67	Indian Roller	*Coracias bengalensis*
CAPITONIDAE		
68	Blue-throated Barbet	*Megalaima asiatica*
69	Lineated Barbet	*Megalaima lineata*
PICIDAE		
70	Black-rumped Flameback	*Dinopium benghalense*
LANIIDAE		
71	Long-tailed Shrike	*Lanius schach*
72	Grey-backed Shrike	*Lanius tephronotus*
ORIOLIDAE		
73	Black-hooded oriole	*Oriolus xanthornus*
DICRURIDAE		
74	Ashy Drongo	*Dicrurus leocucephalus*
75	Bronzed Drongo	*Dicrurus aeneus*
76	Greater Racket tailed Drongo	*Dicrurus paradiseus*
77	Crow-billed Drongo	*Dicrurus annectans*
STURNIDAE		

Family –	Common Name	Scientific Name
78	Common Myna	*Acridotheres tristis*
79	Asian Pied Starling	*Sturnus contra*
CAMPEPHAGIDAE		
80	Long-tailed Minivet	*Pericrocotus ethologus*
SYLVINAE		
81	Yellow-browed Warbler	*Phylloscopus inornatus*
82	Plain Prinia	*Prinia subflava*
83	Jungle warbler	*Turdoides striatus*
84	Striated Grassbird	*Megalurus palustris*
85	Golden-spectacled Warbler	*Seicercus burkii*
MUSCICAPINAE		
86	Black-naped Monarch	*Hypothymeus azurea*
87	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*
88	Little Pied Flycatcher	*Ficedula westermanni*
CORVIDAE		
89	Rufous Tree Pie	*Dendrocitta vagabunda*
90	Large-billed crow	*Corvus macrorhynchos*
BUCEROTIDAE		
91	Oriental Pied Hornbill	*Anthracoceros albirostris*
92	Great Hornbill	*Buceros bicornis*
PYCNONOTIDAE		
93	Red-vented Bulbul	*Pycnonotus cafer*
TURDINAE		
94	White rumped Shama	*Copsychus malabaricus*
95	White-capped Water Redstart	*Chaimarrornis leucocephalus*
PLOCEIDAE		
96	Eurasian Tree Sparrow	*Passer montanus*
97	Scaly-breasted Munia	*Lonchura punctulata*
SCOLOPACIDAE		
98	Jack Snipe	*Lymnocryptes minimus*
99	Common Snipe	*Gallinago gallinago*
100	Marsh Sandpiper	*Tringa stagnatilis*
101	Green Sandpiper	*Tringa ochropus*
102	Wood Sandpiper	*Tringa glareola*
103	Common Sandpiper	*Actitis hypoleucos*
104	Common Green Shank	*Tringa nebularia*
105	Little Stint	*Calidris minuta*
ROSTRATULIDAE		
106	Painted Snipe	*Rostratula benghalensis*
PHASIANIDAE		
107	Jungle Bush Quail	*Perdicula asiatica*

List X - Butterfly

Sl. No.	Common Name	*Scientific Name*	Distribution Status
Family: Papillonidae			

Sl. No.	Common Name	*Scientific Name*	Distribution Status
1	Common Bluebottle	*Graphium sarpendon (Linnaeus)*	common
2	Common Jay	*Graphium doson*	common
3	Tailed Jay	*Graphium ararmemnon*	common
4	Five-bar Swordtail	*Graphium antiphates*	common
5	Common Mormon	*Papilio polytes*	common
6	Red Helen	*Papilio helenus*	Rare
7	Yellow Helen	*Papilio nephelus*	common
8	Spangle	*Papilio protenor*	common
9	Common Batwing	*Atrophaneura varuna*	Rare
10	Commom Batwing	*Troides helena*	common
11	Lime Butterfly	*Papilio demoleus*	common
12	Common Rose	*Atrophaneura aristolochiae*	common
13	Great Mormon	*Papilio memnon*	common
14	Paris Peacock	*Papilio paris*	Not Common
15	Common Raven	*Papilio castor*	Not Common
Family: Pieridae			
16	Common Grass Yellow	*Eurema hecabe*	common
17	Tree Yellow	*Gandaca harina*	Rare
18	Common Emigrant	*Catopsilia Pomona*	common
19	Mottled Emigrant	*Catopsilia pyranthe*	common
20	Great Orange Tip	*Hebomoia glaucippe*	common
21	Chocolate Albatross	*Appias lyncida*	common
22	Striped Albatross	*Appias libythea*	Not Common
23	Common Gull	*Cepora nerissa*	common
24	Psyche	*Leptosia nine*	common
25	Redspot Jezebel	*Delias descombesi*	Not Common
26	Indian cabbage White	*Pieris canidie*	common
27	Yellow Orange Tip	*Ixias pyrene*	common
FAMILY: Lycaenidae			
28	Large Oakblue	*Arhopala arnantes*	Common
29	Common Acacia Blue	*Surendra quercetorum*	Not Common
30	Yellow-disc Tailless Oakblue	*Arhopala perimuta*	Rare
31	Yarnfly	*Loxura atymnus*	common
32	Blue Imperial	*Ticherra acte*	Not Common
33	Common Imperial	*Chentra freja*	common
34	Chocolate Royal	*Ramelane jangala*	Rare
35	White-banded Royal	*Dacalana cotys*	Not Common
36	Common Tit	*Hypolycaena erylus*	common
37	Fluffy Tit	*Zeltus arnasa*	common

Sl. No.	Common Name	*Scientific Name*	Distribution Status
38	Orchid Tit	*Ch;iaria othona*	Rare/ Schedule I
39	Slate Flash	*Rapala manea*	common
40	Common Silverline	*Spindasis valcanus*	common
41	Common Ciliate Blue	*Anthene emolus*	common
42	Elbowed Pierrot	*Caleta elna*	common
43	Common Pierrot	*Castalius rosimon*	common
44	Opaque 6-lineblue	*Nacaduba beroe*	Not Common
45	Common Lineblue	*Prosotas nora*	common
46	Dingy Lineblue	*Petrelaea dana*	Not Common
47	Purple Sapphire	*Heliophorus epicles*	common
48	Common hedge Blue	*Acytolepsis puspa*	common
49	Tailless Lineblue	*Prosotas dubiosa indica*	Not Common
50	Angled Sunbeam	*Curetis acuta*	common
51	Quaker	*Neopithecops zalmora*	Not Common
Family: Nymphalidae			
52	Dark Blue Tiger	*Tirumala septentrionis*	common
53	Blue Tiger	*Tirumala limniace*	common
54	Striped Tiger	*Danaus genutia*	common
55	Glassy Tiger	*Parantica aglea*	common
56	Plain Tiger	*Danaus chrysippus*	common
57	Striped Blue Crow	*Euploea mulciber*	common
58	Magpie Crow	*Euploea radamanthus*	Not Common
59	Common Crow	*Euploea core*	common
60	Common Nawab	*Polyura athamas*	common
61	Tawny Rajah	*Charaxes bernadus*	common
62	Banded Treebrown	*Lethe confusa*	common
63	Common Palmfly	*Elymnias hypermnestra*	common
64	White-bar Bushbrown	*Mycalensis anaxias*	Not Common
65	Common Bushbrown	*Mycalensis perseus*	common
66	Darkbrand Bushbrown	*Mycalensis mineus*	common
67	Common Five ring	*Ypthima baldus*	common
68	Tawny Coster	*Acraea violae*	common
69	Leopard lacewing	*Cethosia cyane*	Not Common
70	Large Yeoman	*Cirrochroa aoris*	Not Common
71	Vagrant	*Vagrans egista*	Rare
72	Common Leopard	*Phalanta phalanta*	common
73	Commander	*Moduza procris*	common
74	Common Lascar	*Pantoporia hordonia*	common
75	Small yellow Sailer	*Neptis miah*	Not Common
76	Yellow Jack Sailer	*Lasippa viraja*	Not Common

Sl. No.	Common Name	*Scientific Name*	Distribution Status
77	Chestnut Streaked Sailer	*Neptis jumbah*	Not Common
78	Common Sailer	*Neptis hylas*	common
79	Knight	*Lebadea martha*	common
80	Common Baron	*Euthalia aconthea*	common
81	Grey Count	*Tanaecia lepidea*	common
82	Common Earl	*Tanaecia julli*	Not Common
83	Common Map	*Cyrestis thyodamas*	common
84	Constable	*Dichorrhagia nesimachus*	Rare
85	Angled Castor	*Ariadne ariadne*	common
86	Courtesan	*Euripus nyctelius*	Rare
87	Yellow Pansy	*Junonia hierta*	Not Common
88	Chocolate pansy	*Junonia lphita*	common
89	Grey pansy	*Junonia atlites*	common
90	Lemon Pansy	*Junonia lemonias*	common
91	Peacock Pansy	*Junonia almana*	common
92	Great Eggfly	*Hypolimnas bolina*	common
93	Danaid Eggfly	*Hypolimnas misippus*	Not Common
94	Orange Oakleaf	*Kallima inachus*	Not Common
Family: Hesperildae			
95	Indian Awlking	*Choaspes benjamini*	Rare
96	Indian Skipper	*Spialia galba*	common
97	Common Small Flat	*Sarangesa dasahara*	common
98	Fulvous Pied Flat	*Pseudocoladenia dan*	Not Common
99	Common Snow Flat	*Tagiades japetus*	Not Common
100	Water Snow Flat	*Tagiades litigiosa*	Not Common
101	Chestnut Angle	*Odontoptilum angulata*	Not Common
102	Rice Swift	*Borbo cinnara*	common
103	Dark Palm Dart	*Telicota ancilla*	common
104	Grass Demon	*Udapspes folus*	common
105	Restricted Demon	*Notocrypya curvi fascia*	common
106	Coon	*Sancus fuligo*	Not Common
107	Chestnut Bob	*Iambrix salsala*	Not Common

Proposed alignment	**AH-2**	**AH-48**
S.No	Common species	Common species
1.	Scientific Name	Scientific Names
2.	*Acanthophthalmus pangia*	*Acanthophthalmus pangia*
3.	*Anguilla bengalensis*	*Acrossochelus hexagonolepis*
4.	*Barilius bendelisis chedra*	*Anguilla bengalensis*
5.	*Barilius vagra*	*Bagarius bagarius*
6.	*Channa orientalis*	*Balitora brucei*
7.	*Crossocheilus latius latius*	*Barilius bendelisis bendelisis*
8.	*Danio aequipinnatus*	*Barilius bendelisis chedra*
9.	*Danio naganensis*	*Barilius vagra*
10.	*Euchiloglansis hodgarti*	*Barilus barila*
11.	*Garra gotyla*	*Barilus bendelisis*
12.	*Garra mullya*	*Channa orientalis*
13.	*Glyptothorax basnetti*	*Clupisoma bhandari*
14.	*Glyptothorax bhutiai*	*Crossocheilus latius latius*
15.	*Glyptothorax conirostris*	*Danio aequipinnatus*
16.	*Glyptothorax deyi*	*Danio naganensis*
17.	*Glyptothorax gracilis*	*Euchiloglansis hodgarti*
18.	*Glyptothorax sinense sikkimensis*	*Gara annandalei*
19.	*Glyptothorax trilineatus*	*Gara gotyla*
20.	*Labeo dero*	*Gara kempi*
21.	*Labeo pangusia*	*Gara lamta*
22.	*Laguvia ribeiroi jorethanensis*	*Garra annandalei*
23.	*Laguvia riberoi riberoi*	*Garra gotyla stenorh*
24.	*Noemacheilus multifasciatus*	*Garra lamta*
25.	*Noemacheilus scaturigina*	*Garra mcclellandi*
26.	*Noemacheilus sikkimensis*	*Garra mullya*
27.	*Noemacheilus spilopterus*	*Glyptothorax basnetti*
28.	*Pangasius pangasius*	*Glyptothorax bhutiai*
29.	*Pseudecheneis sulcatus*	*Glyptothorax conirostris*
30.	*Tor putitora*	*Glyptothorax deyi*
31.	*Barilus bendelisis*	*Glyptothorax gracilis*
32.		*Glyptothorax hori*
33.		*Glyptothorax sinense manipurensis*
34.		*Glyptothorax sinense sikkimensis*
35.		*Glyptothorax trilineatus*
36.		*Labeo dero*
37.		*Labeo pangusia*
38.		*Laguvia ribeiroi jorethanensis*
39.		*Laguvia riberoi riberoi*
40.		*Neolissocheilus hexagonolepis*
41.		*Noemacheilus beavani*
42.		*Noemacheilus carletoni*
43.		*Noemacheilus corica*
44.		*Noemacheilus devdevi*
45.		*Noemacheilus kangjupkhulensis*
46.		*Noemacheilus multifasciatus*

Proposed alignment	AH-2	AH-48
47.		*Noemacheilus scaturigina*
48.		*Noemacheilus sikkimensis*
49.		*Noemacheilus spilopterus*
50.		*Pangasius pangasius*
51.		*Pseudecheneis sulcatus*
52.		*Salmo trutta fario*
53.		*Schizothorax esocinus*
54.		*Schizothorax progastus*
55.		*Schizothorax richardsonii*
56.		*Schizothorax richardspnaii*
57.		*Semiplotus bendelisis*
58.		*Semiplotus semiplotus*
59.		*Tor putitora*

Appendix 10.1: Notification of Jaldapara National Park and Elephant Conservation Area with Elephant movement corridor

GOVERNMENT OF WEST BENGAL
FORESTS DEPARTMENT
FOREST BRANCH

NOTIFICATION

No.3293 For 11H-19/2000 Kolkata, the 28th August, 2002

Whereas the area whose situation and boundaries are described in the Schedule below (here-in-after referred to as the said area) is considered to be of adequate ecological, faunal and floral significance for the purpose of protecting containing and developing wildlife (Elephant) and its environment.

And whereas the said area is comprised of Reserve Forests and after careful consideration is proposed to establish an Elephant Reserve under the Central Scheme Project Elephant.

And whereas Govt. of India vide their letter No. 7-2/00(PE)-(vi), dated 4th October, 2001 have communicated their consent for establishment of an Elephant Reserve in the name of "Eastern Dooars Elephant Reserve" comprising the said territory.

Now, therefore, the Governor is pleased to declare the area described in the schedule below as "Eastern Dooars Elephant Reserve" under the Central Scheme of Project Elephant.

SCHEDULE

A. Situation

District	:	Jalpaiguri
Latitude	:	25°-58" to 26°-57" N
Longitude	:	89°-80" to 89°-51" E
Forest Division	:	Jalpaiguri, Coochbehar, Buxa Tiger Reserve and Wildlife Division-II
Name	:	Eastern Dooars Elephant Reserve
Area	:	Core Area 484.00 Sq.Km. Buffer Area 493.51 Sq.Km. Total : 977.51 Sq.Km.

B. Boundaries

East	:	Sankosh River
North	:	Bhutan
South	:	National Highway 31(P), Falakata, Alipurduar – Assam Road
West	:	Falakata-Madarihat Road

The core area has the following protected areas –

1.	Jaldapara Wildlife Sanctuary	-	115.00 Sq.Km.
2.	Buxa Tiger Reserve	-	369.00 Sq.Km.

with the following forests blocks : -

(a)	Jaldapara	-	1062.30 ha
(b)	Raidak (P)	-	

contd. 2

(c) New Land
(d) Hatipata
(e) Buxadua
(f) Bhutanghat
(g) Santrabari
(h) Bhutri
(i) Chunabasa
(j) Jhamabari
(k) Ranganati
(l) Damanpur

The buffer area consists of the forest blocks of Titi, Dalsingpara, Jaigaon, Hasiwara, Nilpara, Mendabari, Bania, Godamdabri, Hamiltonganj, Nimati, Poro, Raimatang, N. Rajabhatkhawa, S. Rajabhatkhawa, Cheeko, N. Bholka, S. Bholka and part Raglak.

Zone of influence with cover an area of 1800 Sq.Km. over forest area of Bamanpokhri, Khairbari, Kolabari, Bengdubi, Bagdogra and civil area of Darjeeling District Gazaldoba, Mechhasi, Kathambari, Tanghera and Baikunthapur of Jalpaiguri District, Ghish, Gorubattan, Chunabhati and Mongpong of Darjeeling District.. Sukna, Gulma, Sevoke and Lalong of Darjeeling District, Gorumara, Chapramari, Chalsa, Baradighi and Nagrakata of Jalpaiguri District and Banarhat, N. Moraghat, Central Moraghat, S. Moraghat, Garkata, Lankapara, Sulkpara, Domohani and Khutimari in Jalpgirui District. Madarihat, Nilpara, Chilapata, Jaldapara in Jalpaiguri District and Coochbehar, Mathabhanga in Coochbehar District. And civil areas including tea gardens.

