Environmental Impact Assessment (Final)

June 2015

IND: South Asia Subregional Economic Cooperation Road Connectivity Investment Program – Tranche 1 (Non-sample subproject)

Imphal-Kangchup-Tamenglong Road

Prepared by the Manipur Public Works Department, Government of India for the Asian Development Bank. This is an updated final version of the draft EIA originally posted in March 2015 available on http://www.adb.org/projects/documents/ind-sasec-road-connectivity-investment-program-tranche1-imphal-kangchup-tamenglong-road-dec-2014-eia

CURRENCY EQUIVALENTS

(As of 28 February 2015)

Currency unit	–	Indian rupee (INR)
INR1.00	=	$ 0.01597
$1.00	=	INR 62.6345

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	Biochemical 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
IA	Implementing Agency
IMD	Indian Meteorological Department
IRC	Indian Road Congress
IUCN	International Union for Conservation of Nature
IVI	Important value index
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)
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 Household
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 Cooperation
SC	Scheduled Cast – Name of a community in India
SEIAA	State Environmental Impact Assessment Authority
SEMU	Social and Environmental Management Unit
SH	State highway
SIA	Social Impact Assessment
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
ST	Scheduled Tribes – Name of a community in India

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
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. This report summarizes the findings and results of the Environmental Impact Assessment (EIA) for Imphal-Kanchup-Tamenglong Road section (non-sample subproject). This subproject is covered under Tranche 1 of ADB's SASEC Regional Road Connectivity Investment Program in India. The subproject road is located in Manipur State of India. The report also briefly describes the Project, existing environmental conditions in the project area, anticipated environmental impacts and corresponding mitigation measures, public consultation process, the environmental management plan (EMP) and its monitoring plan.

2. The Environmental Impact Assessment (EIA) for the proposed subproject has been carried out as part of project preparation and in compliance with Environmental Assessment and Review Framework (EARF[1]) for the Project.

B. Description of the Project

3. The project road starts at Imphal City and ends at Tamenglong covering a total length of 103.02 kms. The alignment passes through districts of West Imphal, Senapati and Tamenglong connecting major settlements Imphal, Kangchup, Haochong, Bhalok and Tamenglong. The initial 13 km of project road alignment from Imphal to Kangchup is an existing road in plain terrain, whereas alignment between Kangchup to Tamenglong (about 90 km) is new greenfield alignment mostly located in mountainous terrain. The present road section is proposed for improvement and upgradation to four lane (in plain areas) and two lane (in hilly terrain) configurations with shoulders and side drains. Table 1 shows information about the Project Road.

Table 1: Information of the Project Road

Name of the Project	Subproject No.	Project Length (km)	Districts	State
Improvement and Upgradation of Imphal-Kanchup-Tamenglong Road Section in the State of Manipur	Tranche 1 non-sample subproject No. 3	103.052	Imphal West, Senapati and Tamenglong	Manipur

4. The project road will provide shortest connectivity to Haflong on "East West Corridor" of the National Highway Authority of India. It will also reduce the distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur. The project road will also provide connectivity to 18 interior villages (between Kanchup and Tamenglong) which are presently connected by dirt tracks only. The project road starts in Imphal City, just before junction with Takyel Road (towards airport) where existing 4 lane divided carriageway for the project road terminates. The initial 13 km of this road alignment from Imphal to Kangchup is existing road. Further alignment between Kangchup to Tamenglong (about 90km) is new greenfield alignment. Tracks at certain sections between Kangchup to Haochong earlier known as KT road during British era are still being used by settlers to transport wooden logs during dry season and are accessible on foot or Shaktiman

[1] Environmental Assessment and Review Framework for proposed IND: SASEC Road Connectivity Investment Program, ADB, December 2013.

trucks only. It further traverses the hills connecting Bhalok and terminates at Tamenglong. Major length of the alignment is in Tamenglong District while a small section of project alignment traverses through Imphal West and Senapati Districts too. Figure 1 shows the index map of the project road.

5. The proposed alignment for Imphal Tamenglong Road is predominantly a new alignment in hilly terrain between Kangchup to Tamenglong. The pavement of Imphal-Kangchup section of proposed Imphal Tamenglong road for approx. 13 km is in very good condition and recently overlay work has been done. Further up there is no existing road and only an old disused track is visible in small sections. Roadway geometry for existing alignment between Imphal to Kangchup section of Imphal Tamenglong road conforms to IRC standards for both horizontal and vertical geometry. As indicated earlier alignment section between Kangchup to Tamenglong is a new alignment designed conforming to the hill road standards.

Figure 1: Index Map of the Subproject Road

6. As per PWD records the existing ROW width of the Imphal-Kanchup section is in range of 15m to 30m. There are no major bridges (except 1 under construction) along the proposed alignment. However there are 5 minor bridges. At present there is one existing flyover, no ROBs and Underpasses in the project stretch. There are 17 existing culverts on this section of the road out of which 11 nos. are slab culverts, and 6 nos. Hume Pipe culverts.

7. The project engineering team has studied various alternatives for the alignment including the improvement of the existing tracks. However the alignment along existing tracks is too steep and it is not possible to improve it to the project standards. Hence the team has worked out a

new greenfield alignment with a total length of 103.02 km and a spur length of 4.15 km to Haochong and 0.80 km to Kabu Khulen. Feasibility of 1.44 km long single tube bi-directional tunnel was also studied, however after discussion with the client, it was decided to exclude it from the final proposal due to social issues and connectivity issues to adjacent villages. Table 1 present the salient features of the exiting project road.

8. Considering the existing conditions and projected traffic, it is proposed to improvement of 5.54 Km length to four lane divided carriageway, 7.36 km length of 2 lanes with paved shoulder and 2 lane hill section in the rest section. Spurs will be constructed to intermediate lane (5.5m) standards.

C. Description of the Environment

9. As defined in the scope of works baseline data on various physical, biological and social-economic aspects have been collected, analyzed and compiled in order to get the true picture of the existing environment condition in the project influence area.

1. Physical Environment

a. Meteorological Conditions

10. The climate of subproject areas is subtropical temperate. Rainfall is relatively abundant and widespread. The rainy season starts in June with the onset of the south-west monsoon and last up to September. Intermittent rains continue even upto October along with the retreat of the monsoon. The summer months are never oppressive with the average maximum temperature fluctuating from 32°C to 35°C during April-June, the mercury seldom going beyond 37°C.

11. The climate of Imphal West district is warm and temperate in Imphal. In winter there is much less rainfall than in summer. The Köppen-Geiger climate classification is Cwa. The average annual temperature in Imphal is 21.1°C. The average annual rainfall is 1589 mm. The driest month is December with 3 mm rainfall. Most precipitation falls in June, with an average of 359 mm. The warmest month of the year is June with an average temperature of 24.6 °C. In January, the average temperature is 14.5°C. It is the lowest average temperature of the whole year in Imphal. The difference in precipitation between the driest month and the wettest month is 356 mm. The average temperatures vary during the year by 10.1°C.

12. Senapati district has warm and temperate climate. In winter, there is much less rainfall in Senapati than in summer. According to Köppen and Geiger, this climate is classified as Cwa. The temperature here averages 19.5 °C. The rainfall here averages 1655 mm. The driest month is December. There is 7 mm of precipitation in December. With an average of 353 mm, the most precipitation falls in June. With an average of 23.4 °C, August is the warmest month. January has the lowest average temperature of the year. It is 12.8 °C

13. In Tamenglong district the climate is warm and temperate in Tamenglong. In winter there is much less rainfall in Tamenglong than in summer. The Köppen-Geiger climate classification is Cwa. The average annual temperature in Tamenglong is 18.5°C. The average annual rainfall is 3336 mm. The driest month is December with 8 mm. Most precipitation falls in July, with an average of 728 mm. The warmest month of the year is August with an average temperature of 22.2 °C. In January, the average temperature is 12.2°C. It is the lowest average temperature of the whole year. The difference in precipitation between the driest month and the wettest month is 720 mm. The average temperatures vary during the year by 10°C.

b. Topography, Geology and Soils

14. **Topography**: Topographically, the state is divided according to land elevations (lower hills – altitude ranging from 270 to 1,500 meters; mid hills – 1,500 to 2,000 meters; higher hills – 2,000 to 3,000 meters; alpine zone - above 3,900 meters with vegetation and snow bound land – very high without vegetation up to 8,580 meters). The project road is located in lower hills zone with altitude ranging from 500 to 1250m above MSL. It mostly passes through hilly terrain. Geographically the project road lies in the North-Eastern Himalayas between 27000'46" to 28007'48" North latitude and 88000'55" to 88055'25" East longitude.

15. **Land Use**: The existing land use along the project road is mostly agricultural mixed with roadside development in plain terrain and vegetative and forested on hilly terrain. The initial 2.7 km length of Imphal-Kanchup-Tamenglong Road is in urban area and from Km 2+70 to 12+700 (Kanchup) is in rural area. Project alignment beyond Kanchup is predominantly a new alignment along hills. A small section of alignment for approx. 2 km when passing through Imphal town has both residential and commercial settlements on both sides. However, since alignment already is 2 lane with paved shoulder, it would have minimal impact on existing structures on account of geometric and junction improvement. Patches of agricultural activities are also noticed on hills in this section.

16. Data obtained from IRS-P6 LISS-IV 2011 satellite image of the project area shows that about 20% of the project area is covered by thick plantation and 41% by thin plantation followed by degraded forest land (17%), agricultural land (12%), and settlement areas (7%). Water bodies and rivers cover about 3% land area in the project road.

17. **Geology**: Geologically, Manipur state belongs to the young folded mountains of the Himalayan system. The rocks in the state vary from upper cretaceous to the present Alluvium. The oldest rocks found in Manipur are mainly confined in the eastern part of the State close to Indo-Myanmar border and the rocks are grouped as cretaceous rocks consisting chromite, serpentine etc. availability of Asbestos, Chromite, Copper ore, Coal, Big iron, Lignite, Lime stone, Nickel ore and petroleum is reported in some parts of the state. The common rocks found are sandstone, shale, silt, stone, clay stones and slates. The rock system is weak and unstable prone to frequent seismic influence. The state is also seismically active and characterized by frequent landslides. The proposed project roads fall under the Seismic Zone IV, which is a susceptible to major earthquake as per the seismic zone map of India (IS 1893 - Part I: 2002).

18. **Soils**: The characteristics of soil of the project area (Imphal-Kunchuo-Tamenglong Road corridor) vary from place to place due to topographical variations. The soil in general is loamy sand to silty clay loam with a depth of 30 cm to 100 cm and in some cases even more than 120 cm. It has less water holding capacity and is dry in nature. Chemically acidic soil abound resulting from the washing down of the salts in rainwater and also on account of leaching effect. The pH value varies from 7.3 to 7.92. The soils are characterized by low to high organic matter (2.5-4 percent, in some places even more than 5 percent) with low action exchange capacity and high lime requirement. Notwithstanding the relatively high organic matter content, the nitrogen content in the soil is low.

c. Water Resources and Hydrology

19. The state has vast water resources in the form of lakes, ponds, rivers and streams, some with marshy areas. It has abundant of water potential both ground as well as surface

water. Important rivers that flows through the project region are the Nambul, the Ijei, the Bakua, the Irang, the Dingua, and the Iring. The main rivers flowing in the Tamenglong District which will be transverse proposed alignment are Irang, Iring, Ijei (Aga) river. The surface water bodies such as Ijei, Irang and Iring Rivers are close to Project road alignment. The Irang River distance from road varies from 10 to 20 m from the Project road of chainage 65.700 km to chainage 70.000 km. The Ijei River distance from road varies from 10 to 35 m from the Project road of chainage 34.900 km to chainage 36.700 km. In addition to this, many of springs (Jhora) are crossing the Project road.

d. Water Quality

20. In order to represent the true profile of the project area, samples from major surface water source through which the project road runs were collected and analysed as per IS- 2488 (Part I-V). Ground water (drinking water) samples were analyses as per IS: 10500-1991.

21. Water quality is monitored at five locations in order to represent the true profile of the project area. Results show that the pH of the sampled water in the region is well within permissible limits (6.5 – 7.5). In the ground water samples collected from bore well at Kangchup bazar show highest value of the total dissolved solids of 244mg/l which is well within the permissible standards. Total hardness as $CaCO_3$ in the water sample from Irang river is found at 45.6 mg/l which is highest in all samples but very less than the limit (300mg/l) prescribed for drinking water standard limits. BOD level for all analysed water samples is higher than the permissible standards. Other parameters analysed like chloride, sulphate, fluorides are found well within standards. Overall the ground water quality in the project areas in good.

e. Air Quality

22. Ambient air quality in the state is quite pure compared to other neighbouring states. Except for few urban centres like Imphal and Tamenglong, the ambient air quality is good. Ambient air quality for particulate matters (PM_{10} and $PM_{2.5}$), SO_2, NO_x & Pb was monitoring at three locations along the project road.

23. Out of three locations of air monitoring the SPM concentration at Imphal marginally exceeds permissible limits for residential zone i.e. 200 µg/m3 prescribed by MoEF. While at other locations (Kanchup and Tamenglong) the SPM conc. is well within limits. While PM_{10} concentration at all the monitored locations less than the new permissible limit i.e. 100 µg/m3 prescribed by MoEF for sensitive areas. Other parameters monitored i.e. $PM_{2.5}$, NO_x. SO_2 were found within the permissible limits for all the locations. Overall the air quality in the project area in not an issue.

f. Noise Levels

24. Noise levels were monitored at three locations along the project road. It is found that at all the three locations, the average day time noise level varies from 42.5 dB(A) to 58.2 dB(A), whereas average night time noise level ranges from 28.1 dB(A) to 42.5 dB(A).

25. The recorded noise level is marginally higher than the permissible limits for residential area prescribed by CPCB and also by World Bank EHS standards of 55 dB(A) and 45 dB(A) for day time and night time respectively. Night time noise level readings were taken upto 10 pm only as after 10 pm no traffic movements were observed. This noise is mainly from vehicular traffic and local domestic/commercial activities.

2. Biological Environment

a. Vegetation and Forests

26. In spite of its small size, the state's vegetation is rich and varied in character. This is because of its different climatic conditions found in the state and its peculiar physiography. The forest area of the state falls into four distinct zones viz. i) Burma drainage forests, ii) Urkul pine forests, iii) forests overlooking the valley and iv) Barak drainage forests.

27. About 67% of the geographical area of Manipur is hill tract covered forests. Depending on the altitude of hill ranges, the climatic condition varies from tropical to sub-alpine. The wet forests and the pine forests occur between 900-2700 m above MSL and they together sustain a host of rare and endemic plant and animal life. Coveted the world over as some of the most beautiful and precious blooms, orchids have an aura of exotic, mysteries about them.

28. About 2.1 km of the proposed alignment passes through Kangchup-Chiru Reserve forest of Senapati district. About 11.0 km length of the proposed project road section is in hilly terrain between Kanchup-Tamenglong passes Tairenpokpi-Tamenglong Protected Forest area. Starting from local stream Bangla to boundary of Wapong village (chainage 24+000 to Chainage 32+200, length 6.2 km) alignment transverse through forest area.

29. In plain terrain from starting point at chainage km 0.000 to 3+000 the land use is of built-up (major settlements Imphal city) and from chainage 3+000 to 13+000 the landuse of mixed type of residential and agriculture. While in hilly terrain at chainage km 13+000 onwards landuse is mixed of built-up (small settlements), agriculture and unclassified protected forests area of Senapati Forest Division and Tamenglong Forest Division.

30. Details of the forest locations along the project road sections are listed in Table 2.

Table 2: Details of Forest Locations along the Project Road section

Sl. No.	Name of Reserve / Protected Forest	District	Chainage	
			From (Km)	To (km)
1.	Kangchup-Chiru Reserve Forest	Senapati	17+200	19+300
2.	Tairenpokpi-Tamenglong Protected Forest	Tamenglong	24+000	35+000
3.	Kangchup Leimakhong Irang Protected Forest	Tamenglong	35+000	72+400
4.	Unclassed Forest	Tamenglong	72+500	97+900

Source: Field Survey carried out by the Consultant Team, 2014

31. Field survey has been carried out to identify the number and type of trees to be affected by the proposed improvement work of main alignment. It is envisaged that about 2732 trees existing within the proposed formation width of the project road. Among these trees 1351 are on left side and 1381 tress are on right side of the road while travelling towards Tamenglong. These trees are likely to cut for widening of the road.

32. In order to establish baseline data on the presence of important floral habitats in the project area, a vegetation assessment study has been carried using field surveys (sampling of flora species and consultations with local forestry officials and communities).

33. Kangchup RF area is mixed representation Tropical moist deciduous, Northern sub tropical broad leaved hill forests and Northern Montane wet temperate forests, Tairenpokpi Tamenglong and Kangchup Leimakhong Irang protected forest area is typically represented East Himalayan Moist Mixed Deciduous Forest (3C/C3b) and Cachar Tropical Semi Evergreen Forest mixed with Assam Sub-Tropical Pine Forest. A total of 53 different tree species are represented in 22 sample plots, showing the homogeneity of forest.

34. Among the listed species, *Gmelina arborea* (Wang) is the most common and uniformly distributed plant species in the forest areas of Tamenglong district. *Arundinaria clarkei* (Wa/Bamboo) is abundant plant species and in between banana cultivation is done by community in the protected forest area.