It is however pointed out that the intention and puipose of declaration of Elephant Reserve is for undertaking developmental activities and improved measures in the home range of migratory and resident elephant primarily within the state forests as mentioned under schedule of area and for containing the elephants within the forest area with sole idea of reducing man-elephant conflict and degradation thereof without exercising and regulatory control of the wildlife Protection Act 1972 (as amended upto 1991) on the declared Elephant Reserve.

By order of the Governor

Namit Biswas
Joint Secretary to the Govt. of West Bengal

No. 3293/1(6)-For.

Copy forwarded for information to : -

1) The Principal Chief Conservator of Forests, West Bengal ;
2) The PCCF (W/L & B/D) and Chief Wild Life Warden, West Bengal ;
3) The Chief Conservator of Forests, North Bengal ;
4) The Chief Conservator of Forests, South Bengal ,
5) The Inspector General of Police, Forest, West Bengal ;
6) The Secretary to the Govt. of India, Ministry of Environment & Forests, New Delhi

Kolkata,
The 28th August, 2002

Joint Secretary to the Govt. of West Bengal

ELEPHANT CORRIDOR IN NORTH BENGAL

(Study by Wildlife Trust of India, New Delhi)

Sl.No.	Name of Corridor	Lenth k.m.	Width km	Major settelements in it & no.of households
1	Mahananda, Panighata,Mechi	13	1.5	M.M.Terai(230),Nepanis(600),Owldangi(70),Tukrabasti(35),Chengabasti
2	Apalchand -Mahanda,Teest Chaur	11	5	Nayabasti(200),Lalling(18),Saugaion(200),Dhunasigara(100)
3	Apalchand - Gorumara,Via,Barodighi	9	2	Nipiclopur,Gosai labour line of Damdim T.E, Dhobi(200),Prem Nagar(200),Tilabari(850) all of Baradighi T.G, Kumarpara Village, Chawaphilli Village, Sarswati I & Sarswati II T.Gs.
4	Apalchand - Bhutta Bari - Via Sylee T.G	20	1.5	Baltiguri T.G(200), Guabari(50),New Station(200),Chel(200),Ranichera(100)Damdim labourline(400)Damdim,Khagra and Ballinkra Villages.
5	Apalchand - Kalimpong Via Meenglass T.G	21	1	T.Gs - Baniudhura(200), Nayakaman(60), Bansibari(25), Holijungle(45), Chybasa(200), Bhuttabari(450) and Chaklabasti(250)
6	Bhutisbari - Chapramari	7	2	T.Gs Dela(50), Damu(40), Gopal(150), Neora(50), Tila, gudam, Poka, Koka, Gudu, Daya(50) Forest Village - Mal - 4(50)
7	Chapramari - Gorumara,	6	1.5	No human settlements occasionally depridations in Mahabari, Sulkapara Villages and in labour line of inding Meenglass,Kilkot T.Gs
8	Rehli - Central Dians,	15	2	Prayagpore FPC(80) labour lines of T.Gs Red Bank, Lakhipara,Palasbari Rhyabari Kathalguri
9	Rhili - Moraghat,	15	1	Labour lines of T.Gs Karbala,Banarhat,and Moraghat
10	Dumchi - Rhiti	13	2	Labour colonies of T.Gs Dumchipara,Mujnai,Dalmore,Bandapani,Gopalpur,Ramjhors & Makrapara
11	Titi - Dumchi	10	2	Labour lines of T.Gs Dumchi,Mujnai & Hantapara.
12	Bux - Titi,via Torsa T.E	7	1	Labour lines of Torsa,Mahua,Dalsingpara,Beech and Bharnabari villages. Gopalbahadur Basti(350) & Ballalguri
13	Buxa - Titi via Beech and Bharnabari T.E	6	5	Gopal bahadur basti(350),Labourlines of TGs Torsa,Mahua, Dalsigpara,Beech & Bharnabari
14	Sankosh - Buxa, Assam	2	1.5	Forest Villages Kumargram(72) & Sakosh(98)

2004 Study

CCF, WILDLIFE+NORTH

15/05/14

Government of West Bengal
Forest Department
Writers' Buildings, Kolkata-1

No 975-For/FR/O/llM-44/11 Date 22/04/2012

NOTIFICATION

Whereas the area whose situation and boundaries are described in the Scheduled below (herein after) referred to as the said area) is considered to be of adequate ecological, faunal, geomorphological, natural and zoological significance for the purpose of protecting, propagating and developing wildlife and its environment,

And whereas the events referred to in Sub-section (4) of Section 35 of the Wildlife (Protection) Act, 1972, have occurred the collector, Jalpaiguri has since completed the proceedings under Section 19 and 25 of the said Act, in respect of the said area,

And whereas the State Board for Wildlife, West Bengal in its meeting held on 30th June 2008 has approved the upgradation of Jaldapara Wildlife sanctuary for the said purpose;

Now, therefore, in exercise of the power conferred by Sub-section (4) of Section 35 of the Wildlife (Protection) Act, 1972 (53 of 1972), the Governor is pleased hereby to declare, with effect from the date of publication of this notification in the Official Gazette, the said are to be a National Park to be known as Jaldapara National Park and to specify in the Schedule below the limits of the said area which shall be comprised within the said National Park.

The Schedule

A. Situation
District: Jaldapara- Land coveing area of 234.51 Sq. Km. and comprising the following Forest Blocks and compartments.

Block	Compartment	Area in ha.	Area in Sq. Km.
Jaldapara	1 to 5	3451.40	34.51
Malangi	1 to 3	1242.36	12.42
Chilapata	1,2,36,46	1854.52	18.54
Torsa	1 to 3	2626.00	26.26
Baradabri	2,66,76	590.00	5.90
Hasimara	1,2,3a,3b,4	1642.85	16.43
Salkumar	1 to 4	503.00	5.03
Bania	1a,1b,2,3,4,8b	1648.16	16.48
Mendabari	3,4,5a,5b,6a,6b	1022.00	10.22
Jaigaon	1 and2	1758.00	17.58
Dasingpara	1 to 4	1478.00	14.78
Titi	1a,1b,2a,2b,3a,3b (Part) (excluding Ballalguri Forest Village)	3819.00	38.19
Total		21635.29	216.34

B. Boundaries:

North : International boundary with Bhutan and Totopara Village.

East : Jaigaon, Dalsingpore Tea Estate, Beech Tea Estate, Malangi Tea Estate, Subhasim Tea Estate, National Highway 31D, (Santali Patilakhawa Road), Doxate Road, Forest of Baradabari (7 and 8), Mendabari (1,2), Nimtijhora Tea Estate, Forest of Bania (5-8) and Chilapara (3a, 4a)

South : Falakata-Coochbehar Road (National Highway 31).

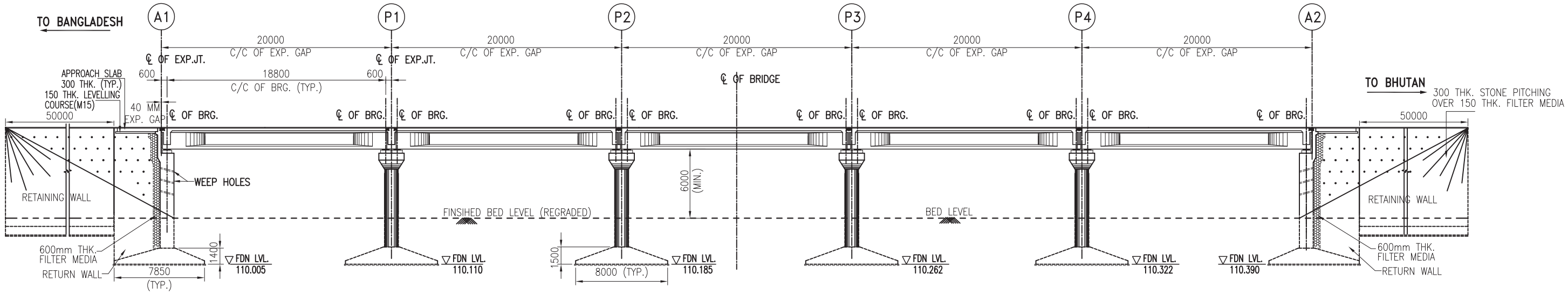
West : Madarihat-Falakata Road Forest of Titi extension, Hantapara Tea Estate, Dumchpara Tea and Hasimara-Madarihat Meter-gauge Railway line.

By order Governor

Sd/-
(U. Mukherjee)
Special Secretary to the Govt. of West Bengal
Forest Department

Con.....p/2

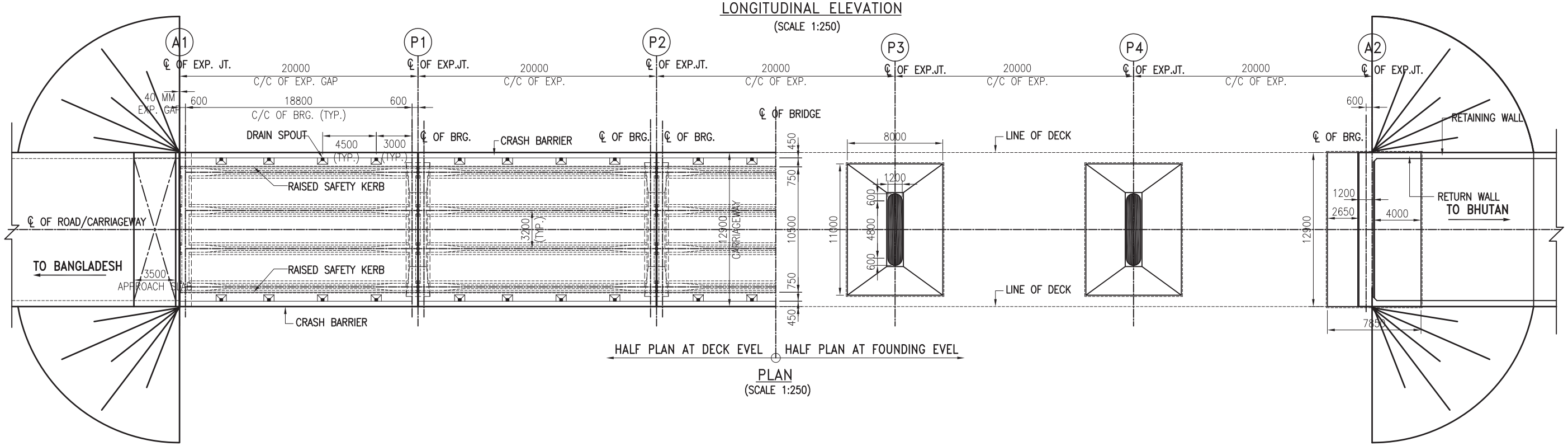
Appendix 11.1: Drawings for Elephant Underpass proposed in AH-48



CHAINAGE	BED LVL.	FRL
85+668.000	114.005	122.095
85+688.000	114.110	122.200
85+708.000	114.185	122.275
85+718.000		
85+728.000	114.262	122.352
85+748.000	114.322	122.412
85+768.000	114.390	122.480

LONGITUDINAL ELEVATION

(SCALE 1:250)



PLAN

(SCALE 1:250)

NOTES:

1. FOR ALL OTHER NOTES AND DETAILS REFER SHEET-2 OF 2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0	13.06.13	INITIAL SUBMISSION				

PROJECT : DETAILED DESIGN FOR THE SUBREGIONAL ROAD CONNECTIVITY PROJECT - DETAILED ENGINEERING DESIGN AND FINALIZATION OF SAFEGUARD DOCUMENTS

CLIENT: ASIAN DEVELOPMENT BANK
PWRD/MoRT&H/ SJDA

DESIGN CONSULTANT : SHELADIA ASSOCIATES INC., USA
Amsrf Shamlra, Flat No: 206 & 207, S D Road, Old Lancer Lanes, Secunderabad - 500 003,AP.

JOB No. :		
DESIGNED	GMS	
DRAWN	MPT	
CHECKED	PRK	
APPROVED	SBG	
DATE 13.06.2013	SCALE: AS SHOWN	

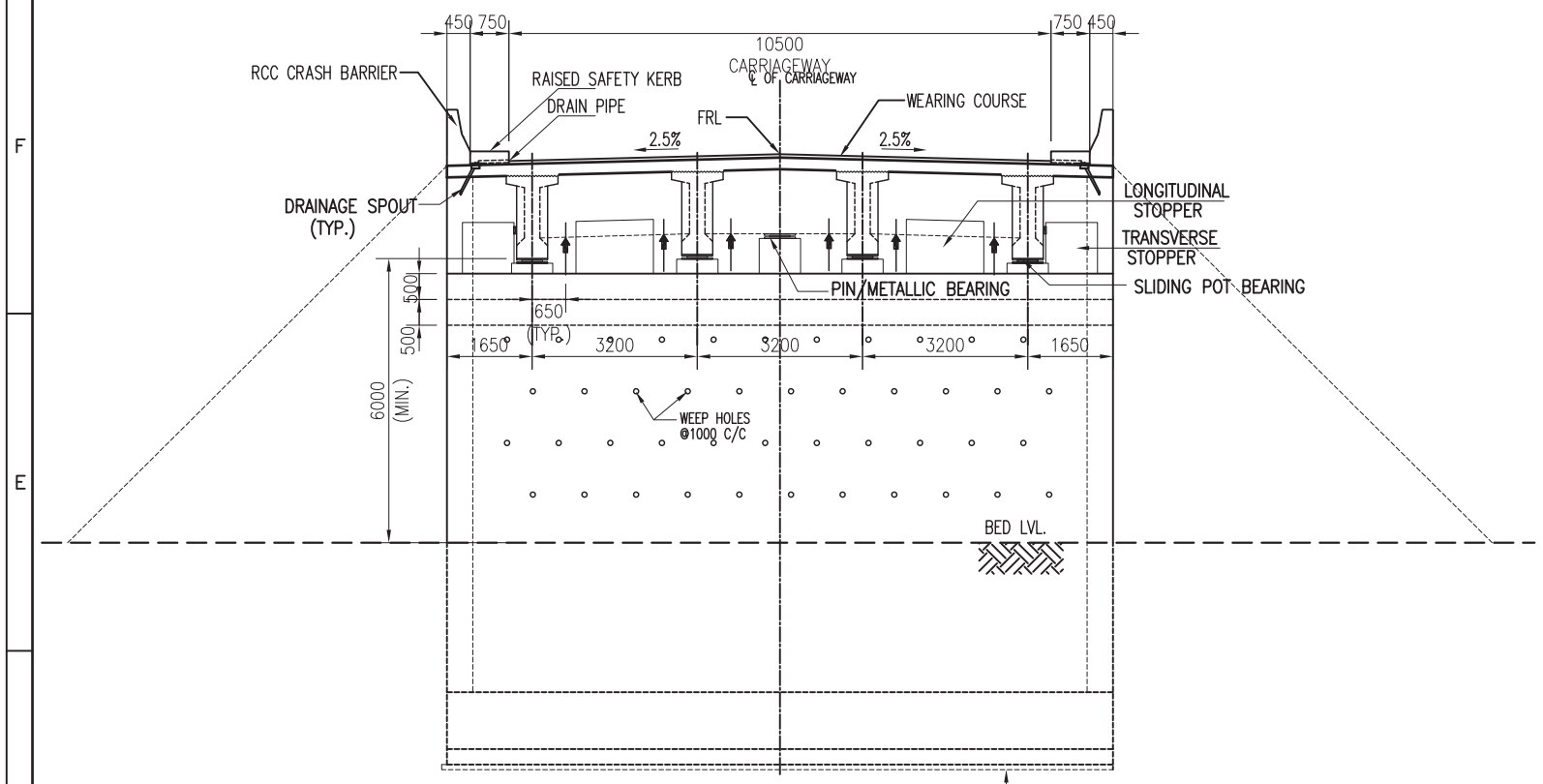
TITLE : ELEPHANT UNDERPASS AT CH:85+718
GENERAL ARRANGEMENT DRAWING

REV. R0
SIZE A2

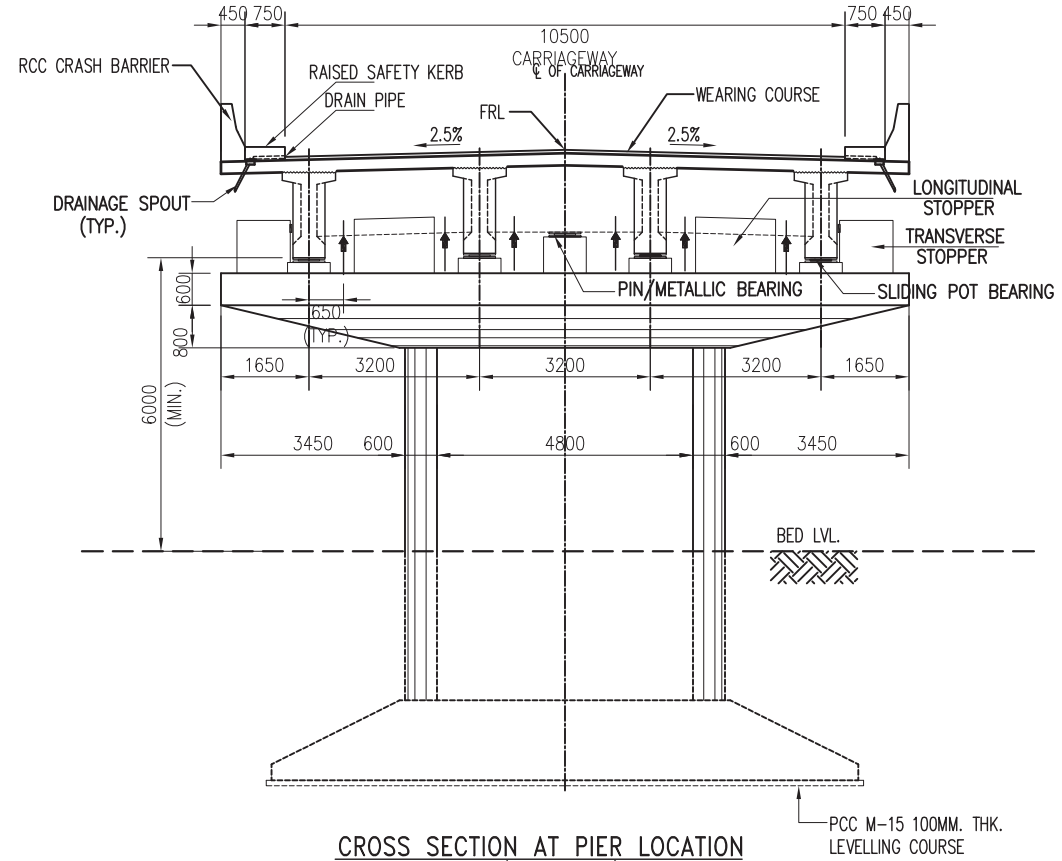
DRAWING NO : ADB / AH48 / EUP / 85+685 / DD / 101

SCALE : -25m -10m 0 10 25m 50m

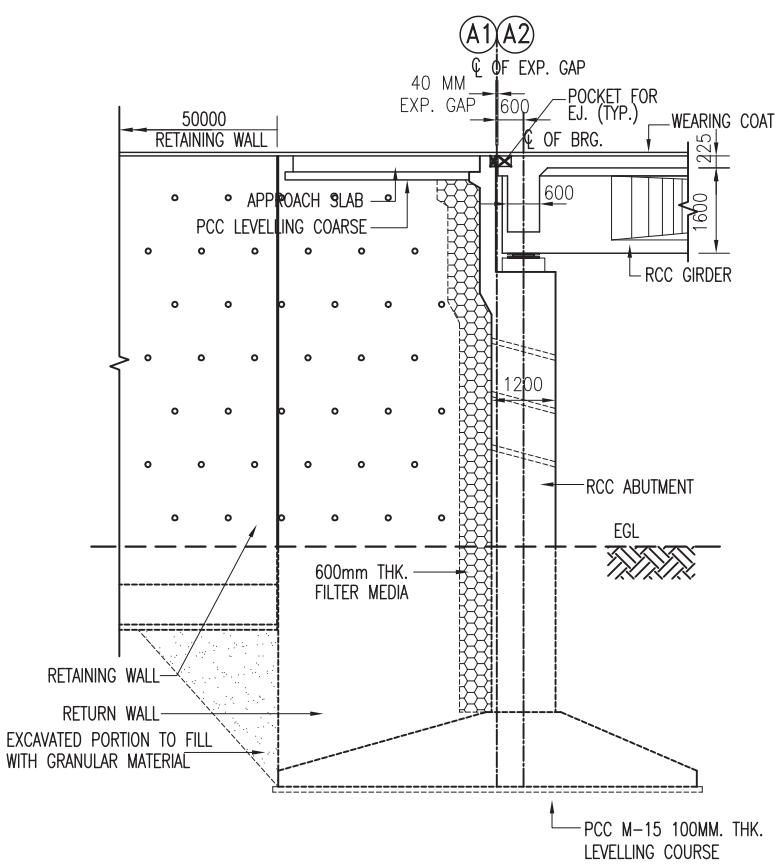
SHEET 1 OF 2



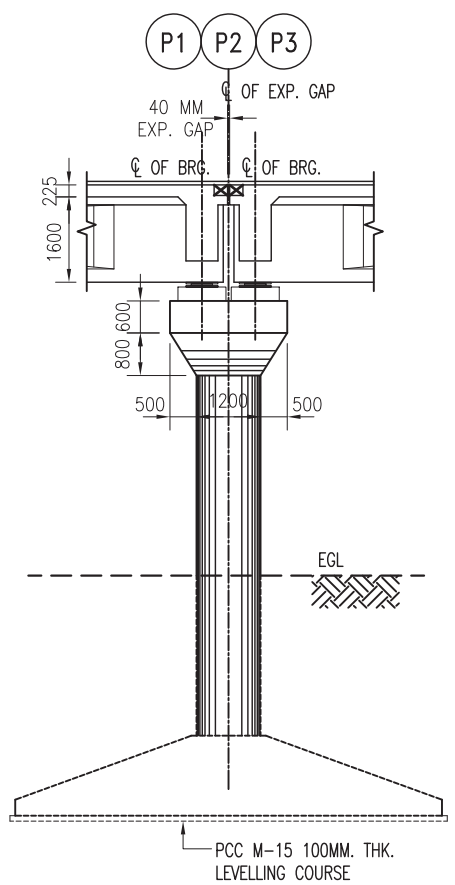
CROSS SECTION AT ABUTMENT LOCATION
(SCALE 1:100)



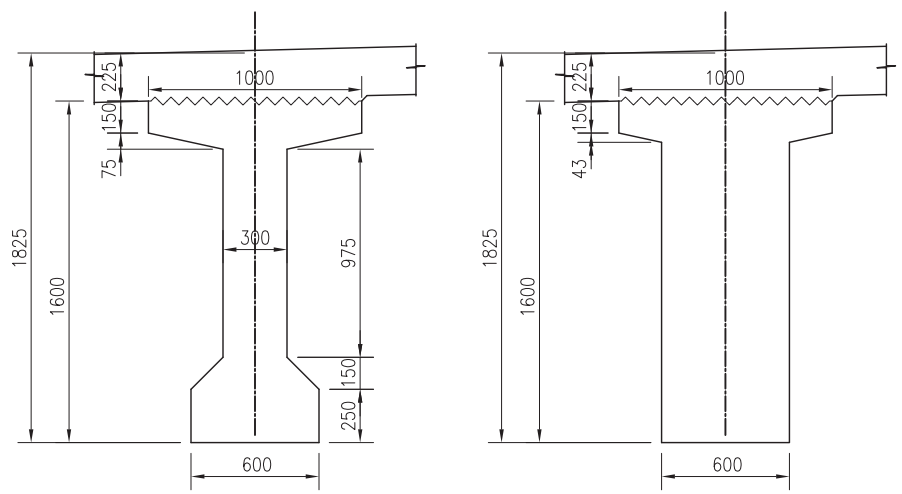
CROSS SECTION AT PIER LOCATION
(SCALE 1:100)



SECTIONAL ELEVATION OF ABUTMENT
(SCALE 1:100)



SECTIONAL ELEVATION OF PIER
(SCALE 1:100)



CROSS SECTION AT MID

CROSS SECTION AT END

PRECAST RCC GIRDER
(SCALE : 1:25)

NOTES:

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE MENTIONED. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.NO DIMENSION IS TO BE SCALED.
2. THE BRIDGE HAS BEEN DESIGNED FOR TWO LANE LOADING WITH FOOTPATH OR THREE LANES OF LOADING WITHOUT FOOTPATH AS PER THE LOAD COMBINATION GIVEN IN TABLE 2 OF IRC:6-2010 WHICHEVER IS CRITICAL.
3. CONCRETE SHALL BE DESIGN MIX AND 28 DAYS CHARACTERISTIC STRENGTH FOR VARIOUS COMPONENTS SHALL BE AS UNDER :

RCC GIRDER	M 40
CROSS DIAPHRAM	M 40
PEDESTALS	M 40
SUBSTRUCTURE	M 35
FOUNDATION	M 35
CRASH BARRIER	M 40
APPROCH SLAB	M 30
PCC LEVELLING COURSE	M 15
RCC STOPPERS	M 40

4. ALL UNTENSIONED REINFORCEMENT SHALL BE GRADE Fe 500 BARS OF DESIGNATION S500 CONFORMING TO IS:1786 STANDARD WITH A MINIMUM YIELD STRENGTH OF 500 N/sq.mm.
5. CLEAR COVER TO OUTERMOST STEEL SHALL BE 75mm ON EARTH FACES & 40MM ON OTHER FACES.
6. BACK FILLING SHALL CONSIST OF SELECTED EARTH CONFORMING TO APPENDIX-6 OF IRC:78-2000 HAVING PROPERTIES C=0, ø = 30° & γd = 20 KN/Cum.
7. WEEP HOLES 100 DIA, SPACED AT 1000 c/c BOTH HORIZONTALLY AND VERTICALLY SHALL BE PROVIDED IN A STAGGERED MANNER IN ABUTMENT & RETURN WALLS FROM 150mm ABOVE OGL.
8. 65mm THK. WEARING COURSE SHALL BE PROVIDED.
10. THE ABUTMENT CAP SHALL BE CONSTRUCTED AFTER COMPLETION OF BACK FILLING BEHIND THE ABUTMENT UPTO 300mm BELOW THE ABUTMENT CAP.
11. THE BRIDGE LIES IN SEISMIC ZONE - IV
12. FOR DETAILS OF CRASH BARRIER, DRAINAGE SPOUT, KERB AND APPRAOCH SLAB REFER MISCELLANEOUS DRAWINGS.
13. THE DIMENSIONS AND LEVELS SHOWN IN THIS DRAWING SHALL BE VERIFIED WITH LATEST PLAN & PROFILE AND RESPECTIVE DETAILED STRUCTURAL DRAWINGS.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0	13.06.13	INITIAL SUBMISSION				

PROJECT : DETAILED DESIGN FOR THE SUBREGIONAL ROAD CONNECTIVITY PROJECT - DETAILED ENGINEERING DESIGN AND FINALIZATION OF SAFEGUARD DOCUMENTS

CLIENT: ASIAN DEVELOPMENT BANK
PWRD/MoRT&H/ SJDA

DESIGN CONSULTANT : SHELADIA ASSOCIATES INC., USA
Amsrl Shamlra, Flat No: 206 & 207, S D Road, Old Lancer Lanes, Secunderabad - 500 003.AP.

JOB No. :		
DESIGNED	GMS	
DRAWN	MPT	
CHECKED	PRK	
APPROVED	SBG	
DATE 13.06.2013	SCALE: AS SHOWN	

TITLE : ELEPHANT UNDERPASS AT CH:85+718
GENERAL ARRANGEMENT DRAWING

REV. R0
SIZE A2

DRAWING NO : ADB / AH48 / EUP / 85+685 / DD / 101

SCALE : -25m -10m 0 10 25m 50m

SHEET 2 OF 2

BANGLADESH ← → **BHUTAN**

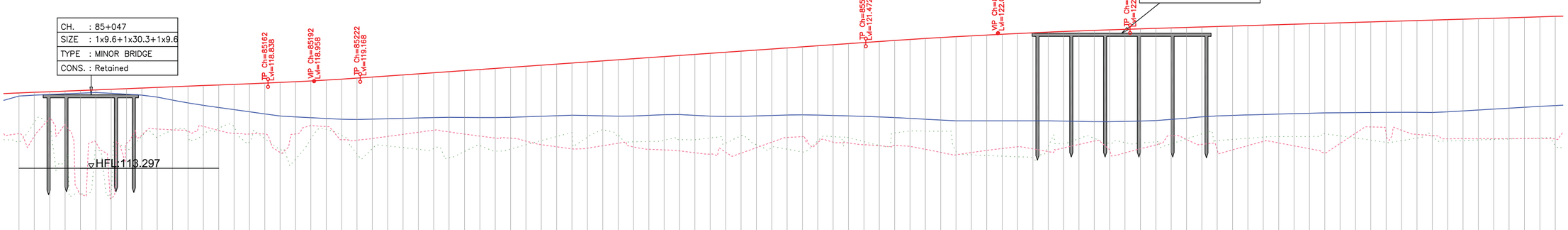
CURVE No. 179		
HIP	E	728565.332
	N	2958535.123
R (m)		2000
△		358°8'33.9"
Ls (m)		–
Lc (m)		64.830
Ts (m)		32.418
Es (m)		0.263
SPEED		100 KMPH
e%		NC

CURVE No. 180		
HIP	E	728801.14
	N	2958570.066
R (m)		2000
△		358°55'23.8"
Ls (m)		–
Lc (m)		37.585
Ts (m)		18.793
Es (m)		0.088
SPEED		100 KMPH
e%		NC

CURVE No. 181		
HIP	E	729097.716
	N	2958619.726
R (m)		1000
△		11°59'16.5"
Ls (m)		50
Lc (m)		159.229
Ts (m)		130.008
Es (m)		5.602
SPEED		100 KMPH
e%		4.44%

CH.	: 85+718
SIZE	: 5x20.0x6.0
TYPE	: EUP
CONS.	: New Construction

CH.	: 85+047
SIZE	: 1x9.6+1x30.3+1x9.6
TYPE	: MINOR BRIDGE
CONS.	: Retained



DATUM=108.00

FRL @ Proposed CL (m): 118.189, 118.229, 118.269, 118.309, 118.349, 118.389, 118.429, 118.469, 118.509, 118.549, 118.589, 118.629, 118.669, 118.709, 118.749, 118.789, 118.829, 118.871, 118.917, 118.969, 119.025, 119.086, 119.153, 119.223, 119.293, 119.363, 119.433, 119.503, 119.573, 119.643, 119.713, 119.783, 119.853, 119.923, 119.993, 120.063, 120.133, 120.203, 120.273, 120.343, 120.413, 120.483, 120.553, 120.623, 120.693, 120.763, 120.833, 120.903, 120.973, 121.043, 121.113, 121.183, 121.253, 121.323, 121.393, 121.463, 121.532, 121.599, 121.663, 121.725, 121.785, 121.843, 121.898, 121.951, 122.001, 122.049, 122.095, 122.139, 122.180, 122.219, 122.256, 122.290, 122.322, 122.352, 122.382, 122.412, 122.442, 122.472, 122.502, 122.532, 122.562, 122.592, 122.622, 122.652, 122.682, 122.712, 122.742, 122.772, 122.802, 122.832, 122.862, 122.892, 122.922, 122.952, 122.982, 123.012, 123.042, 123.072, 123.102, 123.132, 123.162

Vertical Schematic: R=20000.000 L=60.000; P=0.700% L=329.149; R=-43000.000 L=172.000; P=0.300% L=361.714

GL @ 10.0m From PCL(m) (LHS): 114.983, 116.293, 115.982, 116.559, 113.898, 111.703, 114.649, 111.365, 114.610, 115.323, 115.798, 115.421, 115.914, 116.009, 115.020, 115.234, 114.524, 113.886, 115.191, 115.827, 115.430, 114.227, 114.572, 114.747, 114.640, 114.532, 114.586, 113.990, 114.389, 114.771, 114.408, 114.544, 114.827, 115.099, 115.361, 115.538, 115.320, 115.813, 115.361, 115.017, 115.037, 115.119, 115.159, 115.151, 115.267, 114.927, 115.410, 114.829, 114.635, 114.993, 115.295, 114.536, 114.360, 115.082, 115.052, 114.992, 115.352, 115.705, 114.944, 115.289, 115.024, 114.829, 114.783, 114.765, 114.789, 114.592, 114.720, 114.726, 114.534, 114.485, 114.336, 114.429, 114.322, 114.173, 114.384, 114.459, 114.126, 114.086, 114.585, 114.048, 114.697, 113.910, 114.564, 114.382, 114.718, 114.881, 115.220, 115.069, 115.333, 114.914, 114.503, 114.304, 114.966, 114.942, 114.568, 114.812, 115.015, 114.887, 115.409, 115.173, 115.209, 115.530, 114.854, 114.475, 114.492, 115.171, 115.096, 115.246, 115.321, 115.358, 115.359, 115.361, 115.538, 115.403, 115.910, 115.572, 115.267, 115.126, 115.983, 114.982, 115.517, 115.768, 115.096, 115.255, 115.500, 115.425, 115.379, 115.070, 115.216, 115.218, 115.103, 115.220, 115.136, 115.222, 115.169, 115.224, 115.203, 115.236, 115.226, 115.228, 115.269, 114.799