35. Most common plant species found along the forest area are *Gmelina arborea (Wang), Schima wallichii* (Usoi), *Cinnamomum zeylanicum (Ushingsha), Eucalyptus citriodora Hook (Nasik), Psidium guajava (Pungdon), Wendlandia tinctoria* (Fheija), *Cedrela loona* (Tairen) and *Rhus sinensis/Semialata* (Heimang) and *Ficus cunia (Heiret)* etc.

36. Altogether six species, two groups (Anacardiaceae and Orchidaceae) were recorded that falls under different conservation categories. Four species were protected by Government of India, one species by IUCN, and five species by CITES. Among the protected species, *Cycas pectinata* was kept under conservation category by all three i.e. GoI, IUCN and CITES.

b. Wildlife and Protected Areas

37. The State has rich wildlife and has long network of protected area. In order to protect the rich flora and fauna of Manipur from the poacher, the Government has established parks and sanctuaries. The state's protected area network comprises of five wildlife sanctuaries and two national parks. Recognizing the importance of this region as one of the hot spots, majority of the biodiversity rich areas of the state has been placed inside the protected area network system comprising mainly of the National Park and Sanctuary.

38. There are no key biodiversity areas within the buffer distances of 1- and 10-km. Within a 50km buffer zone from the road alignment there are 3 key biodiversity areas, these are the Zeiland Lake Sanctuary, Jiri-Makru Wildlife Reserve, Loktak Lake and Keibul Lamjao National Park.

39. About 2.1 km length of the project road (between km chainage km 17+200 to 19+300) passes through Kangchup-Makang Reserve Forest. However the project road neither encroaches nor passes by any of the protected areas of Manipur. In order to establish baseline data on the presence of important wildlife and faunal habitats in the project area, a Wildlife Assessment Study has been carried using field surveys (walkover transect surveys and consultations with local forestry and wildife officials and local communities).

40. Altogether 11 species of birds were observed during field surveys in forest areas along the project road alignment. Black-headed bulbul (*Pycnonotus atriceps),* Black-headed yellow bulbul (*Pycnonotus melanicterus*), Purple wood pigeon (*Columba punicea*) and Batek were most commonly observed avifauna in the all forest areas. The species of Blue-eared kingfisher (*Alcedo meninting*) and White-breasted kingfisher (*Halcyon smyrnensis*) were also seen in forest areas adjoining Ijei and Irang rivers. Besides these birds, Purple wood pigeon (*Columba punicea*), Forest eagle owl (*Bubo nipalensis*), Tawny eagle (*Aquila vindhiana*), Indian golden-backed three-toed woodpecker (*Dinopium javanense*) were also observed.

41. The areas along the proposed alignment affected forest areas are possible habitat for one globally threatened species (Great Indian hornbill) and five nationally vulnerable (Mrs. Hume's bar backed pheasant, Burmese ring dove, Indian moorhen, the Bar tailed dove, Pheasant tailed Jacana) birds species. One globally near threatened species of bird (Great Indian hornbill) was reported by local forest authorities in the forests along the project road alignemnt.

42. Altogether 7 mammalian species (belonging to 5 families) were recorded in and around the project road alignment through direct sighting and sign survey technique. Of these two species, Slow Loris (*Nycticebus coucang*) and Flying Squirrel *(Hylopetes alboniger)* were recorded by direct sighting in protected forest area of Kangchup Leimakhong Irang. Signs (droppings & footprints) of Barking Deer *(Munitacus muntjak)* were found in the protected forest area of Tairenpokpi Tamenglong and signs of hunting of Barking Deer were also observed near chainage km 26+800 to 27+000 (approx.). Clouded Leopard (*Neofelis nebulosa*), Jungle/Wild Cat (*Felis chaus) and* wild pig *(Sus scrofa)* were recorded on the basis of animal signs (droppings) located in project areas.

43. As per the working plans of forest divisions the area along proposed alignment provides shelter to 16 species of wild animals listed in Schedule of Wildlife Protection (Act) 1972 of India. Of these the Hoolock (*Hylobates hoolock)* is endangered, Hog badger (*Arctonyx collaris*) and Otter (*Lutra lutra*) are threatened. Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Serow (*Capricornis sumatraensis*), Sambar (*Cervus unicolor*) are considered vulnerable. Least concerns animals list includes Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*). Of these species of wild animals Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*) are recorded during site survey in the forest areas.

3. Socio-economic Environment

a. Demography

44. Manipur is one of the sisters' states in north eastern state a population of 2.38 million with about more than 75 percent of the population living in the rural areas. The human population density is very less (only 107 persons/km2) compared to 149 persons/km2 for the north eastern region. Sex ratio is 978 against the 936 in the region. The demographic feature of north eastern states is unique in that there are more than 29 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The major minority groups in the state namely Aimol, Anal, Angami, Chiru, Chothe, Hmar, Kabui, Kacha Naga, Mizo, Mao, Lusai etc. The majority of the people survive on subsistence economy based mainly on the agriculture, supplemented with limited horticulture, animal husbandry, crafts/handloom, etc.

b. Land Resources

45. The area available for land utilization in the state is about 19052 sq.km out of the total geographical area of 22327 sq.km. This means about 85 percent of the area in the state in available under various land uses. Major portion of the land use is under forest cover covering about 70 percent of the land use area. About 8 percent area is under gross cropped area. Agriculture is the second major land use in area.

46. Agriculture is the mainstay of the people. It contributes major shares in the state domestic product and provides employment to about 63 percent of total working force in state. Total net sown area is 160,000 hectares. Rice is principal food grain followed by maize and millets.

47. Though the state has no marine fishery, it has vast inland fishery resources like ponds, tanks, naturals lakes, marshy areas, swampy areas, rivers, reservoirs, submerged cropped land, paddy field etc. The largest source of fish is the Loktak Lake. The production of fish in Manipur for the year 2001-02 was estimated to be 16.5 thousands tones as against the 16.05 in thousand tons in the year 2000-01 showing an increase of 2.8 percent over the previous years.

c. Infrastructure

48. Transportation system is a key factor in the socio-economic development of any state. There is practically no railway network in the state. Two rail heads – one at Dimapur in Nagaland (215 km away from Imphal) and the other at Jiribam (225 km away from Imphal) serves the state. The state has one airport at Imphal, which connects up with the rest of the country. Waterways are also not feasible. Roads, therefore, constitute the only means of transport system in the state for movement of men, materials and services within and outside the state. The total road network stands at around 7200 km, of which 2600 km are unsurfaced roads.

49. The state has endowed with mineral resources. The main mineral reserves in the state includes lime stone (14.8 thousand tons), clay (2.5 thousand tons), and chromite (0.1 thousand tons). For exploiting the mineral resources, it is important to provide a good road and rail infrastructure.

50. The north eastern region has the potential to emerge as a strategic base for domestic and foreign investors to tap the potential of the contiguous markets of China, Myanmar, Lao PDR, Nepal, Bhutan and Tibet. This calls for converting the unauthorised trade into authorised trade, at the policy level as well as at the ground level. The BIMST-EC (Bangladesh-India-Myanmar-Sri Lanka-Thailand Economic Cooperation) initiative is creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry, technology, human resource development, tourism, agriculture, energy, infrastructure and transportation.

D. Analysis of Alternatives

51. Since the Imphal-Kunchup section involves improvement of the existing road, only one alternative alignment was considered for this section. For Kunchup-Tamenglong sections, various alternate alignment options were studied including option of a tunnel, use of existing tracks, and improvement of existing roads connecting Tamenglong to Imphal i.e. NH-53 and NH 137). Besides this an evaluation has been carried out for the 'with' and 'without' project situation-in terms of the potential environmental impacts for the justification of the project. On the basis of analysis we can say that project acquires positive/beneficial impacts "With" project scenario and will greatly improve the environment and enhance social and economic development of the region compared to "Without" project scenario, which will further deteriorate the existing environment and quality of life.

E. Consultation, Disclosure and Grievance Mechanism

52. In accordance with ADB's Safeguard Policy Statement (SPS) 2009 and Environment Impact Assessment Notification of GoI (2006), public consultations were held, as part of environment assessment study. The consultation undertaken with project beneficiaries, local/ government officials, community leaders, women groups, NGO's, stakeholders in corridor of impact and people likely to be effected due to the project on various issues affecting them and incorporation of various measures pertaining to environmental issues based on the responses from the people.

53. Both formal and informal modes of consultation were used in the public consultation process for the project. Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires as well as unstructured questionnaires. In addition, focused ground discussions (FGDs) and personal discussions with officials, on-site discussion with project affected stakeholders, and reconnaissance visits have also been made to the project areas. 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, women representatives, local commuters, and other concerned were also consulted.

54. In compliance with ADB's SPS requirements consultation will be continued throughout the project process. The consultations were conducted during preparation of the EIA. The official consultation with the key stakeholders was undertaken in the months of June 2013 to January 2014 at respective district offices and head quarter in Imphal. Various officials consulted include PWD Officials, Forest Officers, Wildlife Officials, Environmental Officers from pollution control board, statistical officer, officials from NGOs active in the project areas etc.

55. Besides interview surveys, focused group discussions (FGDs) were organized at key locations along the project roads. In total ten (10) FGDs meetings involving 193 affected people, landowners, and village authorities, were organized. Specific emphasis was given to women participants to ensure that gender concerns are addressed in the project. Out of total participants, 73 participants were from women group.

56. Most of the people interviewed strongly support the project. The people living in the entire project area expect the different project elements to facilitate transport, employment, boost economic development and thereby provide direct, or indirect, benefits to themselves.

57. It is envisaged from the interview survey that there is increased environmental awareness among the people. It can also be seen from the table that more than 76% of the persons believes the existing environmental conditions of the area is good. Over 80% of the people agreed that the quality of air, water and noise in the area is good; whereas, about 10% respondent feel that the environmental quality is being deteriorated. Poor road condition and vehicular emissions are the major sources they feel responsible for this. In case of presence of archaeological / historical the responses are very few. In case of cultural and historical sites, the response of the people is mixed. The area experiences natural disasters i.e. floods, earthquake etc. as it also envisaged that 73% of respondent reported history of natural disaster. Only 10% people indicated that there are rare and endangered species of fauna in the forests of the region. Overall, the general environmental conditions in the region are good and people have increased environmental awareness.

58. The project EA will be responsible for the disclosure of this EIA in compliance to ADB's Communication Policy 2011 and ADB SPS 2009. The draft Environmental Impact Assessment Report will was disclosed in the English language in the office of PWD. The report was also made available to interested parties on request from the office of the PWD. Since this is Category A subproject, draft EIA report has been disclosed to the public through the ADB website, 120 days before the approval of the respective tranche for ADB financing. The draft EIA report was also be made available to all stakeholders as part of the consultation process required under the SPS 2009.

59. A Grievance Redress Mechanism (GRM) has been proposed to address grievances related to the implementation of the project, particularly regarding the environmental management plan and to 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.

60. Depending on the nature and significance of the grievances or complaints, the grievance redress mechanism (GRM) will comprise procedures to address grievances i) first 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.

F. Anticipated Environmental Impacts and Mitigation Measures

61. The road rehabilitation and upgradation project activities can cause environmental impacts that are short, or long-term, and beneficial, or adverse, in nature. The overall long-term impacts will be largely beneficial in regard to the socio-economic environment and quality-of-life in the region. The key environmental issues associated with various aspects of the proposed project and impacts on various environmental components have been assessed for various stages i.e. (a) the project location, (b) design, (c) construction, and (d) operation.

1. Environmental Impacts Associated with Project Location, Preliminary Planning and Design

62. **Location issues**: Except initial 13 km section, project road alignment will pass through hilly terrain and it is greenfield alignment which would require construction of new roads. This will require acquisition of about 270 hectare (30 m ROW for 90 km length) of land for road right of way. Although land acquisition requirement has been kept to minimum level, it will have impacts on topography and change in land use in the region. Loss of agriculture land and productive soil is also anticipated due to additional land acquisition.

63. The improvement of the proposed road in greenfield area involve cutting, filling, and the need to cut vegetation along most of the project road length. This will have more significant impact and this matter is discussed in the following sections.

64. About 2.1 km length of subproject road passes through Kanchup reserve forest area. Adverse impacts due to diversion of about 6.3 hectares of reserve forest land are anticipated. Also land clearing will involve cutting of about 2732 trees. Problem of soil erosion is expected in

some locations. Loss of trees will be compensated by planting 8196 trees (1:3 ratio) as compensatory afforestation.

65. The project affected people will be compensated as per the provisions of a Resettlement Plans (prepared as separate report). The widening option, have been devised so as to cause minimise destruction of structures. There are private structures, few small temples, shrines and educational buildings which are coming adjacent to existing carriageway of the project roads. Care will be taken to avoid such community structures or cause damage in their relocation. There will also be a requirement to establish construction camps and related contractor's facilities, borrow pits and quarries. These will be located in environmentally sound and socially safe areas. It is expected that construction materials for the road works will be mined only from approved quarries.

2. Environmental Impacts Due to Construction

66. **Impacts on Topography, Soil and Vegetation**: During the improvement works of the road section and because of felling of trees, hill cuttings, ground clearing; stone quarrying, and construction of structures etc. the micro-level topography may change.

67. During road improvement works there will be cut and fill activities, cutting of trees, stone quarrying, and construction of structures. Even with reasonable care exercised in the final design, the interaction between proposed road features and existing land features could result in significant land instabilities during construction. Thus, the following mitigating measures should be implemented:

- existing vegetation including shrubs and grasses along the road (except within the strip directly under embankments or cuttings) should be properly maintained and all slopes/soil cutting areas should be revegetated as soon as construction activities are completed,
- excavation and earthworks should be mainly undertaken during the dry season when the risks from erosion and silt run-off are least,
- sites for quarrying, borrowing and disposal of spoils are to be confirmed according to the applicable laws and regulations in the state and the practices followed in recent/ongoing projects of international level,
- controlled and environmentally friendly quarrying techniques should be applied to minimise erosions and landslides,
- cut material should be disposed of in suitable depressions,
- materials that will be used for surface dressing will consist of aggregates and gravel, and must not contain silt, and
- Internationally accepted best practice engineering approaches will be incorporated into contract documents and monitored during construction.

68. **Impacts on Surface and Groundwater Quality, Drainage and Hydrology**: A number of rivers and streams crossed the project road. The improvement of the road may result in disruptions to the natural hydrology and water mismanagement that may lead to further problems of soil erosion. Construction activities could also lead to the temporary pollution of rivers from spillage of chemicals and oil at construction sites and waste from construction camps, discharge of sediment-laden water from construction areas and uncontrolled surface water discharge over the road edge creating large–scale erosion on down-slopes. Thus the following mitigating measures are recommended:

- natural courses of water bodies should, as far as possible be maintained and brought back to their natural course,
- all debris and vegetation, clogging culverts should be regularly cleared and disposal of construction debris in streams and rivers should be avoided,
- river-bank slope stabilities should be monitored and appropriate remedial measures applied throughout the construction period,
- if possible, construction work at bridge should also be avoided during the rainy season,
- chemicals and oils should be stored in secure, impermeable containers, and disposed of well away from surface waters,
- no vehicle cleaning activity should be allowed within 300 m of water bodies/ drains,
- construction camps should be equipped with sanitary latrines,
- lined drainage structures should be provided,
- side drain waters must be discharged at every available stream crossing.

69. **Air Quality**: Prediction of the pollutant (CO, NOx and PM10) concentrations has been carried out using CALINE-4, a dispersion model based on Gaussian Equation. It has been observed from the model output that when the traffic volume increases, the concentration of air pollutants also increases correspondingly. However, the maximum predicted pollutant concentrations of PM10, CO and NOx over the existing ambient air quality are found to be within the National Ambient Air Quality Standards (Annex 3).

70. During construction, and at the micro-level only, air quality may be degraded by generation of dust (PM) and generation of polluting gases including SO2, NOx and HC for short periods from vehicular movements, site clearance, earth filling and material loading and unloading. The impacts are expected to be localised, temporary and confined to construction areas. Care should, however, be taken at sensitive urban locations so that harmful impacts can be minimised. The following actions should be implemented:

- regular check-up and maintenance of construction equipment,
- mixing plants i.e. asphalt, concrete, and bricks, should be operated within the permissible limits of CPCB and WB EHS, and be located away from settlements,
- the contractor should submit a dust suppression and control programme to the PIU,
- vehicles delivering loose and fine materials should be covered to reduce spills,
- controlled blasting should be carried out and only with the prior approval of the site Engineer and, if required, PIU,
- bitumen emulsion should be used wherever feasible, and
- bitumen heaters should be used and the use of wood for fuel should be discouraged or prohibited.

71. **Noise Level**: With the exception of the Imphal city, the ambient noise level along the road sections is within standards. During the construction period, noise will be generated from the operation of heavy machinery, blasting works, the haulage of construction materials to the construction yard and the general activities at the yard itself.

72. Noise levels were predicted using Federal Highway Administration's Traffic Noise Model (FHWA TNM) which helps for highway traffic noise prediction and analysis. It is observed that the noise levels (Leq) near the receivers are found to be higher than desired levels for the respective categories. The maximum predicted value 65.5 dB(A) is recorded at the receiver

located close to Section 1 of the monitoring site. The predicted levels show increase in noise levels for future years at all receivers considering increase in traffic volume.

73. Noise and vibration will be unavoidable but the impact will only be temporary and will only affect people living or working near piling locations. Mitigation measures should include (a) provision of noise barriers at sensitive locations, (b) construction machinery should be located away from settlements (c) careful planning of machinery operation and the scheduling of such operations can reduce noise levels, (d) controlled blasting (if any) should only be carried out with prior approval from the Engineer in charge, and (e) contractors should be required to fit noise shields on construction machinery and to provide earplugs to the operators of heavy machines.

74. **Flora and Fauna**: Since about 2.1 km length of the project roads passes through forest areas, it may cause adverse impacts on flora and fauna of the area. Also acquisition of forest land (6.3 hectares) may add minor impacts on the presence of flora and fauna in the forests. Removal of the existing vegetative cover and the uprooting of about 2732 trees is an unfortunate activity, which may reduce the ecological balance in the areas. This may also enhance soil erosion problem. The critical wildlife habitat tests using the biodiversity decision framework tool of IFC, World Bank indicates that there will no major or severe impacts on the critical habitat and its endangered/ threatened species as listed above. The main predicted impact is the damage and disruption of wildlife movement routes (although no specific route exist); and loss of food sources and the nesting sites for birds.

75. To minimise adverse impacts on flora such as trees, contract documents should specify that (a) all wood building material for workers' housing should be brought from outside the project area, (b) workers should be supplied with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract, (c) all contract equipment and plants should be cleaned to the satisfaction of the project engineer in charge prior to their relocation to project sites; (d) during site clearance, care should be taken to ensure that the minimum area of vegetation area is affected and (e) the water sprinkling of trucks used as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation are minimised. Specific measures such as i) construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest area, ii) employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities, iii) Strict anti-poaching surveillance measures need to be implemented, especially during project construction phase in the forest areas, iv) provisions of signage as a precautionary measure to provide awareness about animal movement will be made to avoid accidents, and v) project staff and work crews should not be allowed to have fire-arms and animal traps etc. Further as long-term mitigation measures, the habitat enrichment activities such as planting of native bamboos, fruiting and fodders trees will be carried out. Environment Specialist in collaboration with Wildlife Conservator will determine the suitable plant species for wildlife habitat enrichment. There will be strict compliance monitoring by Environmental Specilaist while constructing road through Reserve Forest area.

3. Environmental Effects Related to Operation

76. **Noise and Vibration, Air Pollution, Runoff, Spoils of Hazardous Materials**: The current traffic flows along the project roads is expected to increase because of improved economic activities associated with better access. The larger numbers of vehicles will be an additional source of noise and gaseous emissions. Traffic volumes will, however, remain low

and this should not be a significant impact. Repairs to culverts and new drainage work will eliminate/ reduce the soil erosion problems presently caused by poor cross drainage.

77. **Land Use and Settlements**: The likely impacts on land use and settlement patterns are limited. Improved access will inevitably lead to increased in and out migration, but this is likely to occur gradually and over a prolonged period. There will be time for new residential areas to be established. There may, however, be a need to control ribbon development.

4. Potential Environmental Enhancement/ Protection Measures

78. In order to improve the environment, additional measures were also proposed during construction for the following: (a) sanitation and housekeeping at the labour/ construction camps (b) provision of water supply (c) hygiene and provision of toilet facilities, (d) sewerage and waste disposal (e) first aid, (f) maintenance of buildings and facilities (g) identification of debris disposal sites, and (h) rehabilitation of quarry and borrow pits.

G. Environmental Management Plan

79. A fully budgeted environmental management plan has been prepared for mitigation/management/ avoidance of the potential adverse impacts and enhancement of various environmental components along the project road. For each mitigation measures to be carried out its location, timeframe, implementation and overseeing/ supervising responsibilities has been identified. Monitoring plan for construction and operation phase has been framed to ensure effective implementation of EMP.

80. The monitoring program included performance indicators for water, air, and noise level monitoring, frequency of monitoring, and institutional arrangements of the project in the construction and operation stages, along with the estimated cost. The reporting system included roles and responsibilities of each party involved in the project implementation i.e. PIU, Supervision Consultant and Contractors and reporting mechanisms during implementation and operation phases.

81. An environmental management budget of INR 3,653,075 (Indian Rupees Three million sixty three one thousand and seventy five only) (US$ 0.59 millions) has been estimated for implementation of the environmental management plan. This budget also includes cost of environmental monitoring and associated trainings.

I. INTRODUCTION

A. Project Background and Rational

1. ADB has a regional cooperation program in four South Asian countries: Bangladesh, Bhutan, India and Nepal, called South Asia Subregional Economic Cooperation (SASEC[2]), which has been supporting regional cooperation in the transport sector through SAARC[3] and BIMSTEC[4] over a decade. Major contributions in this regard include assisting the SAARC Regional Multimodal Transport Study (SRMTS)[5] and BIMSTEC Transport Infrastructure and Logistics Study (BTILS).[6] 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 regional countries. 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. Manipur being landlocked with no rail connectivity presently has to depend on its road network for its transportation requirements. The present study section, Imphal – Tamenglong is part of state highway network. The project road once completed shall provide shortest connectivity to the East West Expressway of the union Government which is a Mass Rapid Transport Corridor of the country. This is of high economic significance as detailed below. The road shall also provide the shortest connectivity to Bangladesh and the nearest Sea Port of Chitagong. In fact the project Road shall provide the shortest connectivity between the ASEAN Countries and SASEC Countries via NH-1 at Imphal. AH 1 is the longest route of the Asian Highway Network, running 12,845 miles (20,557 km) from Tokyo, Japan via Korea, China, Southeast Asia, India, Pakistan, Afghanistan and Iran to the border between Turkey and Bulgaria west of Istanbul where it joins end-on with European route E80. In India AH 1 passes through Numaligarh - Golaghat - Garampani - Barpathar - Naojan - Bokajan - Dimapur - Kohima - Tadubi - Senapati - Kangpokpi - Imphal - Thoubal - Tengnoupal – Moreh (Myanmar border).

3. The project road will also provide connectivity to 18 interior villages which are presently connected by dirt tracks only. The decrease in the length of road shall be of significant economic importance for the state as the state imports more than 70% of its required essential commodities from outside the State. This shall also have a major impact on the economy of the country and the region as a whole.

4. The Project Road (Imphal- Kangchup –Tamenglong Road) is located in the State of Manipur. It passes through the districts of Imphal West, Senapati and Tamenglong and it is 103.02 km long. Besides providing shorted connectivity for the State to East West Corridor, the project road will also reduce the distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur.

5. The project road starts in Imphal City, just before junction with Takyel Road (towards airport) where existing 4 lane divided carriageway for the project road terminates. The initial 13

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

km of this road alignment from Imphal to Kangchup is existing road. Further alignment between Kangchup to Tamenglong (about 90km) is new greenfield alignment. Tracks at certain sections between Kangchup to Haochong earlier known as KT road during British era are still being used by settlers to transport wooden logs during dry season and are accessible on foot or Shaktiman trucks only. It further traverses the hills connecting Bhalok and terminates at Tamenglong. Existing road surface has exposed rocks as it has not been maintained due to heavy rains in the region. The alignment has many settlements and rivers along its length. Alignment traverses through steep mountains towards Haochong settlement, via Waphong settlement. Existing alignment at certain section has very steep grades. Alignment passing through Waphong settlement crosses Ijei River very close to the settlement.

6. The present project aimed to improve 103.02 km of state road network into 4/2 lane configurations between Imphal and Tamenglong in the state of Manipur.

7. Looking at the benefits of the project, the Government of India requested for a project preparatory technical assistance (TA) from the Asian Development Bank (ADB) to prepare an ensuing loan for the international trade corridor in Manipur State (the project). The proposed sector loan will upgrade high priority trade corridors and facilities comprising National Highways (NH) and State Highways (SH) connecting five countries: Bangladesh, Bhutan, India, Myanmar and Nepal in the northeastern part of India. 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.

8. While approximately six road corridors have been identified for financing under the program, two sample subprojects were prepared as part of the project processing. 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 later once as non-sample subprojects under the program. The list of sample subprojects and tentative non-sample subprojects are provided below in Table 3.

Table 3: List of Subprojects included in the Project

No.	Name of Road/Facility	Length (km)
I	**Tranche I subprojects**	
1.	AH-2: Panitanki (Nepal border) – Fulbari (Bangladesh border)	37.271
2.	AH-48: Jaigaon (Bhutan border) – Changrabandha (Bangladesh border)	90.56
	Sub-Total-A	**127.831**
II	**Potential subprojects for succeeding tranches**	
1.	Imphal – Moreh (Manipur)	107
2.	Imphal-Wangjiang-Heirok-Machi-Khudengthabi (Manipur)	65
3.	**Imphal-Kanchup-Tamenglong-Tousem-Haflong (Manipur)**	**80**[7]
4.	Greater Imphal Ring Road	37.72
5.	Mechi bridge (West Bengal)	0.600
	Sub-Total B	**290.32**
	Grand Total (APPROXIMATELY)	**418.151**

[7] This was the Aerial distance estimated during project planning. However design length of the project road section between Imphal and Tamenglong is 103.02 kms.

9. This Environmental Impact Assessment (EIA) covers a non-sample subproject in the State of Manipur i.e. Imphal-Kanchup-Tamenglong road section. All discussions thereafter focused only on this subproject. The environmental assessment report for this non-sample subproject is prepared as part of project preparation in compliance with Environmental Assessment and Review Framework (EARF[8]) for the Project.

B. Project Road

10. The Imphal- Kangchup –Tamenglong- Tousen- Haflong Road (the project road), is located in the State of Manipur. It passes through the districts of Imphal West, Senapari and Tamenglong and it is 103.02 km long. The project road starts in Imphal City, just before junction with Takyel Road (towards airport) where existing 4 lane divided carriageway for the project road terminates. The initial 13 km of this road alignment from Imphal to Kangchup is an existing intermediate lane bituminous road. The alignment further traverse on hilly, terrain towards Haochong settlement via existing KT mud road accessible only in dry season. It further traverses through hills connecting Bhalok and terminates at Tamenglong. Major length of the alignment is in Tamenglong District while a small section of project alignment traverses through Imphal West and Senapati Districts too. Figure 2 shows the index map of the project road.

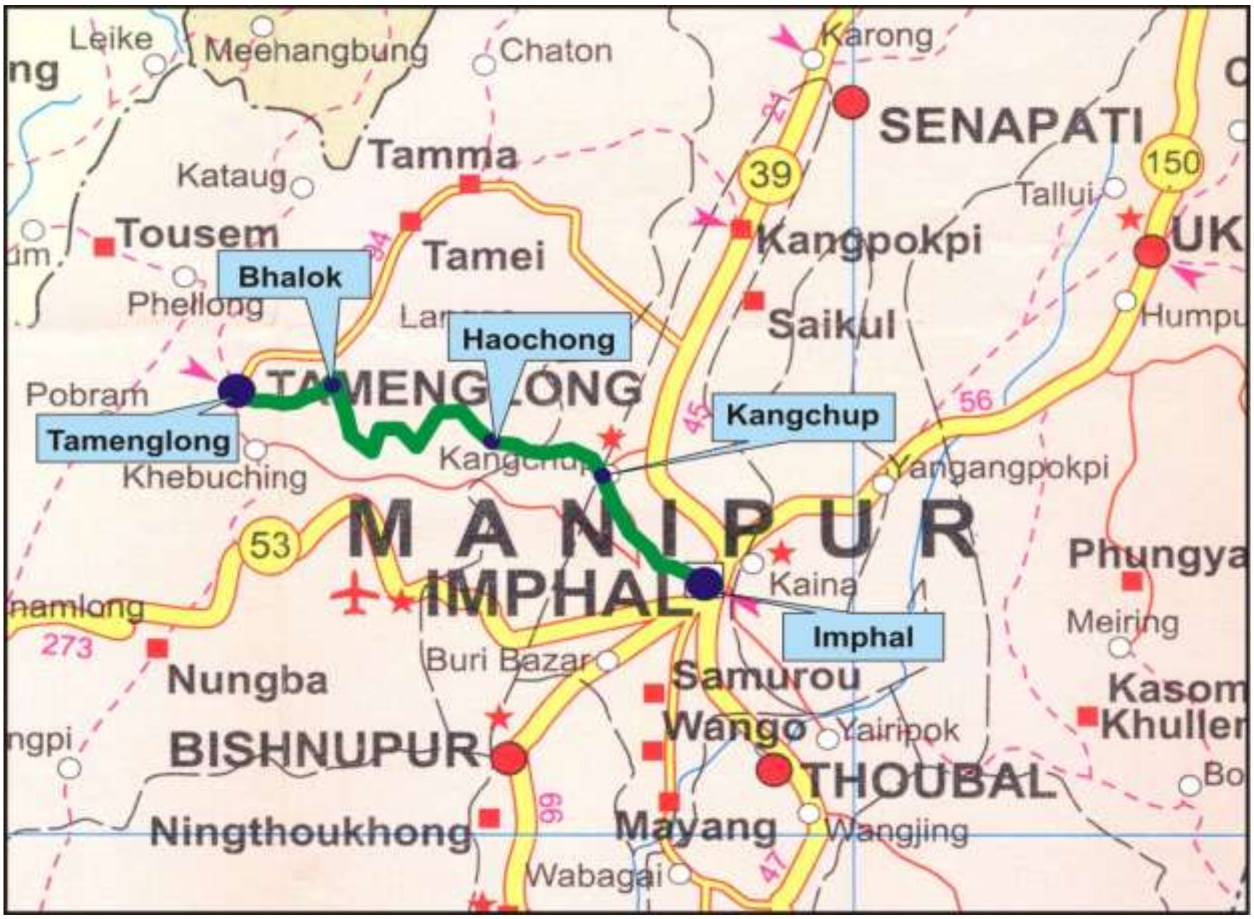


Figure 2: Index Map of the Imphal-Tamenglong Road Project

[8] Environmental Assessment and Review Framework for proposed IND: SASEC Road Connectivity Investment Program, ADB, December 2013.

11. The proposed alignment for Imphal Tamenglong Road is predominantly a new alignment in hilly terrain between Kangchup to Tamenglong. The pavement of Imphal-Kangchup section of proposed Imphal Tamenglong road for approx. 13 km is in good condition and recently overlay work has been done. Further up there is no existing road and only an old disused track is visible in small sections. Roadway geometry for existing alignment between Imphal to Kangchup section conforms to IRC standards for both horizontal and vertical geometry. This section is a new alignment designed conforming to the hill road standards.

12. As per PWD records the existing ROW width of the Imphal Kangchup section is in range of 15m to 30m. There is no major brigges (except 1 under construction) along the proposed alignment. However there are 5 minor bridge. At present there is one existing flyover, no ROBs and Underpasses in the project stretch. There are 17 existing culverts on this section of the road out of which 11 nos. are slab culverts, and 6 nos. Hume Pipe culverts.

13. The project engineering team has studied various alternatives for the alignment including the improvement of the existing tracks. However the alignment along existing tracks is too steep and it is not possible to improve it to the project standards. Hence the team has worked out a new greenfield alignment with a total length of 103.02 km and a spur length of 4.15 km to Haochong and 0.80 km to Kabu Khulen. Feasibility of 1.44 km long single tube bi-directional tunnel was also studied, however after discussion with the client, it was decided to exclude it from the final proposal due to social issues and connectivity issues to adjacent villages. Table 4 present the salient features of the existing project road.

14. Considering the existing conditions and projected traffic, it is proposed to improvement of 5.54 Km length to four lane divided carriageway, 7.36 km length of 2 lanes with paved shoulder and 2 lane hill section in the rest section. Spurs will be constructed to intermediate lane (5.5m) standards.

Table 4: Description of Imphal-Kanchup-Tamenglong Road Section

Sub-project Road Section	Length (km)	Districts	Summary of General Road Condition
Imphal-Kanchup-Tamenglong Road	103.02	Imphal West, Senapati and Tamenglong	The project road section (Imphal- Kangchup – Tamenglong) passes through three districts namely Imphal West, Senapati and Tamenglong of Manipur State covering a total length of 103.02 kms. The project road starts at Imphal City and ends at Tamenglong. The alignment passes through settlements of Imphal, Kangchup, Haochong, Bhalok and Tamenglong. Initial 13 km of this road alignment from Imphal to Kangchup is an existing road. Further alignment between Kangchup to Tamenglong (about 90 km) is new greenfield alignment.

Sub-project Road Section	Length (km)	Districts	Summary of General Road Condition
			Tracks at certain sections between Kangchup to Haochong earlier known as KT road during British era are still being used by settlers to transport wooden logs during dry season and are accessible on foot or Shaktiman trucks only. Existing road surface has exposed rocks as it has not been maintained due to heavy rains in the region. As per PWD records the existing ROW width of the Imphal Kangchup section is in range of 15m to 30m. There is no major brigges (except 1 under construction) along the proposed alignment. However there are 5 minor bridge, no ROBs and no Underpasses in the project road section. There are 17 existing culverts on this section of the road out of which 11 nos. are slab culverts, and 6 nos. are Hume Pipe culverts. It is proposed to improvement of 5.54 Km length to four lane divided carriageway, 7.36 km length of 2 lanes with paved shoulder and 2 lane hill section in the rest section. Spurs will be constructed to intermediate lane (5.5m) standards.

C. Objective and Scope of the Study

15. The objective of this EIA study is to identify potential environmental impacts of the proposed road improvement work and formulate strategies to avoid / mitigate the same. The scope of work to accomplish the above objective, comprise the following.

- understanding the baseline environmental conditions of the project area,
- identifying the potential environmental impacts of the project proposal,
- recommending appropriate mitigation measures to avoid / minimise the environmental impacts, and
- preparing an environmental management plan for implementation.

16. The environmental studies have been confined to the situation around the deemed areas of direct influence caused by constructional and operational facilities along the proposed road section. The following sections of the report, discusses the methodology adopted by the consultants in conducting the EIA study and presents the results of the same.