GL @ 10.0m From PCL(m) (RHS): 115.552, 115.390, 116.559, 116.121, 113.898, 111.627, 114.972, 111.355, 114.930, 115.453, 115.847, 115.794, 115.716, 116.016, 115.491, 115.759, 115.569, 115.526, 115.519, 114.325, 115.529, 116.076, 116.009, 115.827, 115.156, 115.122, 114.232, 115.367, 115.503, 115.638, 115.567, 116.592, 115.774, 115.659, 115.518, 115.389, 115.596, 115.590, 115.261, 115.254, 115.063, 114.832, 114.694, 114.560, 114.601, 114.763, 114.686, 114.925, 115.361, 115.017, 115.531, 114.491, 114.429, 114.159, 114.788, 114.736, 114.306, 114.219, 114.345, 114.657, 114.680, 114.703, 114.829, 114.993, 114.726, 114.583, 114.749, 114.772, 114.751, 114.730, 114.705, 114.669, 114.634, 114.596, 114.540, 114.485, 114.429, 114.383, 114.382, 114.381, 114.380, 114.379, 114.377, 114.366, 114.350, 114.317, 114.342, 114.372, 114.401, 114.472, 114.553, 114.633, 114.704, 114.732, 114.761, 114.789, 114.817, 114.846, 114.874, 114.898, 114.907, 114.916, 114.924, 114.932, 114.931, 114.927, 114.965, 115.025, 115.084, 115.144, 115.203, 115.263, 115.322, 115.373

Level @ Existing Road CL (m): 117.986, 118.046, 118.089, 118.132, 118.176, 118.217, 118.162, 118.107, 118.051, 117.923, 117.729, 117.541, 117.390, 117.247, 117.104, 116.962, 116.829, 116.696, 116.632, 116.582, 116.532, 116.482, 116.469, 116.493, 116.518, 116.543, 116.567, 116.592, 116.608, 116.602, 116.596, 116.590, 116.613, 116.646, 116.679, 116.712, 116.745, 116.727, 116.706, 116.686, 116.691, 116.735, 116.779, 116.788, 116.736, 116.683, 116.657, 116.680, 116.703, 116.726, 116.749, 116.772, 116.751, 116.730, 116.705, 116.669, 116.634, 116.596, 116.540, 116.485, 116.429, 116.383, 116.382, 116.381, 116.380, 116.379, 116.377, 116.366, 116.350, 116.333, 116.317, 116.342, 116.372, 116.401, 116.472, 116.553, 116.633, 116.704, 116.732, 116.761, 116.789, 116.817, 116.846, 116.874, 116.898, 116.907, 116.916, 116.924, 116.932, 116.931, 116.927, 116.965, 117.025, 117.084, 117.144, 117.203, 117.263, 117.322, 117.373

Horizontal Schematic: R=-2000.000 L=64.830; D=187.172; R=-2000.000 L=37.585; D=151.904; CL=50.000; R=1000.000 L=159.229; CL=50.000

Superelevation Schematic: e=4.400; e=4.400

LMCW

RMCW

Chainage (m): 85000, 85010, 85020, 85030, 85040, 85050, 85060, 85070, 85080, 85090, 85100, 85110, 85120, 85130, 85140, 85150, 85160, 85170, 85180, 85190, 85200, 85210, 85220, 85230, 85240, 85250, 85260, 85270, 85280, 85290, 85300, 85310, 85320, 85330, 85340, 85350, 85360, 85370, 85380, 85390, 85400, 85410, 85420, 85430, 85440, 85450, 85460, 85470, 85480, 85490, 85500, 85510, 85520, 85530, 85540, 85550, 85560, 85570, 85580, 85590, 85600, 85610, 85620, 85630, 85640, 85650, 85660, 85670, 85680, 85690, 85700, 85710, 85720, 85730, 85740, 85750, 85760, 85770, 85780, 85790, 85800, 85810, 85820, 85830, 85840, 85850, 85860, 85870, 85880, 85890, 85900, 85910, 85920, 85930, 85940, 85950, 85960, 85970, 85980, 85990, 86000

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ALL THE DESIGNS AND DRAWINGS ARE CARRIED OUT ON THE BASIS OF TOPOGRAPHIC SURVEY CARRIED OUT BETWEEN - JAN 13 TO APR 13

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
0	26.06.13	FIRST SUBMISSION	RP	SKR	PNN	RN

OWNER : PWRD/MoRT&H/ SJDA

PROJECT : DETAILED DESIGN FOR THE SUBREGIONAL ROAD CONNECTIVITY PROJECT - DETAILED ENGINEERING DESIGN AND FINALIZATION OF SAFEGUARD DOCUMENTS

CLIENT : ADB ASIAN DEVELOPMENT BANK

DESIGN CONSULTANT : SHELADIA ASSOCIATES INC., USA
Amsri Shamira, Flat No: 206 & 207, S D Road, Old Lancer Lanes, Secunderabad - 500 003,AP.

JOB No. : ADBTA 8116		
DESIGNED	RP	
DRAWN	SKR	
CHECKED	PNN	
APPROVED	RN	
DATE	SCALE:	HOR 1:2000 VER 1:200
JUNE-2013		

TITLE : PLAN AND PROFILE FROM CH:85+000 TO 86+000

REV. 0

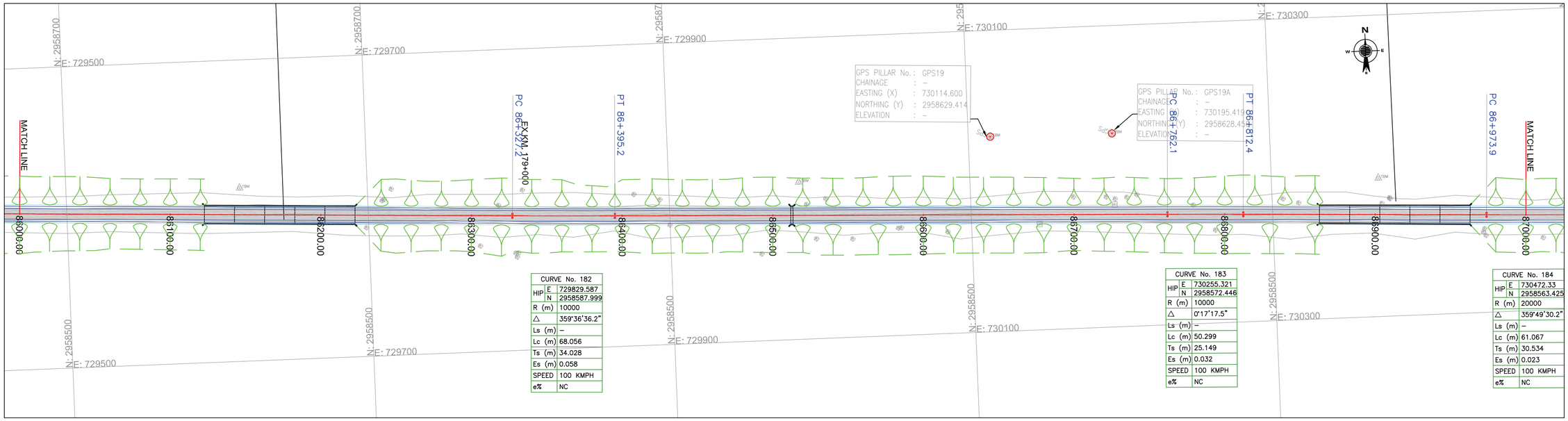
SIZE A2

DRAWING NO : A D B - A H - 4 8 - P P - D D - R 0 - 0 8 6

SCALE : –25m –10m 0 10 25m 50m

SHEET OF

BANGLADESH ← → **BHUTAN**



CURVE No. 182		
HIP	E	729829.587
	N	2958587.999
R (m)		10000
△		359°36'36.2"
Ls (m)		–
Lc (m)		68.056
Ts (m)		34.028
Es (m)		0.058
SPEED		100 KMPH
e%		NC

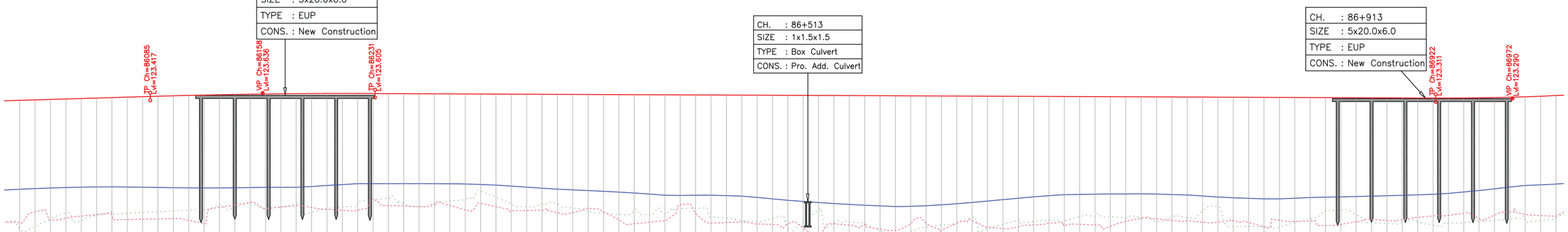
CURVE No. 183		
HIP	E	730255.321
	N	2958572.446
R (m)		10000
△		0°17'17.5"
Ls (m)		–
Lc (m)		50.299
Ts (m)		25.149
Es (m)		0.032
SPEED		100 KMPH
e%		NC

CURVE No. 184		
HIP	E	730472.33
	N	2958563.425
R (m)		20000
△		359°49'30.2"
Ls (m)		–
Lc (m)		61.067
Ts (m)		30.534
Es (m)		0.023
SPEED		100 KMPH
e%		NC

CH.	: 86+173
SIZE	: 5x20.0x6.0
TYPE	: EUP
CONS.	: New Construction

CH.	: 86+513
SIZE	: 1x1.5x1.5
TYPE	: Box Culvert
CONS.	: Pro. Add. Culvert

CH.	: 86+913
SIZE	: 5x20.0x6.0
TYPE	: EUP
CONS.	: New Construction



DATUM=112.00

Chainage (m)	FRL @ Proposed CL (m)	GL @ 10.0m From PCL(m) (LHS)	GL @ 10.0m From PCL(m) (RHS)	Level @ Existing Road CL (m)
86000	123.162	114.799	115.194	117.373
86010	123.192	114.895	115.410	117.410
86020	123.222	114.945	115.360	117.447
86030	123.252	115.439	115.479	117.485
86040	123.282	115.804	115.623	117.502
86050	123.312	115.296	115.717	117.515
86060	123.342	115.666	115.647	117.528
86070	123.372	115.900	115.397	117.515
86080	123.402	115.802	115.417	117.501
86090	123.432	115.852	115.436	117.487
86100	123.459	115.902	115.456	117.473
86110	123.485	115.952	115.341	117.459
86120	123.507	116.002	115.133	117.445
86130	123.528	116.052	116.195	117.452
86140	123.546	116.323	116.353	117.467
86150	123.562	116.169	116.510	117.482
86160	123.576	116.509	116.107	117.495
86170	123.587	116.121	116.205	117.496
86180	123.596	116.210	116.304	117.497
86190	123.603	116.422	115.873	117.551
86200	123.607	115.873	116.061	117.615
86210	123.609	116.109	115.999	117.678
86220	123.608	116.212	116.006	117.729
86230	123.606	116.550	116.694	117.732
86240	123.601	116.676	116.294	117.735
86250	123.597	116.799	116.282	117.737
86260	123.593	116.443	116.240	117.736
86270	123.589	116.234	116.436	117.735
86280	123.584	116.277	116.314	117.725
86290	123.580	116.602	116.023	117.714
86300	123.576	116.698	116.445	117.684
86310	123.572	117.256	116.231	117.631
86320	123.567	116.840	115.973	117.578
86330	123.563	116.419	115.985	117.508
86340	123.559	116.225	115.999	117.437
86350	123.555	116.415	115.843	117.380
86360	123.550	116.435	115.850	117.331
86370	123.546	116.149	116.119	117.282
86380	123.542	—999.008	—999.008	117.234
86390	123.538	—999.008	—999.008	117.187
86400	123.533	117.967	117.116	117.125
86410	123.529	117.219	117.053	117.053
86420	123.525	115.709	115.322	116.982
86430	123.520	115.789	115.783	116.967
86440	123.516	116.122	116.356	116.981
86450	123.512	116.140	115.164	116.981
86460	123.508	115.560	115.200	116.951
86470	123.503	115.501	115.236	116.921
86480	123.499	115.330	115.106	116.839
86490	123.495	115.244	115.079	116.739
86500	123.491	115.454	115.121	116.647
86510	123.486	115.000	115.242	116.576
86520	123.482	115.850	114.381	116.506
86530	123.478	116.022	115.110	116.442
86540	123.474	115.130	115.038	116.383
86550	123.469	115.130	115.100	116.326
86560	123.465	114.661	114.770	116.284
86570	123.461	114.408	114.703	116.243
86580	123.457	114.611	115.135	116.254
86590	123.452	114.896	115.154	116.298
86600	123.448	115.036	114.696	116.350
86610	123.444	115.179	115.153	116.428
86620	123.440	115.523	115.319	116.506
86630	123.435	114.808	114.904	116.598
86640	123.431	115.086	114.808	116.692
86650	123.427	115.364	114.911	116.786
86660	123.423	115.275	115.050	116.869
86670	123.418	115.334	115.152	116.950
86680	123.414	115.304	115.004	117.012
86690	123.410	115.583	115.082	117.032
86700	123.406	115.609	115.045	117.051
86710	123.401	115.576	114.950	117.062
86720	123.397	115.511	115.272	117.068
86730	123.393	115.465	115.491	117.074
86740	123.389	115.225	115.436	117.053
86750	123.384	115.576	115.342	117.026
86760	123.380	115.522	115.323	116.999
86770	123.376	115.948	115.219	116.933
86780	123.371	116.248	115.226	116.865
86790	123.367	114.932	115.319	116.807
86800	123.363	114.952	115.209	116.773
86810	123.359	114.919	114.919	116.740
86820	123.354	114.908	115.347	116.743
86830	123.350	115.188	115.270	116.784
86840	123.346	115.454	115.300	116.825
86850	123.342	115.971	115.009	116.852
86860	123.337	116.020	115.072	116.873
86870	123.333	115.713	115.260	116.894
86880	123.329	115.192	115.399	116.919
86890	123.325	115.134	115.332	116.944
86900	123.320	115.269	115.373	116.970
86910	123.316	115.250	115.538	117.003
86920	123.312	115.031	115.631	117.036
86930	123.310	115.185	115.665	117.098
86940	123.314	115.193	115.809	117.190
86950	123.325	115.271	115.453	117.282
86960	123.342	115.328	115.679	117.394
86970	123.366	115.418	115.881	117.510
86980	123.396	115.285	115.724	117.615
86990	123.432	115.321	115.654	117.660
87000	123.475	115.492	115.603	117.705

Vertical Schematic: R=−42700.000 L=146.276; P=−0.043% L=690.440; R=15562.566 L=100.000

Horizontal Schematic: D=568.522; R=−10000.000 L=68.056; D=366.840; R=10000.000 L=50.299; D=161.513; R=−20000.00

Superelevation Schematic: LMCW, RMCW

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ALL THE DESIGNS AND DRAWINGS ARE CARRIED OUT ON THE BASIS OF TOPOGRAPHIC SURVEY CARRIED OUT BETWEEN - JAN 13 TO APR 13

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
0	26.06.13	FIRST SUBMISSION	RP	SKR	PNN	RN

OWNER : PWRD/MoRT&H/ SJDA

PROJECT : DETAILED DESIGN FOR THE SUBREGIONAL ROAD CONNECTIVITY PROJECT - DETAILED ENGINEERING DESIGN AND FINALIZATION OF SAFEGUARD DOCUMENTS

CLIENT : ADB ASIAN DEVELOPMENT BANK

DESIGN CONSULTANT : SHELADIA ASSOCIATES INC., USA
Amsri Shamira, Flat No; 206 & 207, S D Road, Old Lancer Lanes, Secunderabad - 500 003.AP.