D. Methodology Adopted for EIA Study

17. The Environmental Impact Assessment has been carried out, in accordance with the requirements of the ADB's Safeguard Policy Statement (SPS 2009) and Environmental Assessment and Review Framework prepared for the overall SASEC RCP Project. The

Government of India guidelines for Rail/Road/Highway project; EIA notification 2006 of MoEF, and Highway Sector EIA guidance manual 2010 has also been followed in the process of this environmental assessment. The study methodology has been adopted in such a manner to ensure that environmental concerns are given adequate weightage in the selection of alignment and design of proposed road improvements. The study in this project employs an iterative approach in which potential environmental issues have been examined at successive levels in detail and specificity, at each step in the process.

18. The Environmental assessment is based on the information collected from secondary as well as primary sources on various environmental attributes. Monitoring of air, water, noise and soil quality was also carried out within the ROW and significant issues were examined during field surveys to determine the magnitude of significant environmental impacts.

19. The major steps in the EIA process for the project were as follows:

1. Collection and Analysis of Data

20. Data was collected on various environmental components such as soil, meteorology, geology, hydrology, water quality, flora and fauna, habitat, demography, land use, cultural properties etc, to establish the baseline environmental setup. Secondary data on environment for the project corridor was collected both from published and other relevant sources e.g., the State Department of Forest, Manipur State Pollution Control Board, State Statistical Department etc. The data collection from the field was completed with the help of field surveyors and enumerators/investigators. The interviewers/surveyors were trained for taking the samples and filling up the Questionnaires at site. To ensure the accuracy of the data it was collected under the supervision of the consultant.

2. Environmental Monitoring and Analysis

21. In order to assess the situation in particular sections of the road during the screening and site visit of the area, different locations were identified for monitoring and analysis the noise level, ambient air and water quality. The monitoring and analysis of water quality, air quality and noise level has been done by M/s. Greenvision, a leading environmental research laboratory based in Durgapur, West Bengal in the month of May 2014. Air quality monitoring has been carried out as per MoEF notification of November 2009 the revised national Air Quality standards (Annex 3) and the on-site monitoring results are incorporated in Chapter- 4 of this EIA report.

3. Vegetation and Wildlife Surveys

22. In order to assess presence of flora and fauna along the proposed alignment field surveys have been carried out with the help of field officers of the state forest department. Findings are incorporated in Chapter- 4 of this EIA report.

4. Analysis of Alternative

23. Alternate analysis for the present subproject road alignment has been made on the basis of “with” and “without” project scenario as well as alternate alignment options. The parameters considered for the analysis are the environmental as well as social features and their likely impact on the natural ecosystem.

5. Assessment of Potential Impacts

24. Potential impacts were identified on the basis of: analytical review of baseline data; review of environmental conditions at site; analytical review of the underlying socio-economic conditions with the project influence area.

6. Preparation of the Environment Management Plan

25. An EMP for the project is prepared to specify the steps required to ensure that the necessary measures have been taken and the same will be incorporated during construction and operation stage of the project. The EMP includes the monitoring plan giving details of the resources budgeted and the implementation arrangements.

E. Structure of the Report

26. This EIA report has been presented as per requirements of the ADB's Safeguard Policy Statement (SPS) 2009. The report is organised into following eleven chapters, a brief of each chapter is described below:

- ***Chapter 1 - Introduction***: This section describes the background information about the project and EIA study.
- ***Chapter 2 - Policy, Legal, and Administrative Frameworks***: this section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment.
- ***Chapter 3 - Project Description***: This section presents the key features and components of the proposed project.
- ***Chapter 4 - Description of the Environment***: This section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed project.
- ***Chapter 5 - Anticipated Environmental Impacts and Mitigation Measures***: This section presents the environmental assessment of likely positive and adverse impacts attributed to the proposed project and concomitant mitigation measures.
- ***Chapter 6 - Climate Change Risk Assessment***: This section provides an analysis of climate change impacts and risks due to the implementation of proposed project.
- ***Chapter 7 - Analysis of Alternatives***: This section 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 8 - Information Disclosure, Consultation, and Participation***: This section describes the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the ADB's Publication Policy and related national laws.
- ***Chapter 9 - Grievance Redress Mechanism***: This section describing the formal and informal redress procedures for registering, resolving, and reporting complaints.
- ***Chapter 10 - Environmental Management Plan***: This section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into three sub-sections; mitigation, monitoring, and implementation arrangements

- ***Chapter 11 - Conclusion and Recommendation***: This section stating whether there is a need for further detailed environmental studies / assessments and highlights key findings and recommendations to be implemented by the borrower.

27. An Executive Summary is also prepared and presented in the beginning of the report.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

28. 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 has 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:

- National (India) Environmental Legislation and Legal Administrative Framework,
- Social Safeguard Regulatory Requirements,
- ADB safeguard policies and categorisation of the project,
- Summary of international treaties and applicability to the project

1. National (India) Environmental Policy Framework

29. The legal framework of the country consists of several acts, notifications, rules and regulations to protect environment and wildlife. In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. The national legislations are broadly divided under following categories:

- Environmental Protection,
- Forests Conservation, and
- Wild Life Protection.

30. 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 the country and to control poaching, smuggling and illegal trade of wildlife and its derivatives. It defines rules for the protection of wild life and ecologically important protected areas.

31. State Pollution Control Boards (SPCBs) 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 government departments at Central Level and State level. The administrative framework for environmental protection, forests conservation and wildlife protection is given at Figure 3.

32. The environmental impact assessment requirement in India is based on the Environment (Protection) Act, 1986, the Environmental Impact Assessment Notification, 2006 (amended 2009), all its related circulars; MOEF's Environmental Impact Assessment Guidance Manual for Highways 2010, and IRC Guidelines for Environmental Impacts Assessment (IRC:104-1988) of highway projects. In addition to road widening and rehabilitation including establishment of temporary workshops, construction camps, hotmix plants, and opening of quarries for road construction work require to comply with provisions of The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003): The Wildlife (Protection) Act, 1972 (Amended 1993); The Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Rules 1974; The Air (Prevention and Control of Pollution) Act, 1981 (Amended 1987) and Rules 1982; The Noise Pollution (Regulation and Control) Rules, 2000 (Amended 2002) and Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules 2008 (Amended 2009).

33. A review is undertaken for all the environmental rules and regulation which might be applicable to the proposed Imphal-Kanchup-Tamenglong road section improvement activities. These legislations with applicability to this project are summarised below in Table 5 and approval and monitoring framework is depicted in Figure 4. There is no separate state level legislation. However various acts like Water and Air are enforced through state level authority: State Pollution Control Board.

34. Specifically for the proposed Imphal-Kanchup-Tamenglong subproject in the state of Manipur, the following (Table 5) environmental laws and regulations are applicable:

Table 5: Applicable Environmental National and State Requirements

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Planning Stage: Before start of Civil Works Construction (Responsibility: Executing Agency)						
1.	Implementing Project	Environment Protection Act of 1986 and as amended. EIA Notification 2006 and amendments.	Environmental Clearance	SEIAA, Manipur	PWD, Manipur	6 months
2.	Implementing Project in Forest Area	Environment Protection Act of 1986, Forest Conservation Act	Forest Clearance	Conservator of Forest, Government of Manipur	PWD, Manipur	6 months

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Construction Stage (Responsibility: Contractor)						
3.	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environment Protection Act of 1986 and as amended	Consent-for-establishment	State Pollution Control Board	The Contractor	2-3 months
4.	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environment Protection Act of 1986 and as amended	Consent-for-operation	State Pollution Control Board	The Contractor	2-3 months
5.	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
6.	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	State Pollution Control Board or Local Authority (DM/DC)	The Contractor	2-3 months
7.	Quarry operation	State Minor Mineral Concession Rules, The Mines Act of 1952, Indian Explosive Act of 1984, Air Act of 1981 and Water Act of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	2-3 months

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
8.	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor	2-3 months
9.	Use of surface water for construction	-	Permission for use of water for construction purpose	Irrigation Department	The Contractor	2-3 months
10.	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor	2-3 months

35. In addition to the acts and regulations listed above 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, were referred in the process of preparing this EIA. The following requirements are particularly important and need special attention in order to avoid any delays for a project:

i) Although the proposed project interventions are primerly limited to the improvement of exisiting state highway section and village/districts roads/tracks and the alignment does not pass through any environmentally sensitive areas, part of the project road between Kanchup and Tamenglong is located at an altitude of > 1000 m above MSL. Also majority of the proposed alignment between Kanchup and Tamenglong is new greenfield alignment in hilly terrain. Therefore it falls in the purview of Notification no. S.O. 195(E) dated 19 January 2009 by the Ministry of Environment and Forests on amendment to the EIA Notification, which states that ‘All State Highway projects and State Highway expansion projects in hilly terrain or in ecologically sensitive areas’ need to get environmental clearance prior to construction activities. It is further defined that hilly terrain is defined as ‘All projects located at altitude of 1000 meter and above’. Accordingly, for the proposed road improvement project, implementing authority has to apply for environmental clearance from the State Level Environmental Impact Assessment Authority (SEIAA).

ii) As per the Forest Conservation Rules (1981, amended 2003) a forestry clearance from Department of Forests is required for diversion of forest land for non-forest purpose. Processing of the forestry clearance entails two stages: stage I and stage II. Amongst other requirements stage I clearance requires the applicant to make payments for compensation of forestry land that will be acquired and trees that will be cut under the project. Accordingly timely allocation of budget for this purpose by the applicant is necessary to expedite the clearance process. Although there are no notified protected areas along the proposed Imphal-Kanchup-Tamenglong road subproject, about 2.1 km long section passes through Kanchup Reserve Forest. Also road section between Kanchup and

Tamenglong (hill section) is declared as unclassed protected forest and it does require diversion of forest land. Therefore forest clearance is required as per Government of India requirements.

iii) Cutting of trees in non forest land require a tree cutting permit from the local forestry department. All trees cut under a project must be compensated by compensatory afforestation as required by the State Forest Department.

iv) As per Office Memorandum (OM) issued by MOEF on 19 March 2013 the grant of environmental clearance for linear projects including roads has been delinked from the forestry clearance procedure. Hence, after receipt of environmental clearance construction works may commence on sections/parts of a linear project that do not require forestry clearance. Construction works may commence on sections requiring forestry clearance only after receipt of the respective clearance.

v) Placement of hot-mix plants, quarrying and crushers, batch mixing plants, discharge of sewage from construction camps requires No Objection Certificate (Consent to Establish and Consent to Operate) from State Pollution Control Board prior to establishment.

vi) Permission from Central Ground Water Authority is required for extracting ground water for construction purposes, from areas declared as critical or semi critical from ground water potential prospective by them.

36. Before the start of civil works for the any section of the project road the project proponent (PWD Manipur) must obtain necessary clearances / permits from staturoty authorities. Procedures and steps to be followed to obtain various clearances / permits are presented in Figure 3 to Figure 5 and Table 6 and 7.

2. Social Regulatory Requirements of India and State

37. 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 etc.

3. International Treaties and Relevance to the Project

38. 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:

- **Kyoto Protocol to the United Nations Framework Convention on Climate Change** (Rectified by India in 1997): 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. This amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

- **Convention Concerning the Protection of the World Cultural and Natural Heritage** (Rectified by India in 1972): 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.

4. ADB Safeguard Policy Statement Requirements

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

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

5. Category of the Project

40. The proposed Imphal-Kanchup-Tamenglong Road project has been evaluated considering the outcome of the ADB Rapid Environmental Assessment (REA) checklist and the same is enclosed as Annex 1. All environmentally sensitive areas along the proposed alignment have been critically analyzed to assess the magnitude and extent of likely impacts. The proposed project road alignment passes through plain (for 13km length) and hilly (for 90km lengh) terrains and land use is mostly agricultural / residential in initial 13 kms section and its hilly in remaining sections. Although there are no environmentally sentitive areas along the project road, the project involves widening of existing 5.6 km road section into 4 lane

carriagement and construction of about 97 km of new road to two lane carriageway configuration, which will lead to substaintial change in land use and also land acquisition. 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.

Figure 3: Environmental Legal Administrative Framework in India

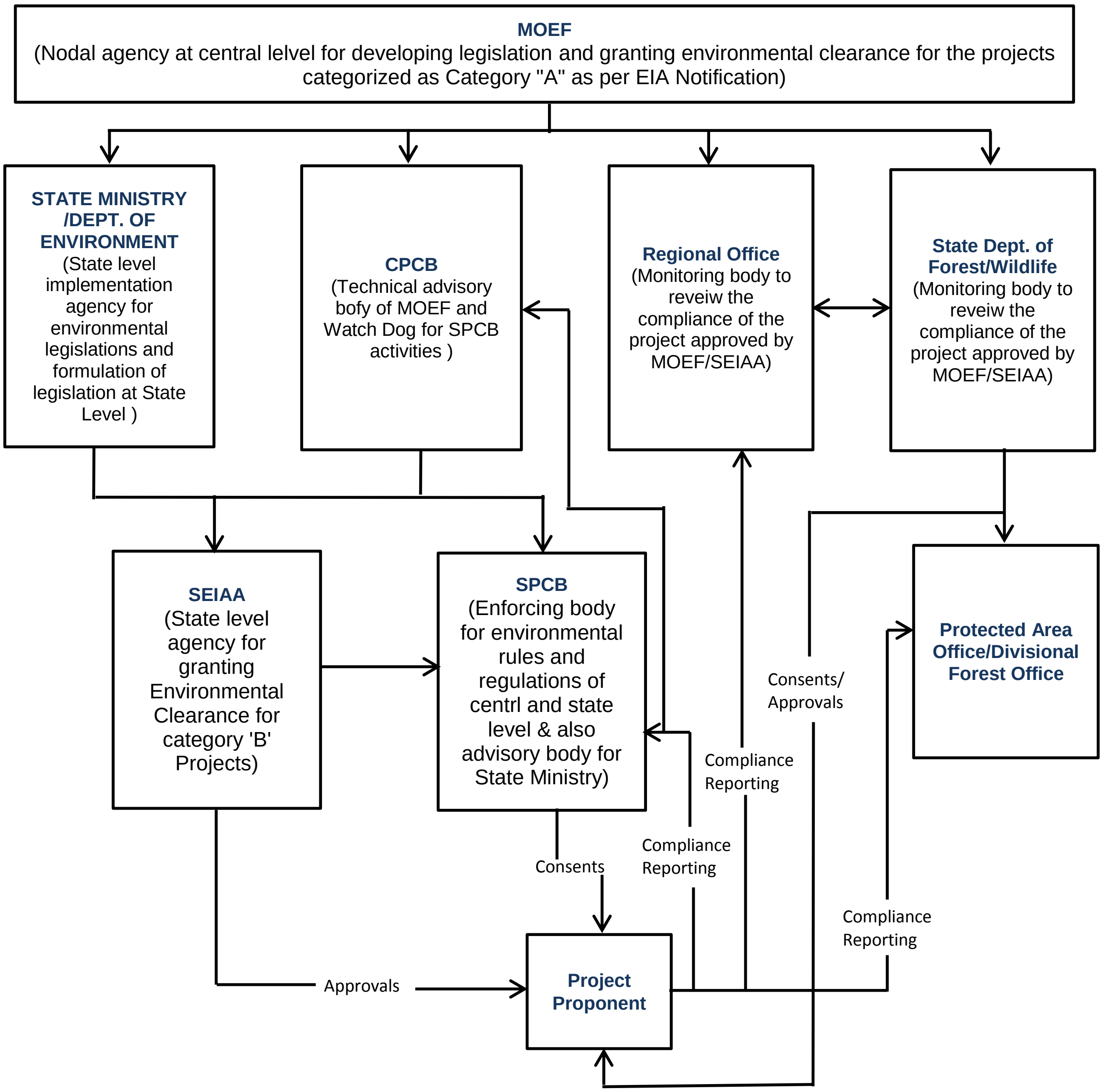
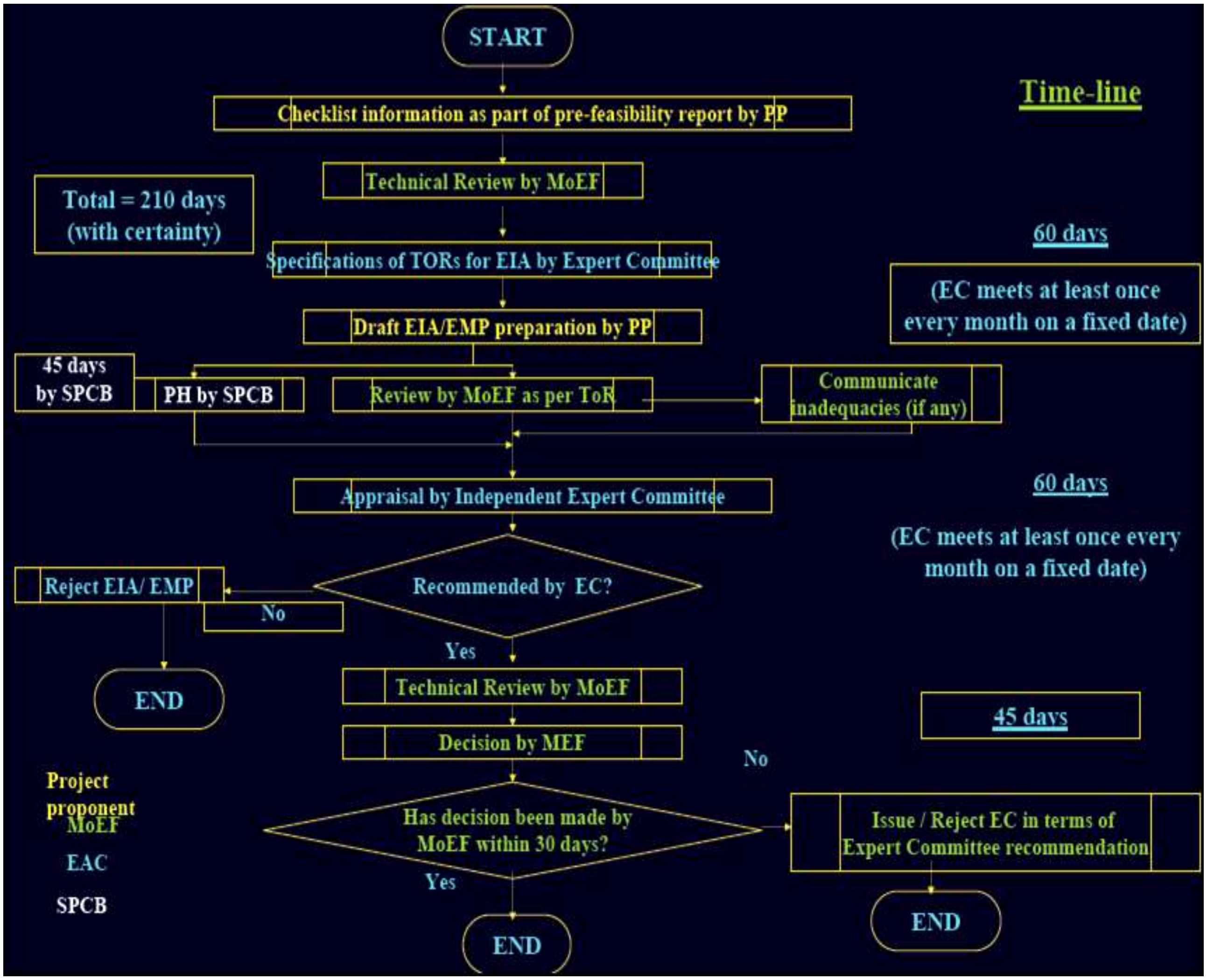


Figure 4: Environmental Clearance Process in India



41. Key Steps in EC Process:

1) Submission of **application** along with Form-I, Pre-feasibility report and other necessary documents to Ministry of Environment and Forest (MoEF) or State Environmental Appraisal Committee (SEAC)
2) **Presentation** of Terms of Reference (TOR) to MoEF or SEAC
3) Obtaining **TOR** from MoEF or SEAC
4) Preparation & submission of **Draft** Environmental Impact Assessment (EIA)/ Environmental Management Plan (EMP)
5) Conducting **Public Hearing**
6) Preparation of **revised EIA/EMP** (as per comment of Public Hearing)
7) Preparation & submission of **Final EIA** to MoEF or SEAC along with Stage 1 forest clearance.
8) Final **presentation** to MoEF or SEAC.
9) Obtaining **Environmental Clearance**.

Figure 5: Procedure for Obtaining Forest Clearance

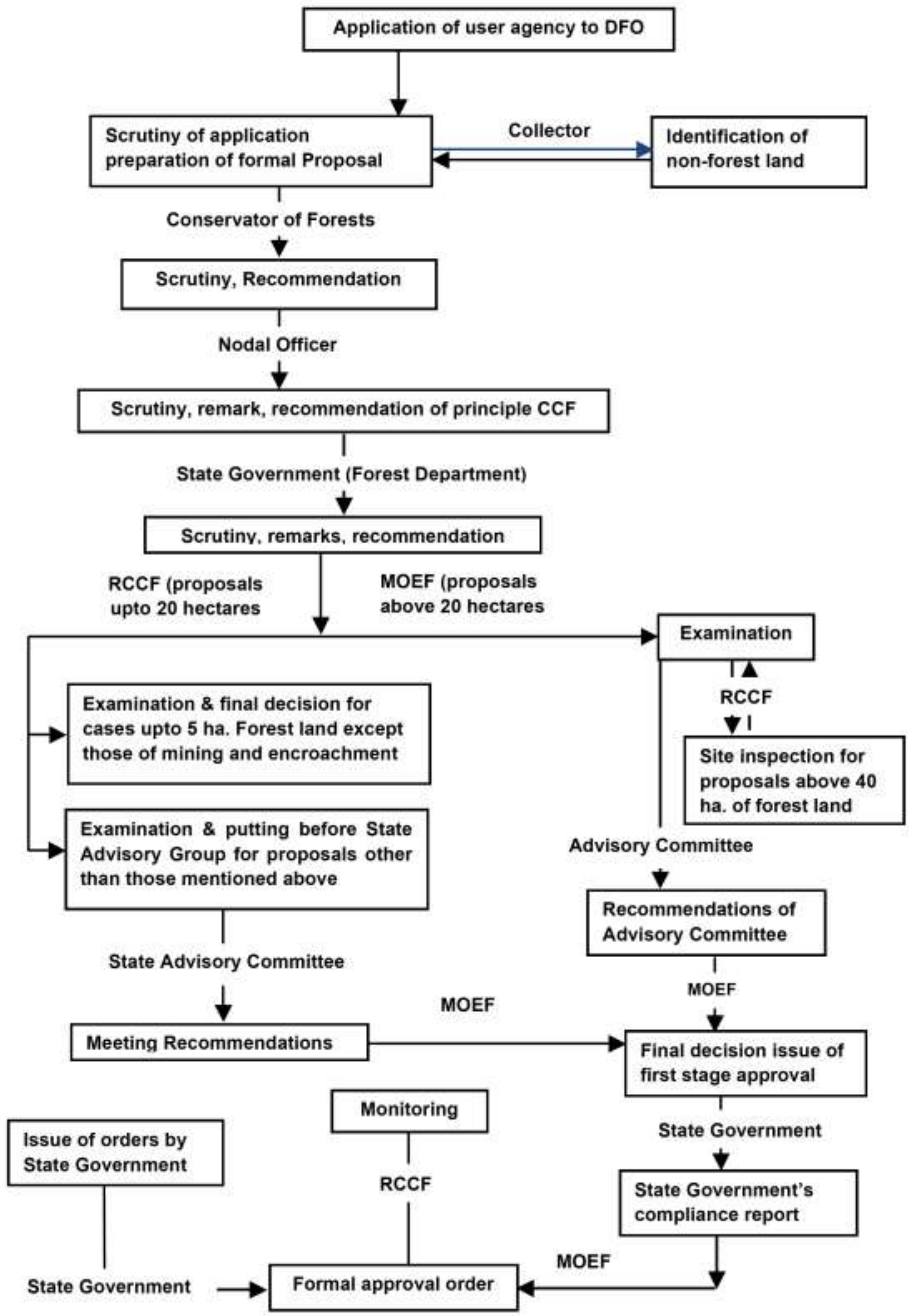


Table 6: Key Steps in Forest Clearance Process

Step No.	Activity	No. of Days
1	Preparation of case / application letter that is submitted to Revenue and Forest Department	7
2	Area calculation to identify land diversion requirement with the help of Revenue Department represented	30
3	Joint visit by Executive Engineer, and District Forest Officer(DFO)	
4	Enumeration of trees by the Forest Department after the visit of Forest Guard and Range Officer	7
5	List is forwarded by the Range Officer to DFO for approval	15
6	Preparation of a combined 'case' papers (documents prepared by Revenue Department, list of trees enumerated by Forest Department and actual area calculation for diversion of forest land are enclosed)	7
7	Case submitted to DFO - DFO Office will examine the case and further send to Conservator of Forests	7
8	Conservator of Forests will examine the papers and further forward the case (subject to the fact that no short-comings/deficiencies are found) to Prin. Chief Conservator of Forests	7
9	Case is further examined by the Prin. Chief Conservator of Forests and forwarded to Additional Secretary (Forests)	4
10	Additional Secretary (Forests) recommends the case for the approval of the Forest Minister.	3
11	Forest Minister approves the case and returns the case file to Additional Secretary (Forests)	8
12	Case file is sent to CF, Shillong (MoEF) after the counter signature of Chief Secretary, State Government. (The case file is counter-signed by the Chief Secretary as the case file goes to MoEF).	2
13	CF (Shillong) examines the case. May opt for conducting a site inspection or may provide an 'in- principle' clearance without conducting the site visit.	90 (primarily due to work load)
14	If CF, Shillong provides 'in-principle' approval, it is conveyed to DFO. The concerned DFO works out the cost for compensatory afforestation and NPV and the total cost/amount is conveyed to the concerned Executive Engineer.	3
15	Executive Engineer requests PWD for releasing the said amount. The Project Director's Office/PWD directly deposits the specified amount into the bank account of the concerned DFO.	2
16	The DFO communicates the amount deposition to CF, Shillong and requests to provide final/formal approval	2
17	CF, Shillong conveys (in writing) the final/formal approval to the concerned DFO.	30
18	DFO conveys the final/formal sanction to the Executive Engineer	2
19	DFO further directs the concerned Range Officer (Forest Department) to mark (process is formally known as 'hammering') the trees for cutting.	1
20	Range Officer hammers/ marks the trees in presence of Executive Engineer or his field representative	10
21	The Range Officer sends the final list of trees to the concerned DFO for information	1
22	DFO forwards the case to Forest Corporation to call 'tender' for cutting the marked trees	3
23	DM, Forest Corporation calls for bid and fixes date/s to receive the tender documents	30

Step No.	Activity	No. of Days
24	After opening of the tenders and their evaluation, tree cutting work is awarded to the selected contractor	15
25	Contractor mobilizes the required lab our and machinery at site	15
26	Contractor cuts the trees.	30
	Total Number of Days (numbers indicate ideal situations)	**331**

Table 7: Key Steps in Tree Cutting Permission Process:

Step No.	Activity	No. of Days
1	Preparation of case / application letter to the Revenue and Forest Department for felling of trees falling within the Right of Way	7
2	Area to be cleared of trees is verified on the ground with the help of Revenue Department	30
3	Joint visit by Executive Engineer, DFO and Revenue Department staff for the verification of the land and trees falling within the ROW	
4	Enumeration of trees by Forest Department after the visit of Forest Guard and Range Officer (both from Forest Department). The details cover number of trees to be cut along with chainage, species and girth information.	7
5	List of trees to be cut is forwarded by the Range Officer to the concerned DFO for approval	15
6	The combined case paper is prepared by enclosing the documents received from Revenue and Forest Department (as prepared in the steps mentioned above).	7
7	Case is submitted to the concerned DFO – the DFO Office examines the case and if there are no observations, sends it to the Conservator of Forests (CF)	7
8	The CF office will examine the case and if there are no observations, will approve the felling proposal.	7
9	The approval from CF office is conveyed to the concerned DFO, who further conveys the final sanction (in writing) to Executive Engineer.	2
10	DFO further directs the concerned Range Officer (Forest Department) to mark (process is formally known as 'hammering') the trees for cutting.	1
11	Range Officer hammers/ marks the trees in presence of Executive Engineer or his field representative.	10
12	The Range Officer sends the final list of trees to the concerned DFO for information.	1
13	DFO forwards the case to Forest Corporation to call 'tender' for cutting the marked trees.	3
14	DM Forest Corporation calls for bids and fixes date/s to receive the tenders.	30
15	After opening of the tenders and their evaluation, tree cutting work is awarded to the selected contractor.	15
16	Contractor mobilizes the required labor and machinery at site.	15
17	Contractor cuts the trees	30
	Total Number of Days (numbers indicate ideal situations)	**187**

III. PROJECT DESCRIPTION

A. Type of Project

42. The present report deals with the Environmental Impact Assessment of Imphal-Kanchup-Tamenglong subproject located in Manipur State included in SASEC Regional Road Connectivity Investment Program in India. The project road starts at Imphal City and ends at Tamenglong covering a total length of 103.02 kms. The alignment passes through Imphal, Kanchup, Haochong, Bhalok and Tamenglong. The initial 13 km of this road alignment from Imphal to Kanchup is an existing state road. Further alignment between Kanchup to Tamenglong (about 90 km) is new green field alignment. The present road section is proposed for improvement and upgradation to four lane (in plain areas from Imphal-Kanchup) and two lane (in hilly terrain from Kanchup-Tamenglong) carriageway configurations with shoulders and side drains. Table 8 shows information about the Project Road.

Table 8: Details of the Project Road

Name of the Project	Subproject No.	Project Length (km)	Districts	State
Improvement and Upgradation of Imphal-Kanchup-Tamenglong Road Section in the State of Manipur	Tranche 1 non-sample subproject No. 3	103.02	Imphal West, Senapati and Tamenglong	Manipur

B. Need for the Project

43. Manipur is one of the eight North Eastern States in India. The geographical area of the state 22.327 sq km constitutes less than 0.70% of the entire country. It lies between latitude of 23°83'N-25°68'N and longitude of 93°03'E-94°78'E. The State capital, Imphal is located at an elevation of 790 m above mean sea level. Geographically the state is bounded on all sides by ranges of hills and particularly land blocked.

44. The total population of the state is 27,21,756 as per 2011 census. Of the total area, only 17 % is in valley and balance in hills and hilly/mountain terrain. The state border totals 854 km of which 352 km is international border with Myanmar to the east and south east. The remaining 502 km separate Manipur to rest of India. The road transport infrastructure in the state of Manipur is far below the all India Standards in terms of road length per sq.km. It is imperative to improve the road transport infrastructure in the state.

45. The national highway corridors namely NH 53, NH 39 and NH 150 are linking the state with the other parts of the country (Figure 7). The NH 39 (recently renamed as NH 102) Imphal Moreh is linking India and Myanmar. The traffic going to Northern Assam and Guwahati presently takes Imphal-Dimapur road (NH-39). Once Imphal – Haflong link is constructed it will provide a shorter route to Guwahati and Northern Assam from Imphal by about 70-80 km. Imphal to Haflong is presently reached using Silchar road (NH-53). Once the new alignment from Imphal to Haflong is completed, this distance will reduce by about 150-160 km. Surfaced road in hill districts are mainly limited to National Highways, State Highways and Major District Roads. Majority of the other district roads and village roads are not surfaced. The existing road system suffer from various types of deficiencies such as inadequate crust thickness, inadequate cross drainage works, weak and narrow bridges and pavement failures etc.

46. Manipur being landlocked with no rail connectivity presently has to depend on its road network for its transportation requirements. The present study section, Imphal – Tamenglong is part of state highway network. The project road once completed shall provide shortest connectivity to the East West Expressway of the union Government which is a Mass Rapid Transport Corridor of the country. This is of high economic significance as detailed below. The road shall also provide the shortest connectivity to Bangladesh and the nearest Sea Port of Chitagong. In fact the project Road shall provide the shortest connectivity between the ASEAN Countries and SASEC Countries via NH-1 at Imphal. AH 1 is the longest route of the Asian Highway Network (Figure 6), running 12,845 miles (20,557 km) from Tokyo, Japan via Korea, China, Southeast Asia, India, Pakistan, Afghanistan and Iran to the border between Turkey and Bulgaria west of Istanbul where it joins end-on with European route E80. In India AH 1 passes through Numaligarh - Golaghat - Garampani - Barpathar - Naojan - Bokajan - Dimapur - Kohima - Tadubi - Senapati - Kangpokpi - Imphal - Thoubal - Tengnoupal – Moreh (Myanmar border).

47. The project road will also provide connectivity to 18 interior villages which are presently connected by dirt tracks only. The decrease in the length of road shall be of significant economic importance for the state as the state imports more than 70% of its required essential commodities from outside the State. This shall also have a major impact on the economy of the country and the region as a whole.

48. The present project aimed to improve 103.02 km of state network into 4/2 lane configurations between Imphal and Tamenglong in the state of Manipur. The project road provides shortest connectivity for the State of "East West Corridor" of the National Highway Authority of India. This shall also reduce the distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur.

Figure 6: Map showing Asian Highway Network

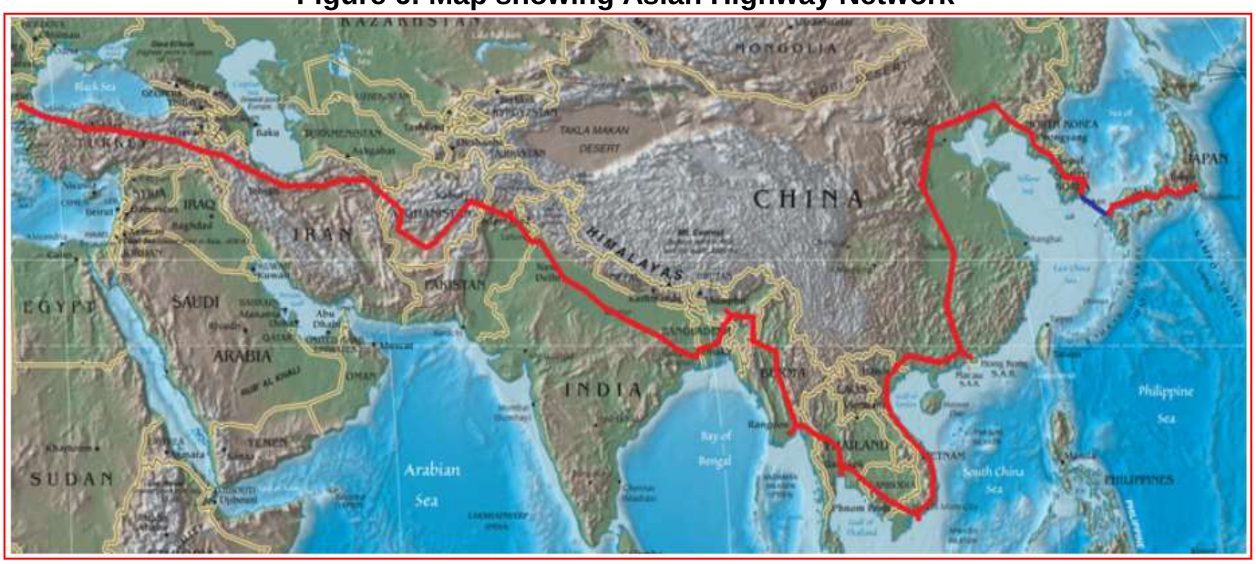


Figure 7: Map showing Surrounding Road Netwrok

49. Looking at the benefits of the project, the Government of India requested for a project preparatory technical assistance (TA) from the Asian Development Bank (ADB) to prepare an ensuing loan for the international trade corridor in Manipur State (the project). The Asian Development Bank (ADB) is supporting the preparation of the Sub regional Road Connectivity Project in the state of Manipur, which is programmed for implementation in 2015 with funding support from ADB. In order to facilitate the implementation of the project, the Government of Manipur has engaged consultants to prepare detailed feasibility study and detailed engineering design to define the project scope for implementation through engineering, procurement and construction (EPC) contract. Besides independent consultants have also been fielded by ADB to prepare the requisite safeguards documents in compliance with ADB and Government of India requirements.