JOB No. : ADBTA 8116

DESIGNED	RP
DRAWN	SKR
CHECKED	PNN
APPROVED	RN
DATE	JUNE-2013
SCALE:	HOR 1:2000 VER 1:200

TITLE : PLAN AND PROFILE FROM CH:86+000 TO 87+000

REV. 0

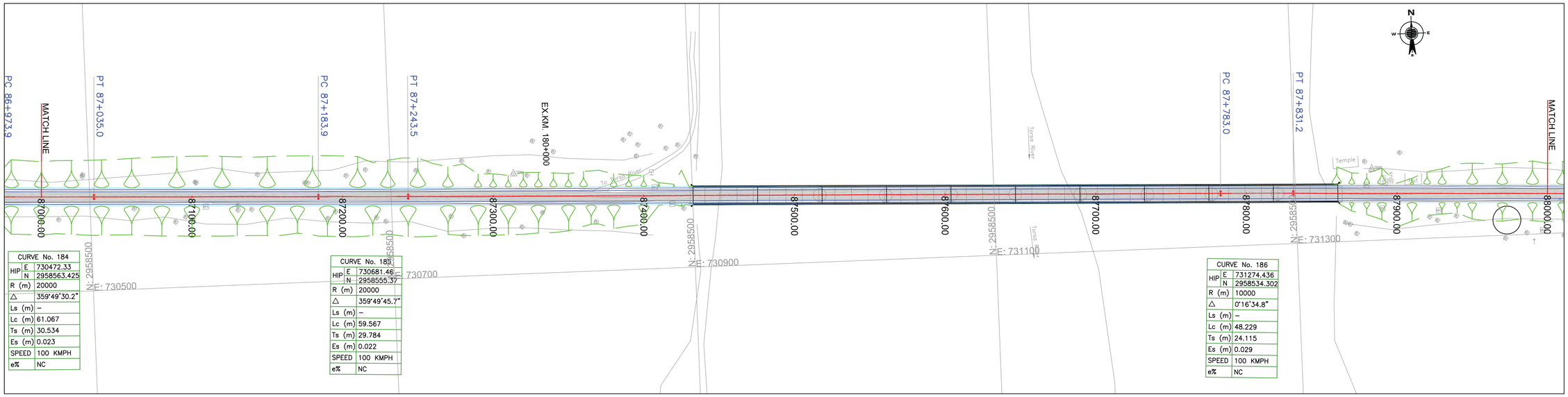
SIZE A2

DRAWING NO : A D B - A H - 4 8 - P P - D D - R 0 - 0 8 7

SCALE : −25m −10m 0 10 25m 50m

SHEET OF

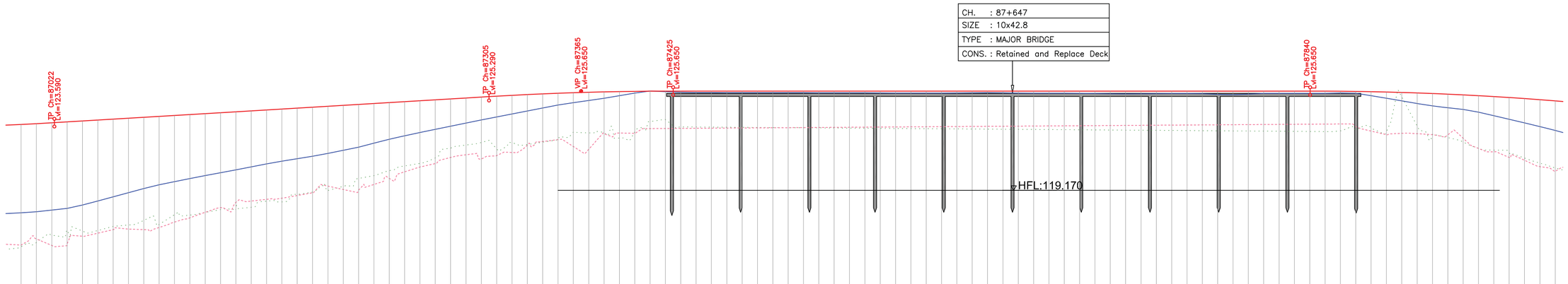
BANGLADESH ← → **BHUTAN**



CURVE No. 184		
HIP	E	730472.33
	N	2958563.425
R (m)		20000
△		359°49'30.2"
Ls (m)		–
Lc (m)		61.067
Ts (m)		30.534
Es (m)		0.023
SPEED		100 KMPH
e%		NC

CURVE No. 185		
HIP	E	730681.46
	N	2958555.37
R (m)		20000
△		359°49'45.7"
Ls (m)		–
Lc (m)		59.567
Ts (m)		29.784
Es (m)		0.022
SPEED		100 KMPH
e%		NC

CURVE No. 186		
HIP	E	731274.436
	N	2958534.302
R (m)		10000
△		0°16'34.8"
Ls (m)		–
Lc (m)		48.229
Ts (m)		24.115
Es (m)		0.029
SPEED		100 KMPH
e%		NC



DATUM=112.00

Chainage (m)	FRL @ Proposed CL (m)	GL @ 10.0m From PCL(m) (LHS)	GL @ 10.0m From PCL(m) (RHS)	Level @ Existing Road CL (m)
87000	123.475	115.492	115.603	117.705
87010	123.524	115.777	116.001	117.778
87020	123.580	116.251	115.579	117.888
87030	123.640	116.558	115.557	117.997
87040	123.700	116.513	116.178	118.215
87050	123.760	116.552	116.379	118.481
87060	123.820	116.820	116.611	118.746
87070	123.880	116.911	116.646	119.020
87080	123.940	117.215	116.609	119.293
87090	124.000	116.950	116.747	119.535
87100	124.060	117.588	117.104	119.740
87110	124.120	117.558	117.383	119.945
87120	124.180	117.734	117.737	120.138
87130	124.240	117.917	118.039	120.326
87140	124.300	117.956	118.386	120.514
87150	124.360	118.068	118.474	120.706
87160	124.420	118.469	118.587	120.898
87170	124.480	118.422	118.662	121.074
87180	124.540	118.899	118.835	121.236
87190	124.600	119.060	119.015	121.398
87200	124.660	119.164	119.449	121.588
87210	124.720	119.435	119.229	121.785
87220	124.780	119.950	119.186	121.990
87230	124.840	120.131	119.557	122.251
87240	124.900	120.463	119.955	122.511
87250	124.960	120.381	120.766	122.740
87260	125.020	120.933	120.695	122.946
87270	125.080	121.292	120.924	123.151
87280	125.140	121.931	121.320	123.359
87290	125.200	122.128	121.494	123.566
87300	125.260	122.299	121.217	123.771
87310	125.319	121.876	121.445	123.964
87320	125.374	122.275	121.645	124.158
87330	125.424	122.166	122.124	124.352
87340	125.469	122.317	122.362	124.547
87350	125.509	122.471	122.484	124.742
87360	125.544	122.979	122.033	124.891
87370	125.574	122.923	121.849	125.036
87380	125.599	122.929	122.883	125.181
87390	125.619	122.586	122.912	125.350
87400	125.634	122.988	122.898	125.520
87410	125.644	123.664	999.004	125.658
87420	125.649	123.794	999.004	125.616
87430	125.650	999.004	999.004	125.574
87440	125.650	999.004	999.004	125.556
87450	125.650	999.004	999.004	125.552
87460	125.650	999.004	999.004	125.547
87470	125.650	999.004	999.004	125.548
87480	125.650	999.004	999.004	125.549
87490	125.650	999.004	999.004	125.549
87500	125.650	999.004	999.004	125.549
87510	125.650	999.004	999.004	125.545
87520	125.650	999.004	999.004	125.539
87530	125.650	999.004	999.004	125.536
87540	125.650	999.004	999.004	125.539
87550	125.650	999.004	999.004	125.540
87560	125.650	999.004	999.004	125.530
87570	125.650	999.004	999.004	125.521
87580	125.650	999.004	999.004	125.519
87590	125.650	999.004	999.004	125.518
87600	125.650	999.004	999.004	125.523
87610	125.650	999.004	999.004	125.530
87620	125.650	999.004	999.004	125.536
87630	125.650	999.004	999.004	125.543
87640	125.650	999.004	999.004	125.539
87650	125.650	999.004	999.004	125.522
87660	125.650	999.004	999.004	125.509
87670	125.650	999.004	999.004	125.511
87680	125.650	999.004	999.004	125.512
87690	125.650	999.004	999.004	125.502
87700	125.650	999.004	999.004	125.492
87710	125.650	999.004	999.004	125.481
87720	125.650	999.004	999.004	125.471
87730	125.650	999.004	999.004	125.476
87740	125.650	999.004	999.004	125.486
87750	125.650	999.004	999.004	125.494
87760	125.650	999.004	999.004	125.499
87770	125.650	999.004	999.004	125.486
87780	125.650	999.004	999.004	125.439
87790	125.650	999.004	999.004	125.410
87800	125.650	999.004	999.004	125.455
87810	125.650	999.004	999.004	125.501
87820	125.650	999.004	999.004	125.501
87830	125.650	999.004	999.004	125.501
87840	125.650	999.004	999.004	125.503
87850	125.648	999.004	999.004	125.505
87860	125.640	999.004	999.004	125.528
87870	125.628	999.004	123.054	125.513
87880	125.610	123.153	123.342	125.347
87890	125.588	123.271	123.041	125.182
87900	125.561	123.005	122.807	125.015
87910	125.528	125.270	122.893	124.847
87920	125.491	125.378	122.871	124.681
87930	125.449	122.790	122.808	124.565
87940	125.401	122.616	122.792	124.450
87950	125.349	122.329	122.574	124.277
87960	125.291	121.912	121.909	124.044
87970	125.229	121.799	121.691	123.810
87980	125.162	121.637	121.320	123.573
87990	125.089	121.280	121.133	123.335
88000	125.012	120.949	120.725	120.083
		120.638	120.414	

Vertical Schematic: P=0.600% L=283.351; R=−20000.000 L=120.000; P=0.000% L=415.202

Horizontal Schematic: 0.000 L=61.067; D=148.969; R=−20000.000 L=59.567; D=539.452; R=10000.000 L=48.229

Superelevation Schematic: e=2.500; e=2.500

LMCW

RMCW

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ALL THE DESIGNS AND DRAWINGS ARE CARRIED OUT ON THE BASIS OF TOPOGRAPHIC SURVEY CARRIED OUT BETWEEN - JAN 13 TO APR 13

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
0	26.06.13	FIRST SUBMISSION	RP	SKR	PNN	RN

OWNER : PWRD/MoRT&H/ SJDA

PROJECT : DETAILED DESIGN FOR THE SUBREGIONAL ROAD CONNECTIVITY PROJECT - DETAILED ENGINEERING DESIGN AND FINALIZATION OF SAFEGUARD DOCUMENTS

CLIENT : ASIAN DEVELOPMENT BANK

DESIGN CONSULTANT : SHELADIA ASSOCIATES INC., USA
Amsri Shamirs, Flat No; 206 & 207,
S D Road, Old Lancer Lanes,
Secunderabad - 500 003,AP.

JOB No. : ADBTA 8116	
DESIGNED	RP
DRAWN	SKR
CHECKED	PNN
APPROVED	RN
DATE	JUNE-2013
SCALE:	HOR 1:2000 VER 1:200

TITLE : PLAN AND PROFILE FROM CH:87+000 TO 88+000

REV. 0

SIZE A2

DRAWING NO : A D B - A H - 4 8 - P P - D D - R 0 - 0 8 8

SCALE : −25m −10m 0 10 25m 50m

SHEET OF

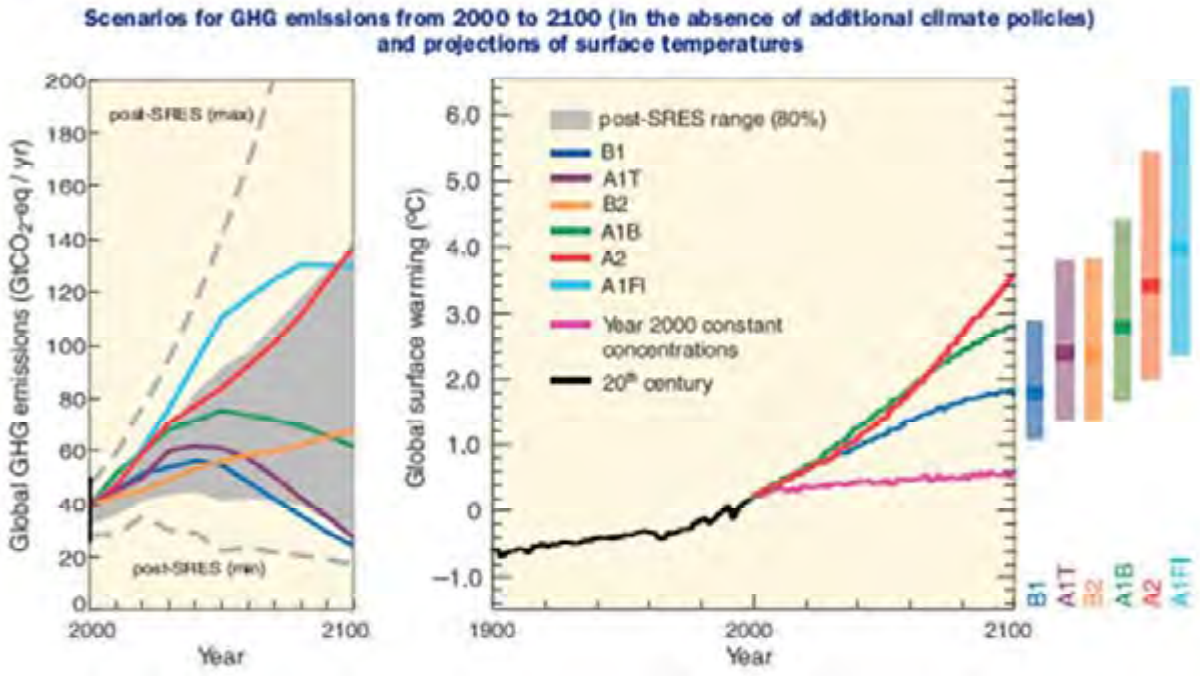
Appendix 12.1: Climate Change Study Report

Climate Change threats for Northern Districts of West Bengal

A. Background

1. Intergovernmental Panel on Climate Change (IPCC) in its 4th Assessment Report indicated that with current rate of Green House Gas (GHG) emissions, the ecosystems by 2100 will be exposed to an atmospheric CO2 level (Fig. 1), which would alter the functioning of ecosystems and reduce biodiversity impacting ecosystem services being provided by forests etc. As per the IPCC, anthropogenic activities have warmed the climate as observed in the past century, that the Earth has warmed on an average by 0.76 °C and the rate of warming is increasing. According to WMO, the year 2010, was the warmest year on record. The Global average temperature in 2010 was 0.53 degrees Celsius above the average level during 1961-90, and it is higher than the two previous warmest years 1998 and 2005 in the last decade. Climate change models, driven by a variety of socio economic scenarios project that the global average temperature may rise by 1.8 to 4.0°C by 2100.