C. Location and Features of the Project Road

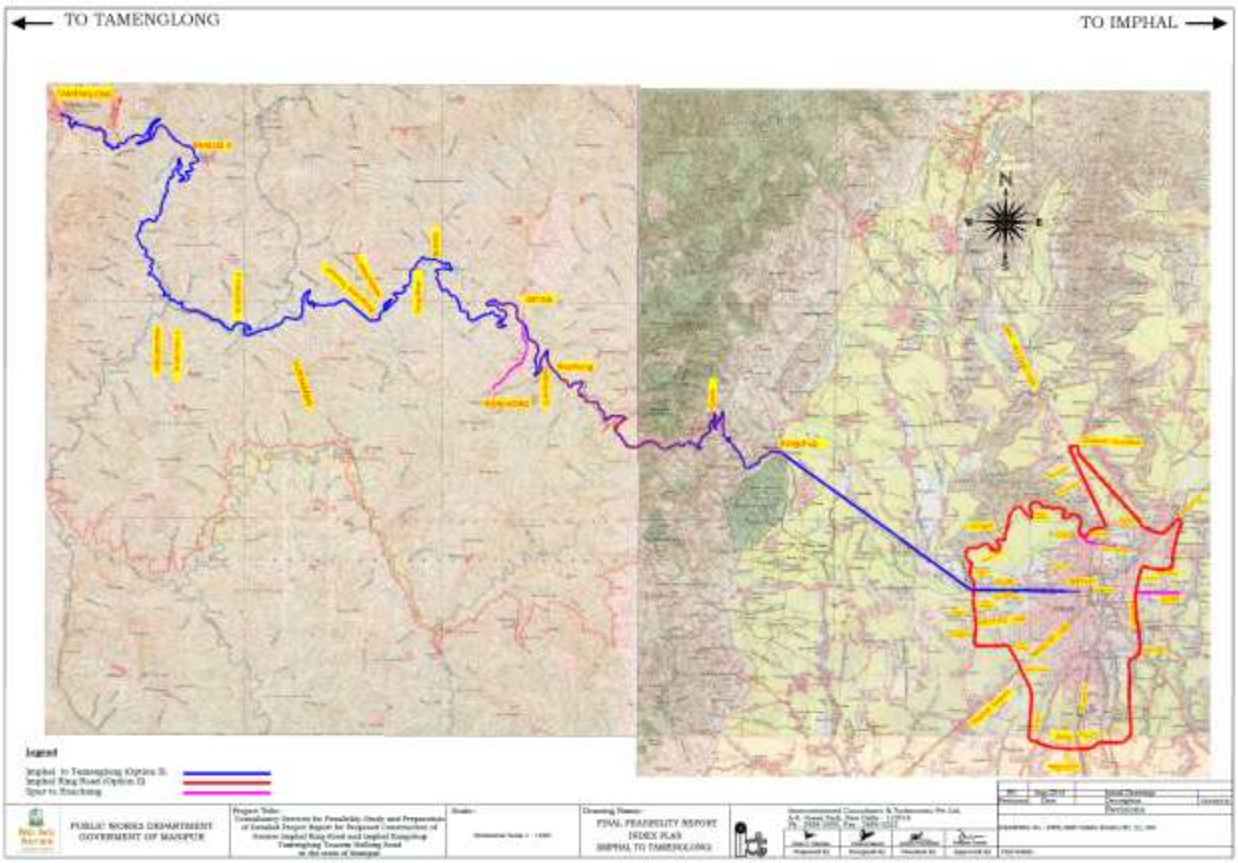
50. The major part of the subproject road section is located in Tamenglong district while small sections of project road also located in Imphal West and Senapati districts of Manipur state. Figure 8 and Figure 9 shows the location map and alignment plotted on topo sheet respectively.

51. The project road starts at the crossing location of NH 37 near the Flyover in central Imphal City. From start of the project, the 2 lane flyover and its approaches with slip road on either side extends for a length of 400m.Then there is existing 4-lane divided carriageway in about 1.46 km length. Further the existing bituminous road continuing with intermediate lane, upto Kanchup for about 13 km. Alignment further traverse on hilly, terrain towards Haochong settlement via existing KT mud road accessible only in dry season. It further traverses the hills

connecting Bhalok and terminates at Tamenglong. Major length of the alignment is in Tamenglong District while a small section of project alignment traverses through Imphal West and Senapati Districts too. The description of the alignment in various sections as given below:

Figure 8: Map showing Project Alignment

Figure 9: Project Alignment on SOI Topo Sheet



52. **Km 0 to Km 13**: This section of the alignment is an existing road in plain terrain. Out of this about 2.9 km is in urban area and the rest in the open rural area. The horizontal and vertical geometry is good. The alignment crosses the proposed Imphal ring road near Iroisemba at Km 2+700. There are 3 river/nallas crossing the alignment in this section. The existing bituminous surface is in good condition. Since the existing road has good geometry and has available Right of Way there is no requirement of any alternate alignment in this section. Water pipe lines run parallel to the project road and may require to be shifted.

Project Road between Imphal and Kangchup

Existing Water Pipe line parallel to project Road

Project road near Kangchup at Km 12

53. **Km 13 to Km 35:** After junction of Kangchup the alignment moves towards west side. There is no existing paved road, however a mud road built during the British era still exists connecting upto Haochong. The existing road is with very steep gradient with majority section having grade upto 10%, more than the design standards and at some locations grades were found to be more than 10%. Existing road is used by locals only during dry season with heavy local Shaktiman trucks or local villagers walk down the section with goods on their back. The mud road is not well maintained and at locations hill side water cross the road further damaging it and also location rocks exposed due to heavy rains. The existing road has very poor horizontal and vertical geometry; therefore a new alignment has been worked out.

54. The alignment in this section passes through hilly terrain and the altitude lies between 842m to 1382m above Mean sea level (MSL). About 2.1 km length of the alignment traverses through Kangchup Chiru Reserved forest. The alignment is parallel to tributary of Ijai River from Km 24+000 till it crosses the river at Km 35+0 near Waphong village. There are several small stream and one major stream crossing the alignment at Km 32.400. Majority of the section is new alignment and a very small section passes along existing path.

Local Shaktiman truck along existing mud Road

Steep gradient with exposed rock of existing road

Hill side stream water crossing over existing mud road in absence of drainage

55. **Km 35 to Km 39.300:** In existing condition there is no bridge structure over Ijai river and the existing mud road further starts on left bank of the river and continue upto Haouchang Village. The existing mud road is frequently accessed by local villagers for farming and other intra village activities. The existing road does not conform to horizontal and vertical geometric standards.

56. The proposed alignment in this section passes through hilly terrain and the altitude lies between 860m to 1136m above MSL. Portion of alignment follow existing alignment with improved geometric. There are some hill side natural drains crossing proposed alignment and proposed with suitable structures for crossing. The proposed alignment crosses existing mud road between Haouchang village and Oktan village. Haouchang is one of the obligatory point as mention in ToR. Hence, spur alignment of approx. length 4.15 km is proposed connecting Haouchang village.

Ijai River crossing the alignment

Existing Mud road toward Haouchang settlement

Steep gradient near Ijai River

57. **Km 39.200 to Km 52:** An existing mud track connects Oktan and Bakuwa Village which is approx. 2 to 3 m wide and covered with thick vegetation and geometric for both Horizontal and vertical do not confirm to design standards.

58. Proposed alignment further junction with Oktan-Haochong mud track traverse westwards towards Bakuwa village. Portion of the alignment follows the existing track to some extent. Since, the gradients of the existing track are in excess of 10% in major length, geometric improvement has been done. At about 50+250 the alignment crosses the Gamgidung tributary and then moves parallel to it on the north side before crossing the Iring River at about km 51+900 west of Bakua village and a major bridge has been proposed. The alignment in this section passes through hilly terrine and the altitude lies between 457m to 1137m above MSL.

Existing Mud Track between Oktan & Bakuwa Village

Bailey bridge near Bakuwa over Iring River

Single Span Steel Bridge over Iring river near Khubu Khulen village

59. **Km 52 to Km 72.500:** At present there is no existing track or road connecting further down to Tamenglong however villages like Kubu kulen, Bakuwa, Nagachin, Lukhambi are connected by mud roads to existing NH 53 and are not maintained properly.

60. The proposed alignment is new greenfield alignment, upon crossing Iring River, a Spur alignment of approx. 800 meter is proposed towards Kubu Khulen settlement with carriageway width as intermediate lane. Further alignment moves towards southward just west of the settlement of Phianchongjang.The alignment in this section is passing through steep hills. The alignment is parallel to Irang river upto Km 60+200. Thereafter it moves westwards moving downward the hill towards Irang River. Then the alignment moves towards westside upto km 72+500 till a major bridge under construction. The alignment in this section passes through steep terrain and the altitude lies between 280m to 970m above MSL.


Proposed alignment crossing low point North of Lukhambi


Lukhambi Settlement


Proposed alignment along mountains before Irang River

61. **Km 72.500 to Km 98**: Mud track exists connecting Warangba part 3 and Warangba Part 2 Village accessible by foot in current condition and is 2 to 3 m wide and majority section runs parallel to Irang River. The existing track has gentle grades however poor horizontal geometry. Further Bhalok is connected with Tamenglong with existing mud road a hill section with poor horizontal and vertical geometry however is the only connectivity for Bhalok settlers.

62. The alignment crosses Irang River at about km 72+500 where a bridge is under construction which has been proposed to be retained. The alignment further moves westwards parallel to the Irang River on the north bank upto Km 76+800. In this section the alignment crosses a tributary of Irang River at km 77+000. Then the alignment crosses Duiga River at Km 82+600 where a minor bridge has been proposed. Further alignment traverse through Bhalok settlement which is one of the obligatory points mentioned in the TOR. In addition to the above rivers, the alignment crosses another five tributaries. Further the alignment continues towards Tameglong hill and follows the existing track to some extent with geometric improvement. Since, the gradients of the existing track are in excess of 10% in major length, geometric improvement has been done. The alignment in this section passes through hilly terrain and the altitude lies between 270m to 1245m above MSL. The alignment connects at Junction with Senapathi Road and existing track along Bhalok Tamenglong.


Existing track between Warangba part 3 and Warangba Part 2 Village


Under construction Bridge at Km 72+450 over Irang River

Existing track connecting Bhalok and Tamenglong

Existing Junction with Senapathi Road at 98+000

63. **Km 98 to Km 103.020:** Existing alignment in this section is mud road for majority section and connects at a roundabout in Tamenglong town and traverse through existing settlement on both side. The existing alignment has poor geometry for both horizontal and vertical.

64. The proposed alignment follows existing mud road to reach Temenglong – Tamei Road T- junction at Km 103.020. The proposed alignment pretty much follow existing road with improved geometrics and crosses a stream at Km 100+600. As the existing bridge is in good condition, the same has been proposed to be retained. The alignment ends at a roundabout in the town of Temenglong. The alignment in this section passes through steep terrain and the altitude lies between 1194m to 1285m above MSL.

Bridge near Tamenglong

Project end Point at Km 103+00 near Tamenglong

Existing track through Tamenglong settlement

D. Engineering Surveys and Investigations

65. Following surveys and investigations had been carried out on the Project roads for collection of data for incorporation in the DPR and evolve the design for improvement and upgradation:

- topographic surveys;
- traffic surveys;
- road and pavement condition survey and inventory;
- culverts and bridges condition survey and inventories;
- material surveys;
- hydrology studies for new bridge structures;
- Geotechnical investigations & subsoil exploration for structures; and
- existing utilities surveys.

66. These surveys had been carried out in accordance with the guidelines in IRC:SP:19 to fulfil requirement in the TOR.

E. Traffic Surveys

67. Traffic surveys were carried out with main objectives to assess:

- The volumes of traffic flows and their characteristics.
- The trip distribution and travel characteristics.
- The through traffic characteristics.
- The commodities distributions.

68. To estimate the traffic flow and travel pattern of users on the project road and other characteristics related to miscellaneous requirements as per the ToR, the following primary traffic surveys were conducted on the influence road network of project road.

- Manual Classified Traffic Volume Count (MCC)
- Junction Volume or Intersection Turning Movement Count (TMC) Survey
- Origin-Destination (O-D) and Commodity Movement Survey
- Axle Load Survey :As the survey was conducted simultaneously in more than one location, and more than one type of surveys were conducted simultaneously in certain locations, there was strict supervision, for which necessary supervisory staff were deployed by the Consultants.

69. Table 9 show details of the various surveys carried out.

Table 9: Details of Traffic Surveys and Schedule

Location No.	Description of Location	Dates	Remark
1. Manual Classified Volume Count Survey (MCC)			
1	Near Thangal Bazar (Km.0.00)	13/3/2014	1 day
2	Uripok - Kangchup Road (km.12.90) OC-9	4/3/2014	1 day
3	NH-37, Noney Near Assam Rifles Check Post (Km.58.90)	12/3/2014 to 18/3/2014	7 day
4	SH Road, Near Bahlok Junction (Km.6.00)	13/3/2014 to 15/3/2014	3 day
5	Near Imphal Public School, Old Air Port (OC-1)-on surrounding network	6/3/2014 to 12/3/2014	7 day
6	Km 5+300 After Lamsang Thong Maning Junction)	31/3/2014	1 day
2. Origin & Destination Survey			
1	Uripok - Kangchup Road (km.12.90)	4/3/2014	1 day
2	NH-37, Noney Near Assam Rifles Check Post (Km.61.00)	18/3/2014	1 day
3	SH Road, Near Bahlok Junction (Km.6.00)	14/3/2014	1 day
4	Near Imphal Public School, Old Air Port (OC-1)-on surrounding network	11/3/2014	1 day
3. Turning Movement Survey			
1	Near Noney Village (Km. 63.00) Noney Junction	8/3/2014	1 day

Location No.	Description of Location	Dates	Remark
2	Near Khongsong Village (km. 108.00) Khongsong Junction	14/3/2014	1 day
4. Axle Load Survey			
1	NH-37, Noney Near Assam Rifles Check Post (Km.61.00)	18/3/2014	1 day
2	Near Old Airport on AH-1	10/3/2014	1 day

70. **Annual Average Daily Traffic (AADT)**: The traffic plying on any road generally varies over the different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have more realistic picture of the traffic on the project road, it is required to assess seasonal variation in traffic to estimate Annual Average Daily Traffic (AADT). In the absence of any reliable data on seasonal variation, no correction was carried out. The traffic survey was carried out for 12 hours from 6 AM to 6 PM and for the remaining time traffic is negligible. In order to account for the daily traffic the ADT observed for 12 hours is increased by 5% to arrive at the AADT. It can bee seen from Table 10 that the maximum AADT for Imphal-Tamenglong section is estimated at MCC-01 (km 2+000) near Imphal City, which is of the order of 23,470 PCUs (27514 vehicles). The lowest AADT volume is found at MCC-04 (km 6+000 on SH road), which is 281 PCUs (244 Vehicles). For the traffic volume count carried out on the surrounding network for Imphal- Tamenglong section, the highest volume of traffic is observed at OC-01, of the order of 38,723 PCUs (30,075 vehicles).