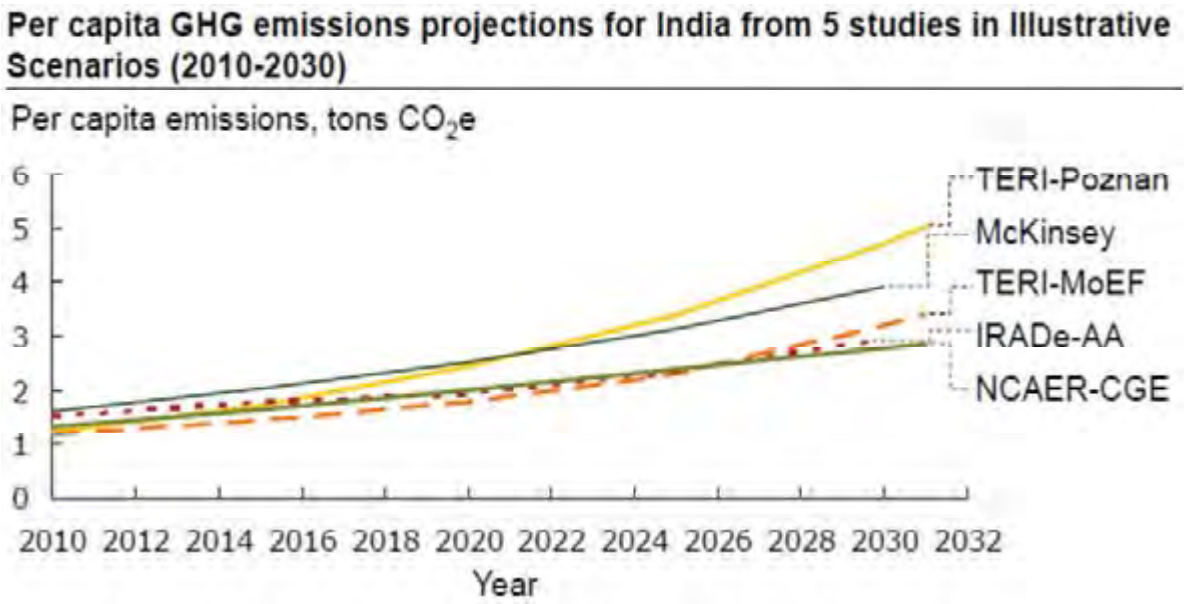
Fig. 1: Scenarios for GHG emissions from 2000-2100 (Source: IPCC 4th Assessment Report)



2. Climate Change is an important issue taken seriously in India as evident from recent initiative of government in launching National Action Plan on Climate Change (NAPCC). Under NAPCC, eight national missions viz National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for Green India, National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change have been formed to tackle climate change in India involving various ministries and organizations. Various states have come up with their respective state level action plans. Also various organizations/individuals conducted studies on vulnerability and assessment of climatic hazards especially in areas like health, agriculture, tourism, water resources, sea level rise etc in

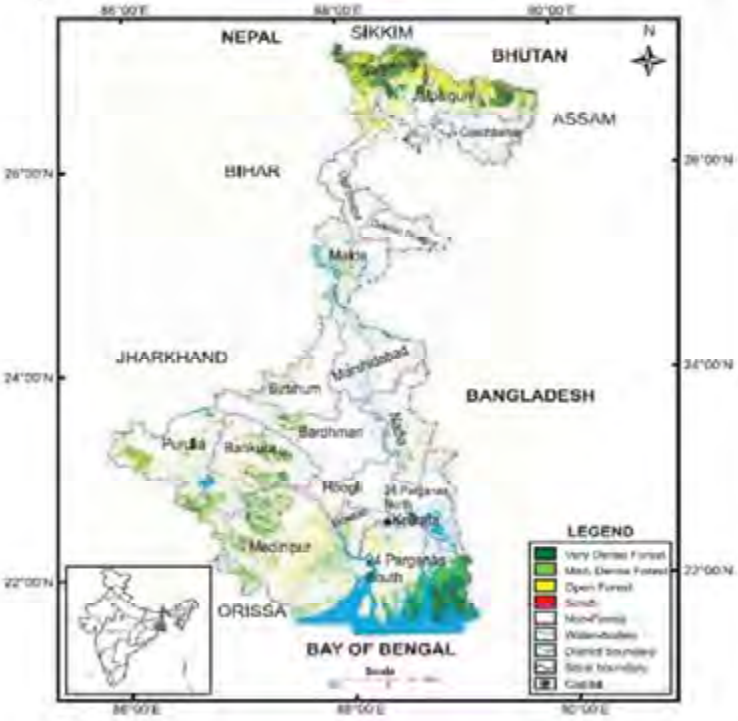
the state of West Bengal. Almost all studies point towards an increasing trend and indicate that state is vulnerable to changing climate (Fig 2).

Fig. 2: Per capita GHG emissions projections for India by various models for scenarios (2010-2030 (Source: MoEF ppt by Prodipto Ghosh, 2009)



3. Among, various states of India, West Bengal, though covering only 2.7% of country's geographical area, has unique combination of forests ranging from coastal mangroves to high altitude Himalayan forests. The total recorded forest area of West Bengal is 11879 sq km, which is 13.38% of its geographical area. The northern districts i.e. Jalpaiguri and Darjeeling are having rich forest cover i.e. 19% & 17% of state's forest area respectively (Fig. 3).

Fig. 3: Forest Cover Map of West Bengal (SFR, 2011)



4. District-wise forest cover in West Bengal is given below (Table 1)

Table 1: District-wise forest cover in West Bengal (SFR, 2011)

District	Geographical Area	2011 Assessment				Percent of GA	Change	Scrub
		Very Dense Forest	Mod. Dense Forest	Open Forest	Total			
Bankura[T]	6,882	213	510	333	1,056	15.34	0	4
Bardhman[T]	7,024	44	135	82	261	3.72	0	1
Birbhum[T]	4,545	0	42	63	105	2.31	0	2
Kolkata	185	0	0	0	0	0.00	0	0
Coochbehar	3,387	0	15	79	94	2.78	0	1
Dakshin Dinajpur[T]	2,219	0	2	13	15	0.68	0	0
Darjeeling[Th]	3,149	714	663	912	2,289	72.69	0	0
Howrah	1,467	0	53	93	146	9.95	0	0
Hoogli	3,149	0	9	52	61	1.94	0	0
Jalpaiguri[T]	6,227	681	514	1,309	2,504	40.21	-2	8
Malda[T]	3,733	0	113	51	164	4.39	0	0
Medinipur[T]	14,081	253	1,171	1,172	2,596	18.44	1	0
Murshidabad[T]	5,324	0	63	44	107	2.01	0	0
Nadia	3,927	2	74	53	129	3.28	0	0
North 24 Pargana	4,094	20	18	51	89	2.17	0	0
Purulia[T]	6,259	43	373	381	797	12.73	0	13
South 24 Pargana[T]	9,960	1,014	889	503	2,406	24.16	2	0
Uttar Dinajpur	3,140	0	2	174	176	5.61	0	0
Grand Total	**88,752**	**2,984**	**4,646**	**5,365**	**12,995**	**14.64**	**1**	**29**

B. Climatic Threats in North Bengal

5. North Bengal is prone to both floods as well as droughts. Historically, the region has faced some of the severest floods and even a few droughts in spite of good forest cover in the area.

C. Floods in North Bengal Districts

6. The North Bengal districts have fast flowing turbulent rivers like Torsa, Raidak, Teesta, Jaldhaka and Mahananda, which bring down heavy quantities of boulders, sand and silt. The Northern flood plain of North Bengal called Terai Teesta flood plain is further subdivided into various plains i.e. Piedmont Plains (where due to sudden fall in gradient river channels deposit transported material at the foothills), Dilluvial Plains (basically flood prone zone, which is formed from materials eroded from piedmont fans and mountains); Northern Riverine Plains (constituting of true riverine plain with flooding and deposition of sand). Following is map showing flood prone areas in West Bengal (Fig. 4).

Fig 4: Flood prone areas in West Bengal (Source: WBPCB, 2009)

7. Recent rains (July 2012) have affected nearly 80,000 people in West Bengal's three districts alone i.e. Darjeeling, Jalpaiguri and Cooch Behar.

(Courtesy: RPAPCC, WWF-India)

8. Following table (Table 2) shows record of large floods in West Bengal.

Table 2: Records of large Floods in West Bengal

Period	Description
1978	Major flood. Affected 235 blocks in Midnapore, Howrah Hooghly Murshidabad, Nadia, 24 Parganas, Bankura, Burdwan, Birbhum, Malda, Puruliya. Human Life lost: 1,370; Houses Damaged 13,61,338; Population Affected: 156.25 lakhs.

18/10/1985 - 20/10/1985	Caused by tropical cyclones.
22/09/1986 - 10/10/1986	Flooding due to heavy rains in some areas of Kolkata, Hooghly, Howrah, the Parganas and Midnapore.
23/08/1988 - 09/15/1988	Monsoonal rains caused flooding in areas of Balurghat and Dinajpur lying under the purview of the Ganges and Churani rivers.
03/07/1990 - 24/07/1990	Flooding due to monsoonal rain.
14/09/1991 - 15/09/1991	Flash floods caused damage 35,000 houses.
08/07/1993 - 13/08/1993	Flooding observed in Jalpaiguri district.
26/09/1995 - 02/10/1995	Flooding triggered by heavy rains caused erosion, severe agricultural damage and outbreak of diseases.
10/07/1996 - 24/07/1996	Flooding due to monsoonal rains.
01/08/1997 - 01/08/1997	Flooding due to monsoonal rains.
05/07/1998 - 02/09/1998	Monsoon rains caused flooding of the Ganges river.
11/07/1999 - 03/08/1999	Flooding due to monsoonal rains.
24/10/1999 - 12/11/1999	Tropical cyclones caused destruction of an estimated number of 1,500 villages. Floods due to brief torrential rains affected areas of Kolkata, Burdwan and Birbhum.
02/08/2000 - 01/10/2000	Besides flash floods triggered by incessant torrential storms, disaster is also accredited to the opening of sluice gates of dams. The fatalities counted to the tune of 1,262 besides affecting millions of people.
31/07/2001 - 01/09/2001	Monsoonal rains caused flooding in Kolkata.
21/06/2002 - 28/08/2002	Flooding in Jalpaiguri, Cooch Behar and Jalpaiguri in north Bengal due to monsoonal rains. Flash floods swamped ten villages, causing four deaths and 11,000 displacements.
11/06/2003 - 10/10/2003	Monsoonal rains caused floods affecting the regions of Darjeeling, Jalpaiguri, Malda and Murshidabad.
20/06/2004 - 07/10/2004	Heavy monsoonal rains affected several districts Heavy rains caused floods in many areas. About 3,000 coastal villages were inundated and 60,000 huts and many roads washed away.
07/07/2005 - 27/07/2005	Heavy monsoon rains triggered flash floods and landslides.
24/06/2006 - 03/08/2006	The regions of Birbhum, Burdwan and Murshidabad were affected mainly from continuous monsoonal downpour.

18/09/2006 - 05/10/2006	Monsoonal rains and tropical cyclone-driven storms in the Bay of Bengal hit India and Bangladesh. West Bengal recorded 50 deaths, 300 were injured and 30,000 mud houses destroyed. Heavy rains left large parts of Kolkata city under water; subsequently 2,000 people were evacuated from the city.
03/07/2007 - 22/09/2007	The hazard affected Kolkata and several other districts. Eighty-three deaths were reported, and millions of people were marooned in 3,000 villages in coastal areas of the state.
22/09/2007 - 08/10/2007	Heavy rain from tropical depression in the Bay of Bengal caused flooding leading to 51 deaths, and affecting 3.2 million people.

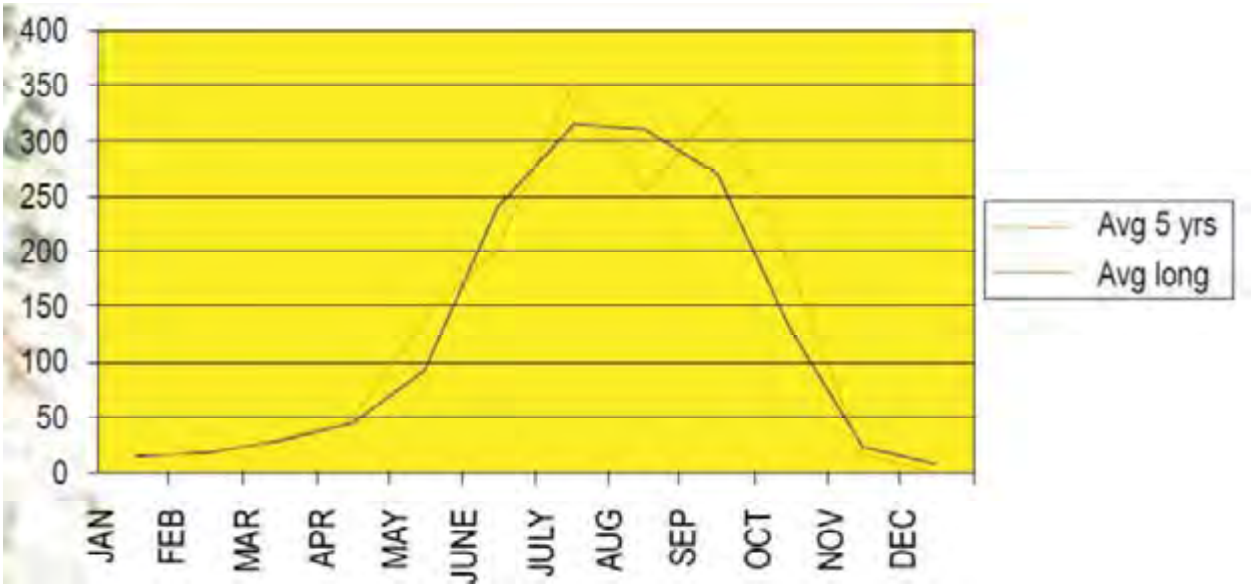
(Source: Department of Disaster Management, Govt of West Bengal & SIAG, West Bengal)

9. West Bengal is highly prone to floods as shown in the Flood Hazard Map (Fig 5), and north Bengal districts like Jalpaiguri have faced this reality many times in the past.

Fig. 5: Flood hazard map of India (Source: Department of Disaster Management, Govt of West Bengal)

10. Rainfall pattern for 5 years average in Gangetic plains including North West Bengal has seen an overall increase, which is not uniformly distributed as trend shows a decline in rainfall in months of June, whereas a mild increase in months of July to August (Fig 6). Also winter month's precipitation has seen significant decline.

Fig. 6: Last 5 years' average Precipitation in Gangetic Flood Plain compared with long term trend



Courtesy: RPAPCC, WWF-India

11. The similar observation was seen for annual rainfall in northern districts of West Bengal for the year 2010 (Table 3). Among these Darjeeling and Jalpaiguri had higher rains, which also boosts of highest forest cover in the state.

Table 3: Annual Rainfall in West Bengal by District as seen in 2010

District	Annual Rainfall in West Bengal by District during year 2010 (in mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Darjeeling				72	355	896	1142	876	456	188	33	
Jalpaiguri		2	74	159	396	900	1044	688	539	70	10	
Cooch Behar			30	385	600	711	863	525	496	61	2	

Source: Bureau of Applied Economics and Statistics, W.B.

12. Floods are most severe of threats due to climate change in north Bengal as West Bengal's 43% of geographical area is under threat as compared to all-India average of 12.17%. North Bengal is prone to flooding due to fast flowing rivers from snow fed rivers in Ganga-Brahmaputra basin and glacial lake outbursts. Table 4 below shows flood affected area and years in West Bengal.

Table 4: Flood years and affected area during floods in West Bengal between 1960-2000

Flood affected area (in sq. km)	Years during which the flood occurred	Total No. of years
Below 500	1985, 89, 92, 94 & 97	5
Between 500 2000	1962, 63, 64, 65, 66, 72, 75 & 96	8
2000 5000	1960, 61, 67, 69, 70, 74, 76, 80, 81 & 82	10
5000 10000	1973, 77, 93, 95 & 98	5
10000 15000	1968, 79, 83, 90 & 99	5
15000 20000	1971, 86, 87 & 88	4
Above 20000	1978, 84, 91 & 2000	4

Courtesy: RPAPCC, WWF-India

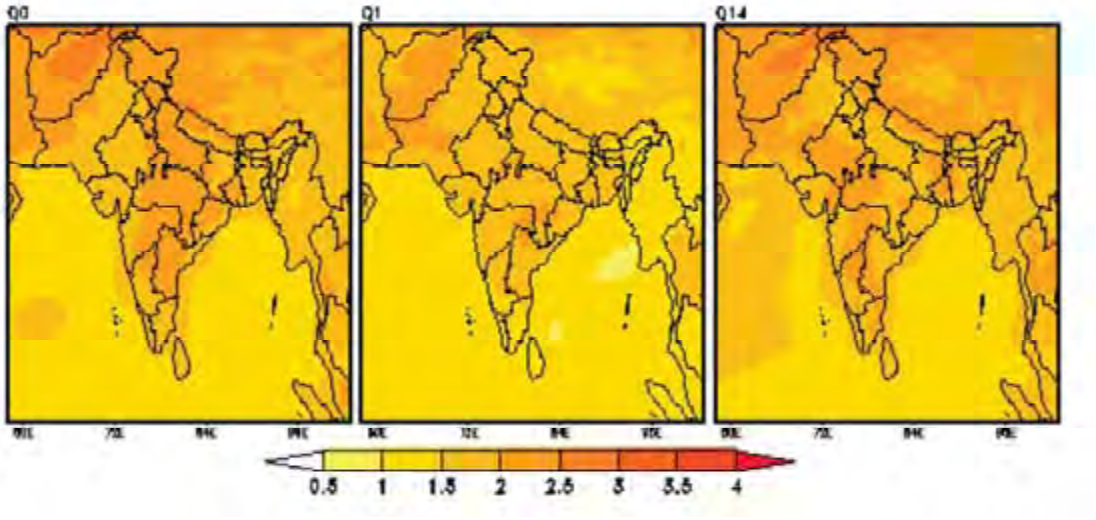
D. Droughts in North Bengal

13. Temperatures in West Bengal over last 100 years have risen to almost maximum 1 degree C as compared to eastern India, where average temperature rose by 0.6 degrees. The uncertainty in rainfall pattern and rising temperatures has added drought woes to the state. There is prediction for an increasing trend with respect to annual surface air temperature in West Bengal in 2030s. Various climate change models (BIOME, PRECIS, HadCM etc have been used for predictions. In a recent estimate by the government, nearly rupees 800 crores loss has been incurred in north Bengal alone due to droughts. Southern districts are more prone to droughts as compared to northern districts as shown in map of West Bengal drought affected blocks (Fig 6).

Fig 6: Drought affected blocks in West Bengal (Source: WBPCB, 2009)

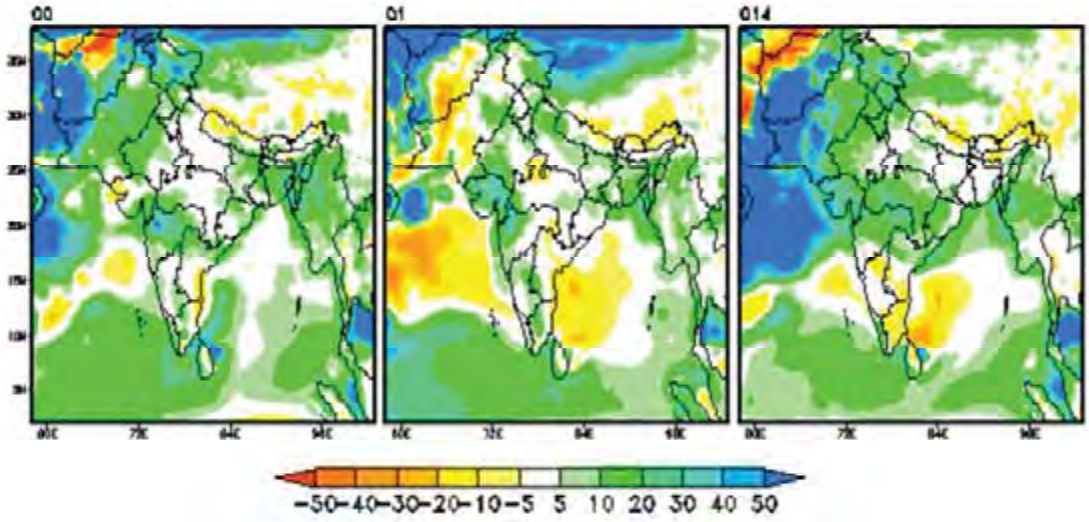
14. Droughts are caused when a region constantly receives below average precipitation. Also there are changes in surface air temperatures due to drier conditions. In West Bengal, there has been a predictive increase in the annual surface air temperature for 2030s (Fig 7).

Fig 7: Changes in the annual surface air temperature in 2030s with respect 1970s



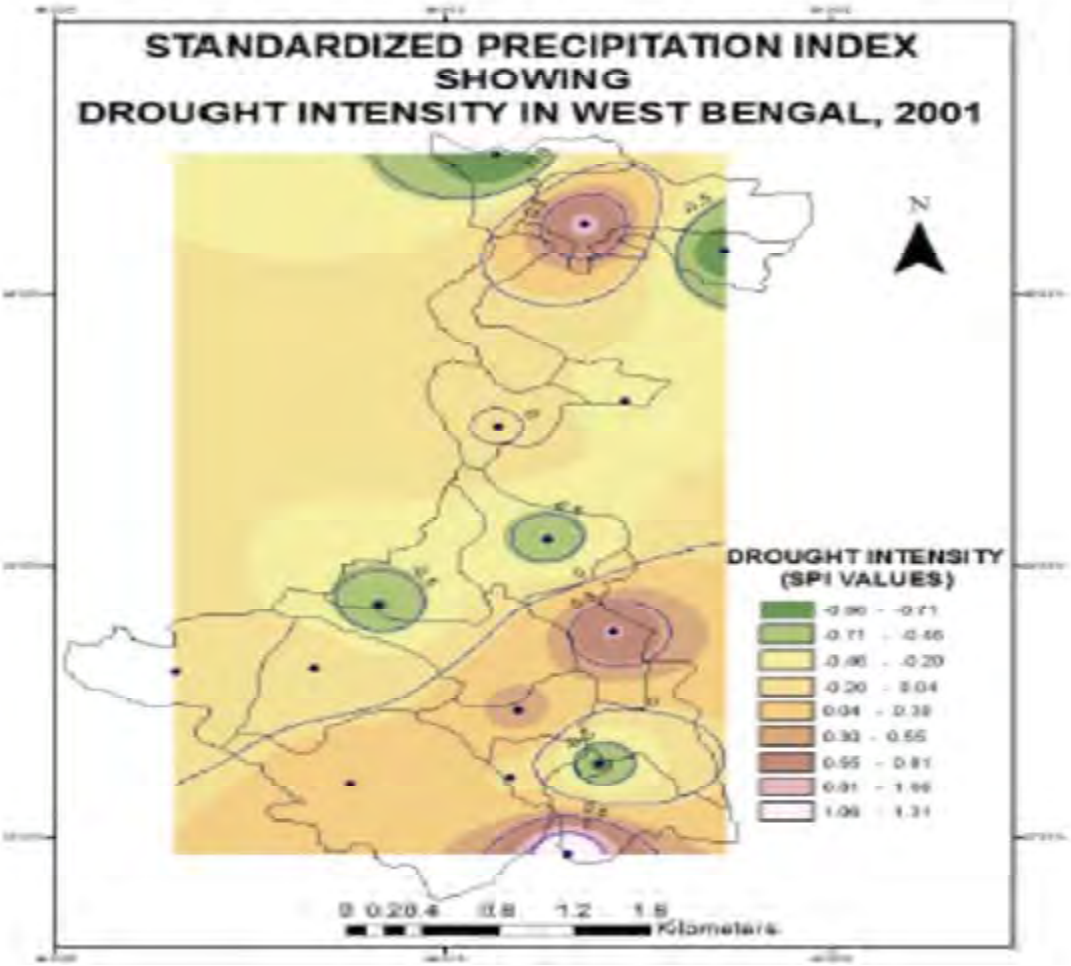
15. PRECIS models have predicted changes in summer monsoon precipitation towards 2030s for India, in which significant changes in precipitation pattern both positive and negative, have been observed for West Bengal (Fig 8).

Fig 8: Percentage change in the summer monsoon precipitation by three PRECIS runs towards 2030s with respect to 1970s



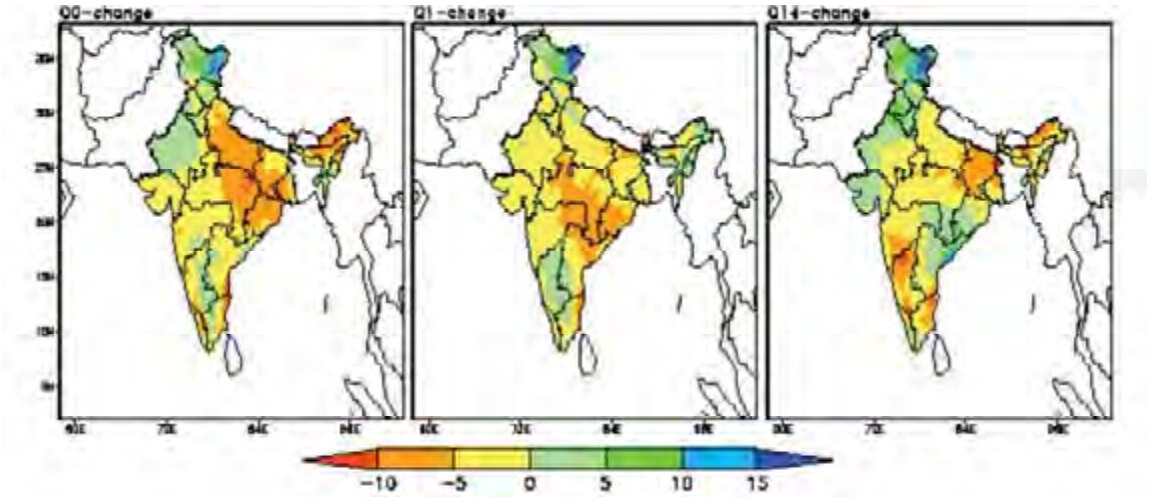
16. Studies (Kar et al, 2012) also showed that drought intensity has increased over years in West Bengal as observed in 2001 was high in few northern districts of West Bengal (Fig 9).

Fig 9: Drought Years with various intensities (SPI value) (Ref: Kar et al, 2012)



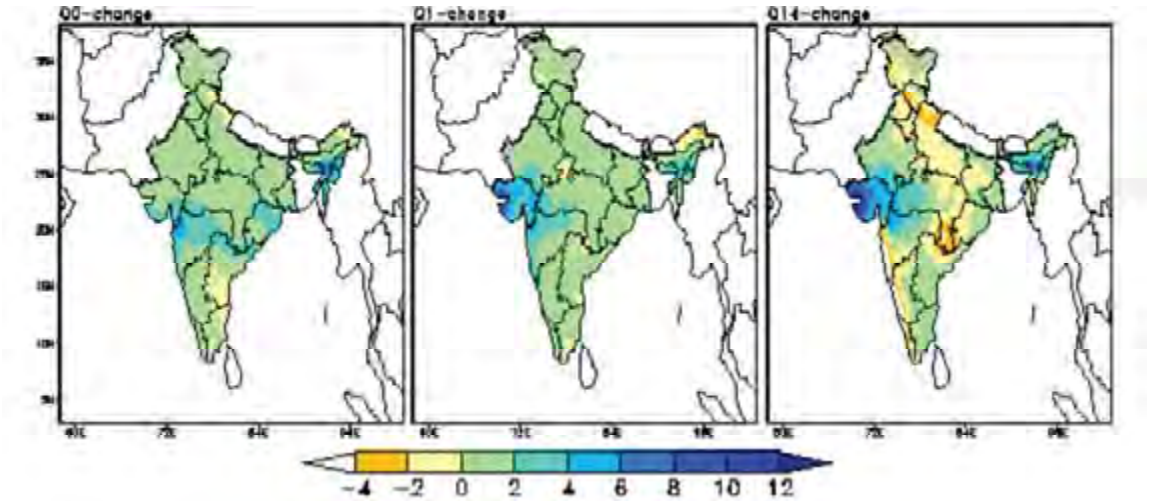
17. The modelling studies have also shown that frequency of rainy days in 2030s is significantly impacting the climate at various places in India Fig 10).

Fig 10: The change in the frequency of rainy days in 2030s with respect to 1970s (Source: IITM, 2010 ppt for MoEF workshop)



18. Also, there are changes predicted for intensity of rainy days in 2030s (Fig 11)

Fig 11: The change in the intensity of rainy days in 2030s with respect to 1970s



19. In Jalpaiguri district of West Bengal a comparison of magnitudes of Extreme Precipitation Rainfall Event (EPRE) before and after 1980 showed 39 events upto 1980 and 47 events between 1980 and 2010 (Ref: State Disaster Management Department, Govt of West Bengal).

E. Impacts on wildlife in North Bengal

20. **Habitat Loss:** Various studies draw inference that with increasing temperatures, the sensitive animals of high altitude like Red Panda may face habitat loss. Also flooding due to glacier melt & rivers would inundate presently suitable habitats in plains within protected areas and render many species homeless.

21. **Forest fires:** Severe heat would dry up soil and forest floors impacting forests, which would be prone to forest fires causing huge loss to vegetation as well as killing/displacing wild animals.

22. **Changes in vegetation structure & patterns:** Temperature sensitive species like Orchids would be hard hit with temperature rise and there would be changes in existing

vegetation structures to cope with rising temperatures. Climate Change may trigger changes in the net Primary Productivity (NPP) status of the forests, which is likely to increase.

23. **Landslides in the hills**: Incessant rains may trigger landslides on hills, further escalating the existing land-use of the hills.

24. **Changes in Phenology**: Temperature anomalies may trigger early flowering ad thus changes in phenology of the vegetation, which would also impact the dependent wildlife.

F. Changes in micro-climate

25. North Bengal has a unique micro-climate due to its forest cover and numerous wildlife sanctuaries and National Parks, which has created local variability in the climate of the region. As per IPCC and State Action Plan reports, West Bengal would be facing issues of rising temperature and uncertainties in precipitation patterns.

26. The current micro-climate especially in northern districts of West Bengal due to changing temperature and precipitation would alter local forest ecosystem and thus bringing changes in habit and habitat of wildlife and biodiversity. The wildlife most impacted would be larger mammals like elephants, rhinos and gaur, which are solely dependent on vegetation species occurring in the region seasonally as seasonality patterns will change causing migration and movement of animals outside of their forest boundaries. This may lead to enhanced conflicts with man especially in agriculture lands and tea gardens.

27. Also, developmental projects like Asian Highway, which is passing through forests and adjoining areas and requiring felling or clearing of trees and vegetation, may alter the local micro-climate if trees felled are in substantial numbers.

G. Repercussions of Climate Change on Asian Highway Project in North Bengal

28. Climate Change predictions strongly suggest increase in events like erratic and intense rainfall and temperature increase. All these, together can cause repercussions on developmental projects like that of Asian Highway Network.

29. Proposed road Corridors of AH-2 and AH-48 are passing through or from nearby areas of wildlife sanctuaries/national parks/reserve forests, where increased transportation will have its impacts on the biodiversity of the area. The AH48 corridor is connecting Bhutan with Bangladesh through North Bengal area of India and is passing through Jaldapara National Park, which is famous for its one-horned Rhinoceros *(Rhinoceros unicornis)* and Elephant population.

30. The corridor also passes through Hasimara, Birpara, Goyerkata, Telipara, Falakata, Dhupguri and Mainaguri, which are areas having proximity to forests and wildlife corridors.

H. Floods hazard mapping for AH projects

31. The northern states of West Bengal, where Asian Highway project is proposed are prone to regular floods as it has number of rivers from north to south and at places cutting across the proposed highway. To understand the proposed impacts, an analysis was done by overlaying rivers, its drainage and road network on landsat data.

32. A Slope Map is prepared to assess steepness or degree of inclination of a feature relative to the horizontal plane, which can be conveniently calculated from contour lines on a topographic map. For the slope study of the area very high quality ASTER (Advanced Spaceborne Thermal

Emission and Reflection Radiometer) DEM is downloaded. These DEMs of the Terra satellite is freely available for 99% of the globe, and represents elevation at a 30 meter resolution. After downloading the DEMs the farther processing is done using the ARC GIS 9.3 version. Also 30 m interval contours are generated using the 3 D Analyst -Surface analysis-slope Slope map of 1 km radius from the road is made in ARC GIS software by using Spatial Analyst tool. Aspect Map shows the direction of slope as an Aspect Value of 0 means that the slope is facing the North. Here, we have prepared an Aspect Map of 1 km radius from the road is made in ARC GIS software using spatial analysis tool. Also, False Colour Composite (FCC) Landsat data was used for the study. The outcome is Slope map and Aspect map, which helped in deducing flood hazards for areas on AH-2 (Fig 14 & 15) and AH-48 (Fig 16 & 17) as explained below.