Table 10: Annual Average Daily Traffic (AADT)-Normal Traffic

Vehicle Type	MCC 1		MCC 2		MCC 3		MCC 4		MCC 5		MCC 6	
	Veh.	PCUs	Veh.	PCUs	Veh.	PCUs	Veh.	PCUs	Veh.	PCUs	Veh.	PCUs
Car	7393	7393	2167	2167	231	231	57	57	7350	7350	1181	1181
Taxi	2293	2293	412	412	142	142	17	17	1138	1138	169	169
3-Wheeler (Passenger)	5259	5259	3106	3106	177	177	17	17	5335	5335	791	791
2-Wheeler	10713	5357	4507	2254	228	114	83	42	7432	3716	1454	727
Mini Bus	26	39	20	30	20	30	0	0	329	494	6	9
Standard Bus	35	105	15	45	20	60	1	3	683	2049	8	24
LGV-3 Wheeler	227	341	134	201	1	2	0	0	779	1169	26	39
LGV-4 Wheeler	319	479	495	743	125	188	60	90	1591	2387	53	79.5
2-Axle Truck	156	468	173	519	220	660	27	81	3720	11160	107	321
3-Axle Truck	9	27	11	33	66	198	1	3	775	2325	4	12
4-6 Axle	3	14	2	9	2	9	0	0	175	788	0	0
More than 6 Axle	0	0	0	0	0	0	0	0	0	0	0	0
Tractor	3	5	15	23	5	8	0	0	49	74	20	30
Tractor with trailor	2	9	51	230	1	5	0	0	49	221	1	4.5
Cycle	355	178	671	336	355	178	0	0	559	280	320	160
Cycle Rickshaw	663	1326	75	150	0	0	0	0	104	208	7	14
Hand Cart	56	168	4	12	2	6	0	0	2	6	7	21
Animal Drawn	2	12	16	96	0	0	0	0	5	30	0	0
Total Traffic (Vehicles)	**27514**	**-**	**11874**	**-**	**1597**	**-**	**265**	**-**	**30075**	**-**	**4154**	**-**
Total Traffic (PCUs)	**-**	**23470**	**-**	**10364**	**-**	**2005**	**-**	**312**	**-**	**38723**	**-**	**3582**

Source: Traffic Survey carried out for March 2014

71. **Identification of Homogeneous Sections:** As the project road is not proposed to be built as a fully access controlled highway, the number of intersecting roads is bound to be large. Thus, the project road stretches of Imphal-Tamenglong section, which are having a length of 111.055kms has been divided into five homogeneous road sections on the basis of traffic generation and dispersal nodes located along the alignment as seen during the reconnaissance carried out as well as the observed traffic flows. Homogeneous sections have been identified for the purpose of traffic analysis, presentation of traffic, and traffic forecast. Table 11 gives the details of the homogeneous sections defined for the study, based on homogeneity of traffic and other features.

Table 11: Homogeneous Sections of the Project Road

Sl. No.	Homogeneous Section	Location		Length (approx) kms	Traffic Volume AADT (PCU) Base Year 2014
		From	To		
1.	HS-I (not in scope of improvement proposal)	Indo-Myanmar Road Intersection	Uripok-Kanchup Road and Takyel road Intersection	2.4	23486
2.	HS-II	Uripok-Kanchup Road and Takyel road Intersection	Lamsang Thong Maning Intersection	5.54	10361
3.	HS-III	Lamsang Thong Maning Intersection	Near Kanchup Geljang	7.3	3581
4.	HS-IV	Near Kanchup Geljang	Near Sonpram (Junction with Senapati Rd)	85.16	2910
5.	HS-V	From Near Sonpram (Junction with Senapati Rd	Tamenglong	5.02	2030

72. **Traffic Projections / Growth Rates:** For estimating the traffic growth rates, the elasticity of transport demand obtained for various modes by regressing the vehicle registration data with selected socio- economic parameters were utilised. Traffic growth rates established for the study are based on historic traffic data, vehicle registration data, GDP growth and taking into consideration the likelihood of diverted and generated traffic. Based on available evidence and data, the base traffic growth rates as per TA are reasonably in order and adopted are Passenger – 8.6% and Freight – 6.4%. Table 12 and Table 13 present summary of growth rates for the project road section and traffic in opening year.

Table 12: Summary of Recommended Growth Rates for Project Road

Vehicular Modes	Growth Rates			
	2014-19	2019-2024	2024-2029	2029-2034
Car / Jeep / Van	7.6	8.0	7.3	6.0
Taxi	4.0	4.5	3.5	3.0
Two Wheelers	6.5	7.0	6.5	5.0
Three Wheelers	5.0	5.5	4.5	3.0
Bus / Mini bus	4.5	5.0	4.0	3.0
Light Commercial Vehicles	6.0	6.5	5.5	4.0
3 Axle Trucks	6.5	7.0	6.0	5.0
2 Axle Trucks	5.5	6.0	5.0	4.5

Vehicular Modes	Growth Rates			
	2014-19	2019-2024	2024-2029	2029-2034
MAV	6.5	7.0	6.0	5.0
Tractor	2	2	2	1

Table 13: Traffic for the Project Road in the Year of Opening

Sl. No.	Homogeneous Section (HS)	Location		Length (approx. km)	Traffic Volume AADT (PCU) Base Year 2014	Traffic Volume AADT (PCU) Year of Opening 2017
		From	To			
1.	HS- I (not in scope of improvement proposal)	Indo-Myanmar Road Intersection	Uripok-Kanchup Road and Takyel road Intersection	2.4	23468	31186
2.	HS– II	Uripok-Kanchup Road and Takyel road Intersection	Lamsang Thong Maning Intersection	5.54	10361	15606
3.	HS– III	Lamsang Thong Maning Intersection	Near Kangchup Geljang	7.3	3581	7221
4.	HS – IV	Near Kangchup Geljang	Near Sonpram (Junction with Senapati Rd)	85.16	2910	3427
5.	HS-V	From Near Sonpram (Junction with Senapati Rd	Tamenglong	5.02	2030	2382

73. **Traffic Forecast:** Traffic projections for all the homogenous sections were computed with the growth rates given in Table 13. The yearly projections summary for 20 years from year 2014 for Vehicles and PCU and for each homogenous section of Project Road is given in Table 14.

Table 14: Year wise AADT Projections for Project Road Sections (VEH & PCU)

Year	HS I		HS II		HS III		HS IV		HS V	
	Veh’s	PCU	Veh’s	PCU	Veh’s	PCU	Veh’s	PCU	Veh’s	PCU
2014	27513	23468	11873	10361	4154	3581	1424	2854	1445	2883
2017	33763	30798	15179	15217	6084	7221	1668	3337	1695	3379
2019	41271	37588	18464	18525	7409	8822	2062	4125	2099	4186
2024	61213	55728	27128	27234	10919	13011	3043	6069	3102	6164
2029	80788	73975	35633	35928	14399	17161	3942	7821	4015	7935
2034	100644	93144	44159	44978	18009	21635	4896	9747	4986	9885

74. **Capacity Analysis and Level of Service**: The projected traffic is compared with the Design Service Volume (DSV) at Level of Service (LOS) -B (for rural roads, IRC: 64- 1990) to examine whether the facility would be able to carry the anticipated traffic or capacity augmentation would be needed. The design service volumes and capacities based on IRC 64-1990 are shown in Table 15.

Table 15: Design Service Volume (PCU/day)

Terrain	Lane Configuration	Design Service Volume (LOS B)	Design Service Volume (LOS C)
As per IRC: 64 –1990 (Guidelines for Capacity of Roads in Rural Areas)			
Plain Terrain with Low Curvature.	2 Lane with earthen shoulder	15,000	22,500
	2 Lane with 1.5m paved shoulder	17,250	25,875
	4 Lane with 1.5m paved shoulder.	40,000	60,000
As per IRC:SP48-1998 (Hill Road Manual)			
Hilly Terrain with Low Curvature.	2 Lane with earthen shoulder	7000	10,500
	2 Lane with 1.5m paved shoulder	8,050	12,075

75. The homogenous sections I, II and III have plain terrain. It may be noted that Homogenous Sections I, would be required to be widened to 4 lane with paved shoulder configuration from the year of opening 2017. Homogenous section II would cross the 18000 PCU mark by the year 2018 which is only 1 year after the year of opening. Therefore, it is logical to improve this section of the project road also to 4 lanes with paved shoulder configuration. The homogenous section III may be improved to 2 lane with paved shoulder configuration as it has less than 10000 PCUs but more than 8000 PCUs of traffic by the year 2019, which is only two years after year of opening, 2017.

76. The new alignment of the project road is completely hilly terrain therefore, for improvement proposals IRC: SP: 48-1998 has been followed. It has two homogenous sections which are homogenous section IV and V. The Homogenous section IV and V, cross 5000 mark in the year 2020 which is 3 years after the year of opening 2017. Therefore, it is logical to improve both of these sections to two lane configuration by the year 2017 itself.

77. The improvement proposal for the various homogenous sections is given in Table 16.

Table 16: Widening Proposal for the Project Road (Year of Upgradation)

Sl. No.	Homogenous Section	Improvement Proposal			
		2 Lane with Granular Shoulder	2 Lane with Paved	4 lane with Paved Shoulder	6 Lane with Paved shoulder
1	HS-I (not in the scope of improvement proposal)	-		2017	2025
2	HS-II	-		2018	-
3	HS-III	-	2019	2030	-
4	HS-IV	2020	-	2032	-
5	HS-V	2020	-	2032	-

78. **Design Standards for the Project Road .** The IRC design standards have been followed in consultation with ToR, while formulating the road design standards. As the project road sections pass mainly through hilly terrain, the ruling design speeds considered for the formulation of design standards are 100 km/hr. for plain sections and 50 km/hr. for hilly sections. The purpose of formulation of design standards is to avoid any inconsistency in design during the road construction and operation.

79. **Proposed Improvement Works**. The proposed improvement work for the project road corridor includes upgrading of the proposed Imphal-Kunchup-Tamenglong Road along existing road for a length of 14.7 km and 96.355 along greenfield. From the analysis of projected traffic and the design service volume values, the improvement proposal for various homogeneous sections are presented in Table 17.

Table 17: Details of Improvement Proposal for Various Sections

Sl. No	Chainage (In Km)			Status of Existing Road	Proposal	Remarks
	From	To	Length	CW (m)	Lane Configuration	
Main Imphal Tamenglong Road						
3	0+000	2+840	2.840	5.5m-BT	4 Lane Urban	Concentric Widening
4	2+840	3+640	0.800	5.5m-BT	4 Lane Rural	Left Widening
5	3+640	5+140	1.500	5.5m-BT	4 Lane Rural	Concentric Widening
6	5+140	5+540	0.400	5.5m-BT	4 Lane Rural	Left Widening
7	5+540	12+900	7.360	5.5m-BT	2 lane with Paved Shoulder	Concentric Widening
8	12+900	98+000	85.100	-	2 Lane Hill Road	New Construction
11	98+000	103+020	5.020	4-5 m gravel Road	2 Lane Hill Road	Reconstruction with Geometric improvement
SPUR to Haochong						
1	0+000	4+150	4.15	Track	Intermediate Lane (5.5m)	New Construction
SPUR to Kubu Khulen						
1	0+000	0+800	0.800	Track	Intermediate lane (5.5m)	New Construction

F. The Design

80. The improvement proposal involving design for the Project road specifies widening and strengthening of existing road. The design of the Project road incorporates the following design components:

- analysis of present traffic and future projections,
- analysis of present pavement structure and its strength and design requirements for the new pavement and overlay over the design period for widening and strengthening,
- determination of adequacy of the hydraulic capacity and structural parameters of the existing structures, determination of adequacy of the road's geometry (horizontal as well as vertical); and
- ensuring road safety aspects are addressed.

G. Design Standards

81. Although the project road is composed of State Highway and district roads warranty the corresponding set of design standards recommended by IRC, the nature of land use abutting the corridor has made introduction of location specific deviation essential from the point of view of safety and socio economic contribution. The design considerations and the standards

adopted to formulate the typical cross sections and for preliminary design are discussed in the following sections.

82. The following IRC codes, inter alia, were used as reference:

IRC: 3-1983	:	Dimensions and Weights of Road Design Vehicles
IRC: 37-2001	:	Guidelines for the Design of Flexible Pavements
IRC: 48-1988	:	Hill Roads Manual
IRC: 58-2002	:	Rigid Pavements for Highways
IRC: 64-1990	:	Guidelines for Capacity of Roads in Rural Areas
IRC: 70-1977	:	Guidelines on Regulation and Control of Mixed Traffic in Urban Areas
IRC: 73-1990&	:	Geometric Design Standards for Rural (Non Urban)
IRC: 86-1983	:	Geometric Design Standards for Urban Roads in plains
IRC SP-73-2007	:	2 Lane manual for PPP project
IRC SP-84-2010	:	4 Lane manual for PPP project
IRC: 81:1997	:	Flexible Road Pavements Using Benkelman Beam Deflection Technique
IRC-SP 13:2004	:	Guidelines for the Design of Small Bridges and Culverts

83. Besides, AASHTO and the TRL guidelines for pavement and geometric design were appropriately referred to.

H. Geometric Design Standards

84. The salient parameters for the geometric design of road suggested are given in Table 18-20.

Table 18: Design Speed

Type of Section	Ruling		Absolute Minimum
	Desirable	Minimum	
Rural	100 km/h	80 km/h	60km/h
Urban/Builtup Section	60 km/h	50 km/h	30 km/h*
Hill Roads	Ruling	Minimum	-
National and State Highways	50 km/h	40 km/h	-
Major District Roads	40 km/h	30 km/h	-

* From the point of view of safety only.

85. Safe stopping sight distances confirm to an object height of 0.15 m and driver's eye level of 1.05 m above road.

Table 19: Sight Distance Standards

Palin/Rolling Terrain				Hilly Terrain		
Design Speed (km/h)	Sight Distance (m)			Design Speed	Stopping Sight Distance	Intermediate Sight Distance
	SSD	ISD	OSD			
100	180	360	640	25	25	50
80	130	240	470	30	30	60
60	80	160	300	35	40	80
50	60	120	235	40	45	90
30	30	60	110	50	60	120

86. On hill roads stopping sight distance is absolute minimum from safety angle and must be ensured regarding of any other considerations. Radii for the plain terrain and hilly terrain are given in Table 20 and 21 respectively.

Table 20: Geometric Standards for Horizontal Alignment

Particulars	Design Speed(km/h)				
	100	**80**	**60**	**50**	**30**
Minimum radius of horizontal curve(m)*	400	255	130	90	35
Maximum super elevation ‘e’	5%	5%	5%	5%	5%

** Minimum radius of the curve calculated based on maximum super elevation value of 5% and friction coefficient of 15%.*

Table 21: Minimum Radii of Horizontal Curves

Classification	Mountainous Terrain	
	Areas not affected with Snow	
	Ruling Min (m)	**Absolute Min (m)**
National Highways and State Highways	80	50
Major District Roads	50	30

87. The super-elevation should be attained gradually over the full length of the transition curve so that the design super-elevation is available at the starting point of the circular portion. In case where transition curve cannot be provided for some reason, 2/3 of the super elevation may be attained on the straight section before start of the circular curve and the balance 1/3 on the curve.

88. In developing the required super-elevation, it should be ensured that the longitudinal slope of the pavement edge compared to the centre-line (i.e., the rate of change of super-elevation) is not steeper than 1 in 150 for roads in plain and rolling terrain.

89. Methods of attaining Super elevation in Hill Roads: The normal cambered section of the road section is changed into super elevation section in two stages. First stage is the removal of adverse camber in outer half of the pavement. In the second stage, super elevation is gradually built up over the full width of the carriageway so that required super elevation is available at the beginning of the circular curve. There are three different methods for attaining super elevation;

i) Revolving pavement about the Centre line;
ii) Revolving pavement about the inner edge and;
iii) Revolving pavement about the outer edge

90. When culverts fall on a horizontal curve, the top surface of the wearing course of culverts should have the same profile as the approaches. The super-elevation may be given to the abutments keeping the deck slab thickness uniform as per design. The level of the top of the slab of the culverts should be the same as the top level of the approaches so that undue jerk while driving on the finished road is avoided.

91. On Indian highways, the proportion of slow moving vehicles and heavily laden commercial vehicles in the traffic stream is substantial. Consequently, it has been observed, 70% to 80% of the vehicles travel at two-third of the design speeds. Also, speed restrictions are often imposed on curves because of line-of-sight limitations. Therefore, vehicles travelling at speeds less than the design speed, particularly the SMVs such as tractor-trailers find it difficult to negotiate superelevation higher than 5%. Slow traffic on the outer lane (s) on a

curve tend to drift toward the centre of the curvature (i.e. toward the fast lane) posing hazard to themselves and all other road users. The other issue is the roll-over factor, which affects slow-moving vehicles, against travelling on the outer lane of curve. The camber break between the carriageway lane and the paved shoulder, i.e. the roll-over, has to be restricted to 8% else vehicles like tractor-trailers would overturn. Assuming that the paved shoulder camber cannot be less than 2.5%, the super-elevation shall be limited 5% so that the roll-over (2.5% + 5%) remains within 8%. However this required a flatter radius than what is proposed in the Table 22.

Table 22: Longitudinal Gradients in Rural Stretches (Plain/Rolling Terrain)

Particulars	Design Speed (km/h)			
	100	**80**	**60**	**50**
Gradient				
• Ruling maximum	3.3%	3.3%	3.3%	4%
• Absolute maximum	3.3%	4%	4%	4%
Min. 'K' Value (for safe stopping sight distances)				
• Summit curves				
SSD	74	33	14.5	8.2
ISD	135	60	27	15
OSD	427	230	94	58
• Sag curves	43	26	15	10
Grade difference not requiring vertical curve	0.5%	0.6%	0.8%	1.0%

Note: Length of curve = K × grade difference in per cent

92. Hilly Terrain: broken back grade lines, i.e. two vertical curves in the same direction separated by a short tangent, should be avoided due to poor appearance, and preferably replaced by a single curve. Decks of small cross drainage structures (i.e. culverts and minor bridges) should follow the same profile as the flanking road section, with no break in the grade lines.

93. The proportion of slow moving vehicles and heavily laden commercial vehicles in the traffic stream is substantial. Consequently, it has been observed, 70 to 80% of the vehicles travel at two-break in the grade line. Recommended gradients for different terrain conditions, except at hair-pin bends are given in Table 23.