1. Flood hazards for AH-2

33. For studies on AH-2, we have taken the actual alignment of the road and made a buffer of 500 meters from the both side of the road, which shows if there is a flood in the river than the 500 meters radius area from the road will be effected. For assessment, we have taken the major rivers of the Project area Like Tista, Jaldhaka, Mujha, Torsha and a 500 meters radius buffer is generated for these rivers and assessment made for road alignment and number of trees which will be affected by the flood. The results are shown in the following table 5:

Table 5: Results of flood hazard mapping for AH-2

Effected Road alignment (Chainage)	Number of trees impacted	Remarks / Corrective actions
0 to 10 km	Lower side of the road (2209)	Chainage 1 may be impacted due to flooding and siltation from rivers as there may be soil erosion due to trees impacted on lower side of chainage. Corrective action may require elevated drainage culverts /road
30 to 40 km	Upper side of the road(1283), Lower side of the road(874)	Chainage 3 may be impacted by incessant flooding from river. Also trees on both lower and upper side of roads may be impacted. Corrective action may require elevated drainage culverts/road
70 to 80 km	Upper side of the road (2106), Lower side of the road (1568)	Chainage 7 may be impacted by flooding from river on both the sides of the road i.e. upper and lower. Also soil erosion due to impacted trees may lead to siltation and flooding. Corrective action requires watershed management and elevated drainage culverts / road
80 to 90 km	Upper side of the road(478), Lower side of the road(348)	Chainage 8 may be impacted due to flooding and also erosion due to impacted trees on upper and lower side of road. Corrective action requires elevated drainage culverts / road

Fig 14: Aspect map of the proposed AH-2 area

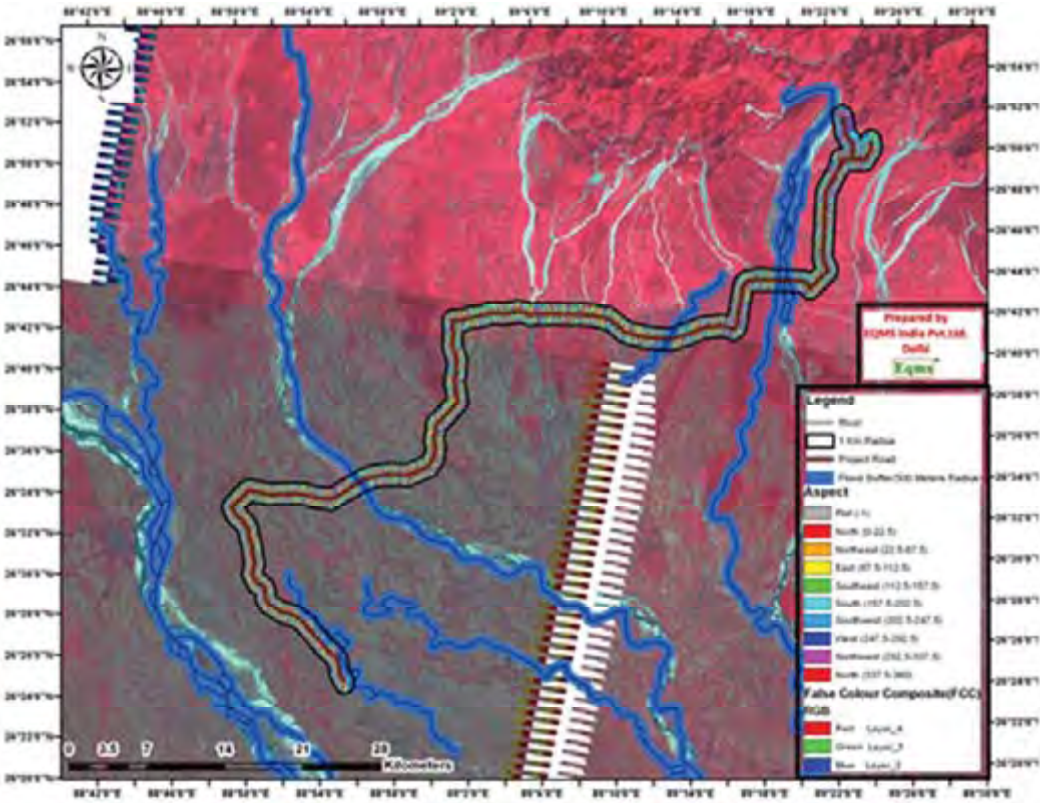
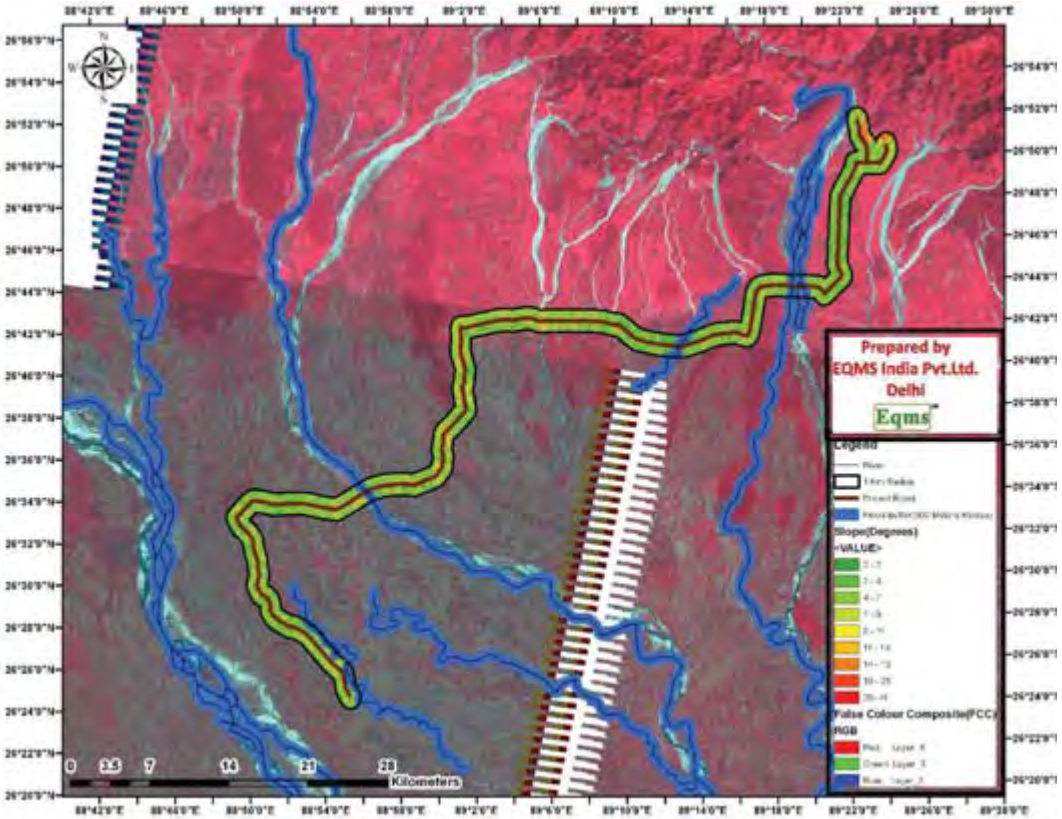


Fig 15: Slope map of AH-2



34. Both Aspect and Slope maps of AH-2 indicates that overall 4 Chainages i.e. Chainage 1, 3, 7 & 8 may be badly impacted due to flooding from the river. The area has an history of flooding, but these zones on AH-2 requires better planning and management from climate change perspectives through watershed management and drainage management through raised culverts/road etc.

2. Flood hazards for AH-48

35. For assessment of flood hazard for AH-48, we have taken the actual alignment of the road and made a buffer of 500 meters on both the side of the road assuming if there is a flood in the river than 500 meters radius area from the road will be effected. For this assessment, major rivers considered were Mechi, Balason and Mahananda, for whom 500 meters radius buffer was generated. The chainage impacted and the number of trees which will be affected by the flood is shown in the following Table 6:

Table 6: Results of flood hazard mapping for AH-48

Effected Road alignment (Chainage)	Number of trees	Remarks
0 to 10 Km	Upper Side (492), Lower side (452)	Chainage 1 may be impacted due to floods from river. Also trees impacted on both upper and lower side of road. Corrective action requires watershed management and drainage culvert / road elevation.
20 to 30 km	Upper Side (935)	Chainage 2 may be impacted due to floods and soil erosion and siltation from impacted trees on upper side of the road.

		Require drainage management and culvert/road elevation
30 to 40 km	Lower side of the road (692)	Chainage 3 may be impacted by flooding. Also soil erosion due to impacted trees on the lower side of the road Needs management of drainage/culvert
Alternative road	Upper side (2451) Lower side(123)	Alternative road may be impacted by flooding. Soil erosion due to impacted trees on upper and lower side. Needs watershed management and soil/silt management through raised culverts/road

Fig 16: Aspect Map AH-48

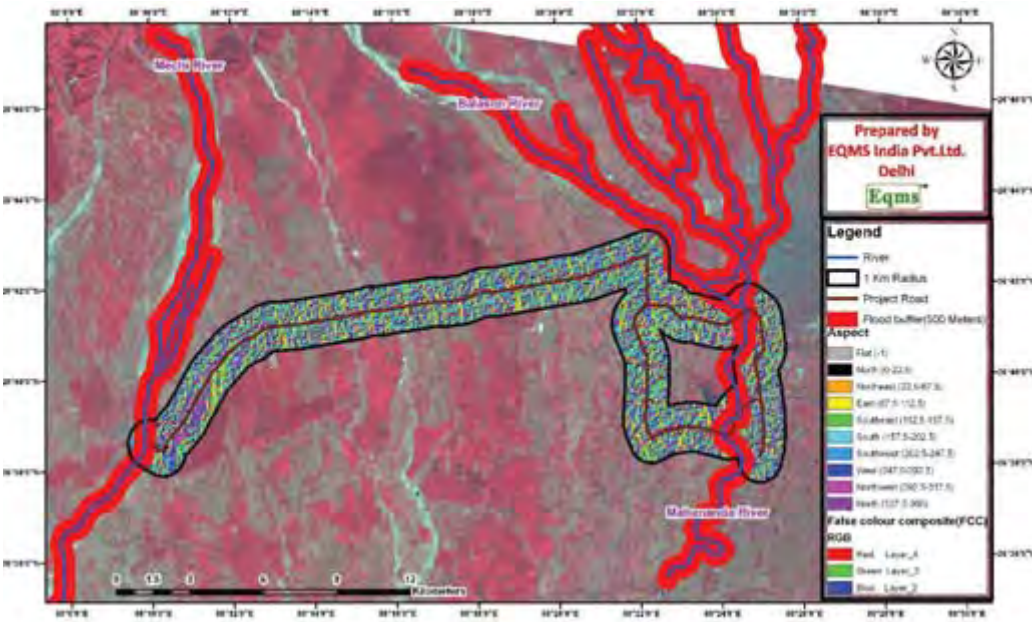
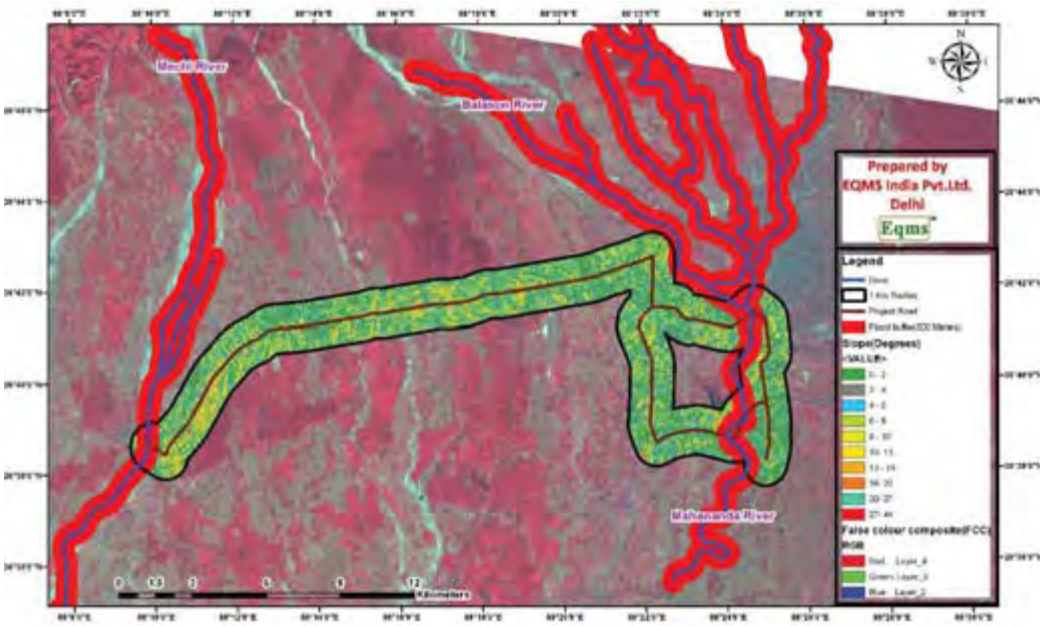


Fig 17: Slope Map AH-48



36. The analysis shows that for AH-48, three chainages i.e. Chainage 1, 2 & 3 along with alternative roads may be impacted more for flooding amongs all sections of chainages.

I. Need for a robust Climate Modeling study

37. The areas AH-2 & AH-48, falling in flood prone zone of West Bengal need a detailed study using climate change models for prediction and forecasting of climate change events. The study requires robust data collection on past events and forecast to develop a climate model for prediction of events in the area. There is need to have a long term vision about the AH projects based on predictive model forecast. Till date, macro-level studies for such forecasting is lacking.

J. Carbon stock in Forest

38. Forest Survey of India (FSI) conducted an assessment of Carbon Stocks in Indian Forests and estimated to be 59.2 Mt, which is capable of removing 217.07 mt CO2 eq annually and helping in mitigation of GHGs. Main species found in North Bengal forests are *Shorea, Mesua, Eugenia, Bischofia Artocarpus spp., Cinamommoum spp., Amora spp.* Terminalia *spp. Schima*, *chuckrassia, amoora, cedrela* etc.

39. During proposed AH-2 & AH-48 corridor implementation, **a huge number** of trees may be subjected to felling/clearing. The baseline for current stock has to be made through field sampling and enumeration of tree species, size and density estimation.

1. Carbon assumption and its Restocking for Jaldapara National Park section of AH-48

40. Just for sample, an assumption of Carbon for woody tree species in Jaldapara National Park section of Alignment AH-48 was done. Following important species were observed during field data collection (Table 7):

S. No	Common name	Scientific name	Number of trees	Rough Organic Carbon Value (t/tree)	Estimated Organic Carbon (tC)

1	Aam	*Mangifera indica*	96	3.59*	344.64
2	Bot	*Ficus relogiosa*	14	4.91*	68.74
3	Neem	*Azadirecta indica*	73	2.08*	151.84
4	Ficus sp.	*Ficus sp.*	33	4.46*	147.18
5	jamun	*Syzygium cumini*	44	1.3**	57.2
6	Koroi	*Albizzia lebbek*	121	1.35*	163.35
7	Semul	*Bombax ceiba*	578	1.53***	884.34
8	Tatul	*Tamarindus indica*	177	1.42*	251.34
9	Acacia	*Acacia sp.*	122	0.69**	84.18

Source: *B. L. Chavan et. al. Sequestered standing carbon stock in selective tree species grown in University campus at Aurangabad, Maharashtra, India/ International Journal of Engineering Science and Technology Vol. 2(7), 2010, 3003-3007.

**Hangarge L. M., D. K. Kulkarni, V. B. Gaikwad, D. M. Mahajan and Nisha Chaudhari; Carbon Sequestration potential of tree species in Somjaichi Rai (Sacred grove) at Nandghur village, in Bhor region of Pune District, Maharashtra State, India

***Mohammed Alamgir, M. Al-Amin; Organic carbon storage in trees within different Geopositions of Chittagong (South) Forest Division, Bangladesh, September 2007, Volume 18, Issue 3, pp 174-180 ;Journal of Forestry Research

41. Assuming that total 1258 woody tree species (according to our assumption of more C sequestrating species), within 20km stretch of Jaldapara Section of AH-48 Alignment are to be cut, which may lead to a loss of 2152 tC. Considering in terms of Carbon value, trees of high Organic Carbon contents need to be planted more for faster recovery of C loss.

42. Therefore, Considering average life cycle of trees as 30 years, the number of trees to be planted against loss should be 30 times to recover in one year, but, it is not feasible practically, thus ratio of 1:5 times for tree plantation should be undertaken to recover the C-loss in approximately 6-7 years period (based on favourable ecological conditions).

43. Based on total i.e. 3674 tree present in Jaldapara National Park section, above selected woody species constitute 34% approx, thus recommended to plant total 34% of woody trees in the ratio 1:5 for replenishment of C stock in 7-8 years.

K. Suggested measures to combat climate change impacts

- Reforestation of catchment areas and slope stabilization of landslide and Flash flood prone areas.
- Conduct studies on climate modeling at macro-level for forecasting of climatic events in the area
- A carbon assessment of trees would help in planning for its mitigation measures in the event of increased vehicular numbers and its movement by suggesting GHG emission reduction measures, which needs detailed field data collection and subsequent modeling of scenarios for future.
- Revival/safeguarding of wildlife corridors as connectivity between disjointed patches of forests in North Bengal for wildlife
- Provide biodiesel/CNG as alternatives to vehicles running on the highway for reduced carbon emissions
- Educate & aware forest dependent communities to participate in GHG reduction measures and provide suitable alternatives to them
- There is need to undertake Carbon Stock assessment study for impacted areas of proposed AH-2 and AH-48 alignment, which will give a clearer picture for

restocking of area with appropriate species and numbers to compensate for loss of carbon stock due to felling of trees during project construction phase.

- As carbon enhancement measures, the ratio of woody trees to be planted for compensation of felled trees comes around 1:5 as compared to proposed 1:3 ratio for general afforestation of trees.

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