Table 23: Recommended Gradients for Different Terrain Conditions

Classification of Gradient	Mountainous Terrain and steep terrain more than 200 m above MSL	Mountainous Terrain up to 3000 m height above MSL
Ruling Gradient	5% (1 in 20.0)	6% (1 in 16.7)
Limiting Gradient	6% (1 in 16.7)	7% (1 in 14.3)
Exceptional	7% (1 in 14.3)	8% (1 in 12.5)

Note: Gradients upto the ruling gradients may be used as a matter of course in design.

Table 24: Cross-Sectional Elements

Element Characteristics	Design Values	
	Ruling	Minimum
Widths		
Lane	3.5 m*	-
Paved shoulder	2.0 m/1.5m	1.5 m
Earthen shoulder	2.0 m	1.0 m
Slow/parking lane	2.5 m	1.5 m
Median	1.50m with RCC crash barrier. If standard wide median of 4.5m is provided, no crash barrier would be required.	
Footpath	2.5 m	1.5 m
Cross-Fall		
Carriageway	2.5%	0.5%***
Paved shoulder	2.5%	0.5%
Hard /gravel shoulder	4.0%	1.0%
Earthen shoulder	4.0%	1.0%
Footpath	3.0%	1.0%
Median top	4.0%	-
Embankment Side Slope (Vertical: horizontal)		
Fill	1(V):2(H) (min)	1(V):1.5(H)
Cut	2(V):1(H)	

* Add 0.25m on each kerb side to account for kerb shyness.

** Wide paved shoulder where necessary (ref: Para 7.4.5).

*** At junctions only, where camber may reduce to zero for level matching with cross roads

I. Widening Options

94. The widening scheme proposed for this project is given in Table 24.

J. Typical Cross-sections

95. Based on the traffic estimates, capacity and the proposed Right of Way (ROW) various typical cross-sections have been worked out for the Imphal Tamenglong road. These are described as given below:

- **TCS 1** – (4 Lane divided Carriageway - Urban) Four lane divided carriageway with 7.25m width either side separated by a 1.5m wide median. It has 2.0m wide paved shoulders and 1.5m wide drain cum footpath on either side. The proposed ROW is 30m. This cross-section is applicable for widening of existing intermediate lane for a length of 5.54 km.
- **TCS 2** – (2 Lane with Paved Shoulder) Two lane 7.0m wide carriageway with 1.5m paved and 1.0m earthen shoulders either side. There will be earthen drain of base width 0.6m either side. The proposed ROW is 30m. This cross-section is applicable for widening of existing intermediate lane for a length of 7.3 km.
- **TCS 3** – (2 Lane in Box cut-Hill section) Two lane 7.0m wide carriageway with 0.9m wide earthen shoulder and unlined drain on either side. This cross-section is applicable in the hill section involving hill cutting on both sides. The applicable

length shall be as per the design of vertical profile to be done based on the topographic survey.

- **TCS 4 –** (2 Lane with half cut/Fill-Hill section) Two lane 7.0m wide carriageway with 0.9m wide earthen shoulder on either side and unlined drain on hill side. This cross-section is applicable in the hill section involving hill cutting on one side and filling on the valley side with provision of breast wall / Retaining wall. The applicable length shall be as per the design of vertical profile to be done based on the topographic survey.
- **TCS 5 –** (2 Lane with Fill-Hill section) Two lane 7.0m wide carriageway with 0.9m wide earthen shoulder on either side and unlined drain on hill side. This cross-section is applicable in the hill section involving fill in both sides with provision of breast wall / Retaining wall. The applicable length shall be as per the design of vertical profile to be done based on the topographic survey.
- The Typical cross section for SPUR to Haouchang & Kubu Khulen is same as above for hill road in cutting/filling with carriageway width of 5.5m.

96. Figure 10 to 14 show some of the typical cross-sections considered as strategies in this study.

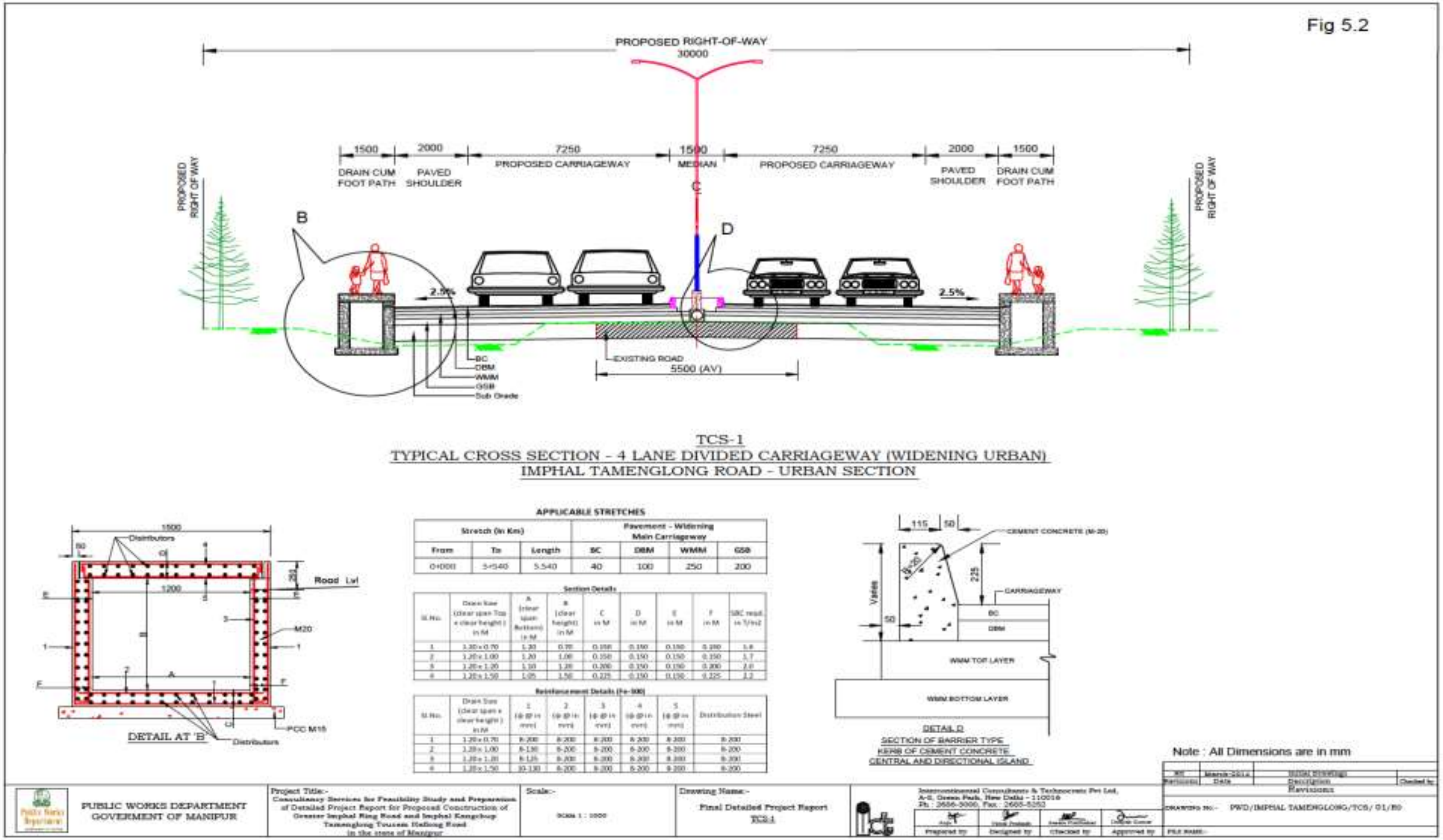
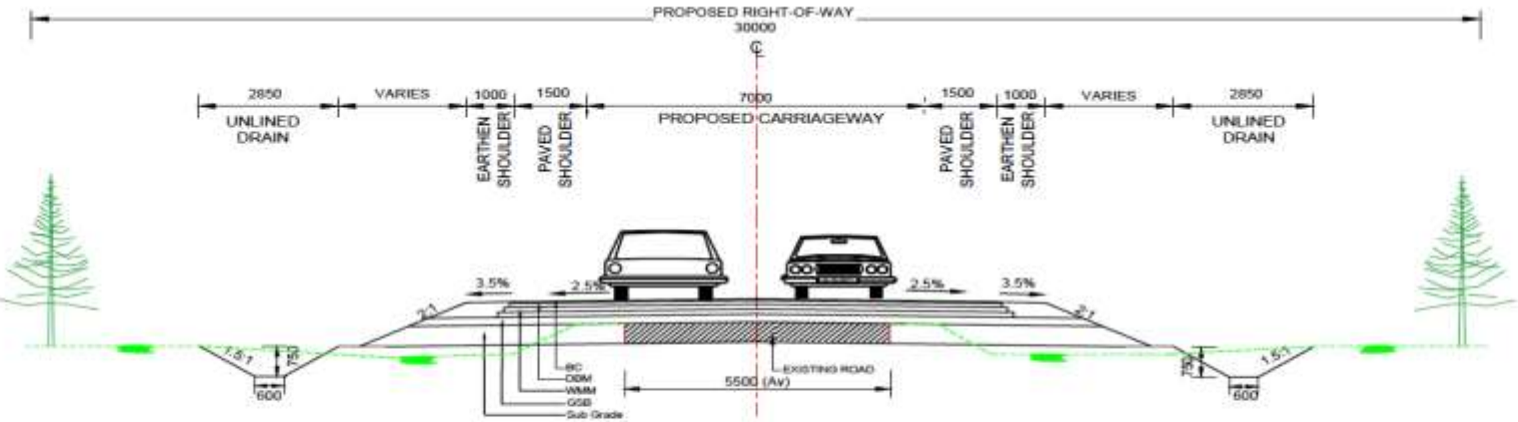


Figure 10: TCS -1 (Lane divided Carriageway – Urban)

Fig 5.3



TCS-2

TYPICAL CROSS SECTION - 2 LANE CARRIAGEWAY WITH PAVED SHOULDER (WIDENING)

IMPHAL TAMENGLONG ROAD - RURAL SECTION

APPLICABLE STRETCHES

Stretch (in Km)			Pavement - Widening Main Carriageway			
From	To	Length	BC	DBM	WMM	GSB
5+540	12+900	7.360	40	100	250	200

Note : All Dimensions are in mm

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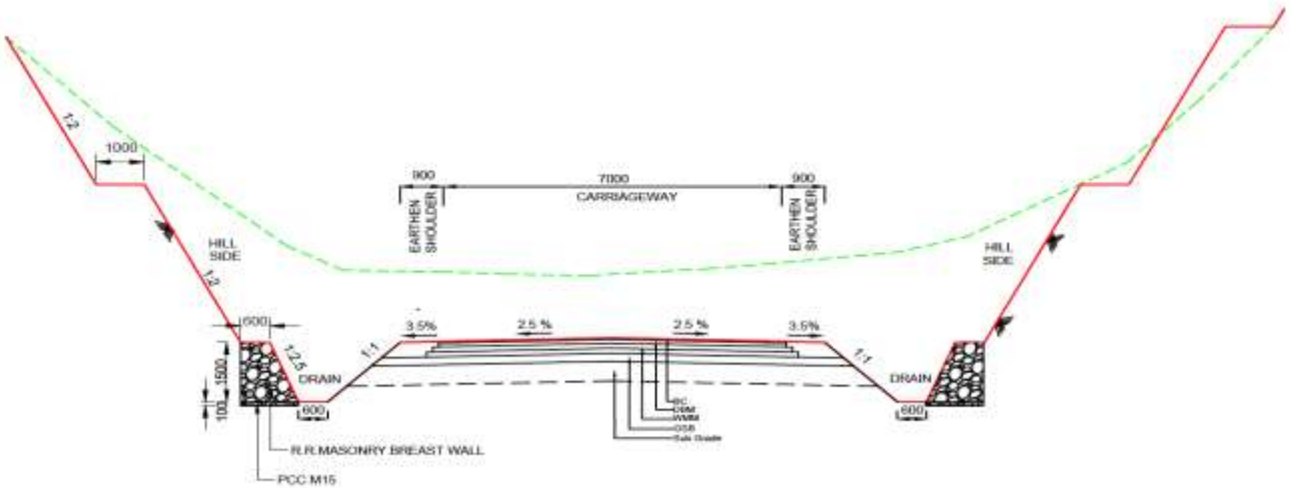
Figure 11: TCS-2 (2 Lane with Paved Shoulder)

Fig 5.4



TCS-3
TYPICAL CROSS SECTION - 2 LANE CARRIAGEWAY (BOX CUT)
IMPHAL TAMENGLONG ROAD – HILL SECTION

APPLICABLE STRETCHES

Applicable Chainage (in Km)			Pavement Composition			
From	To	Length	BC	DBM	WMM	GSB
12+900	32+000	19.100	40	65	250	200
32+000	52+000	20.000	40	95	250	200
52+000	88+000	36.000	40	65	250	200
88+000	103+020	15.020	40	80	250	200

Note :
1. All Dimensions are in mm
2. The applicable Stretch shall be as per design

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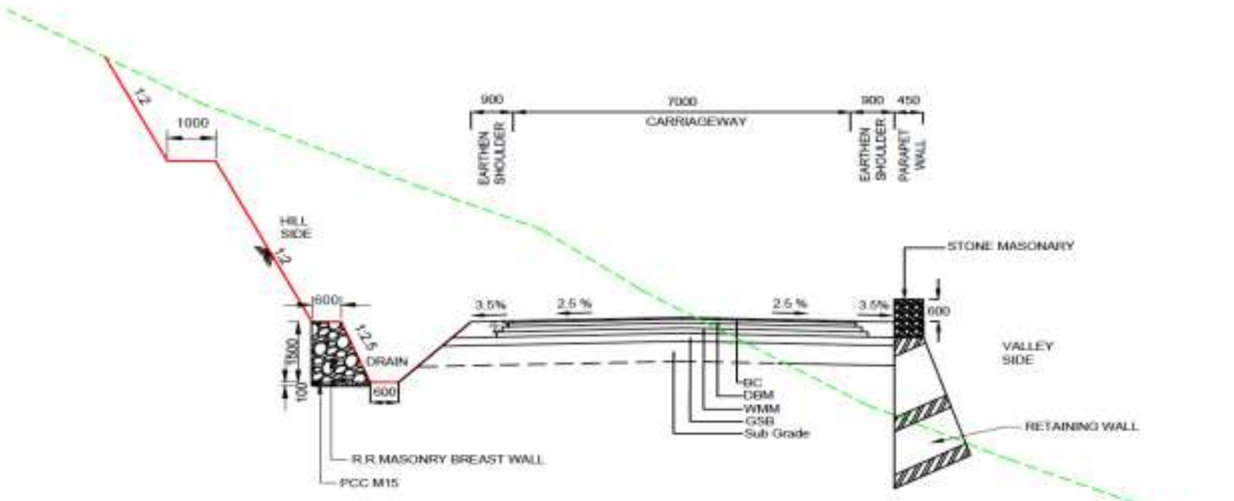
Figure 12: TCS-3 (2 Lane in Box cut-Hill section)

Fig 5.5



TCS-4

TYPICAL CROSS SECTION - 2 LANE CARRIAGEWAY (HALF CUT / FILL)

IMPHAL TAMENGLONG ROAD - HILL SECTION

APPLICABLE STRETCHES

Applicable Chainage (in Km)			Pavement Composition			
From	To	Length	BC	DBM	WMM	GSB
12+900	32+000	19.100	40	65	250	200
32+000	52+000	20.000	40	95	250	200
52+000	88+000	36.000	40	65	250	200
88+000	103+020	15.020	40	80	250	200

Note :
1. All Dimensions are in mm
2. The applicable Stretch shall be as per design
3. The parapet wall shall be 2m continuous with 1m gap

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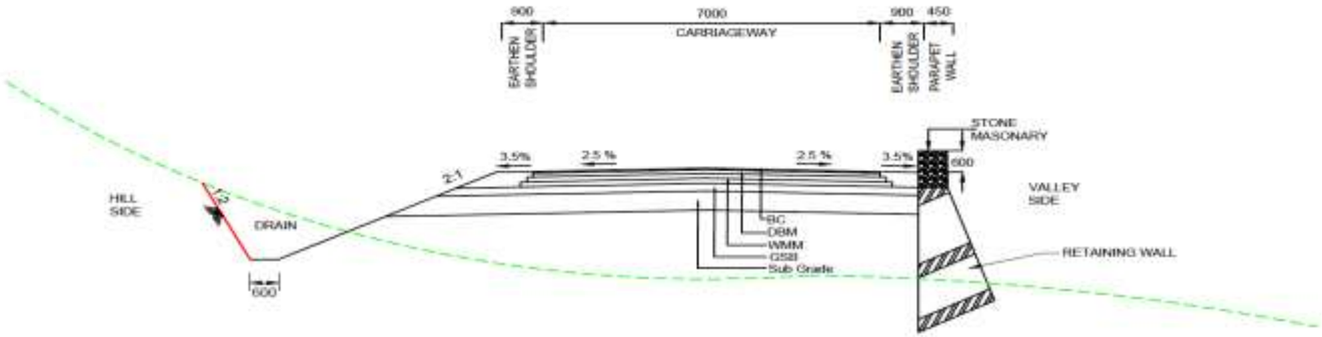
Figure 13: TCS-4 (2 Lane with half cut/Fill-Hill section)

Fig 5.6



TCS-5
TYPICAL CROSS SECTION - 2 LANE CARRIAGEWAY (FILL IN HILL SECTION)
IMPHAL TAMENGLONG ROAD - HILL SECTION

APPLICABLE STRETCHES

Applicable Chainage (in Km)			Pavement Composition			
From	To	Length	BC	DBM	WMM	GSB
12+900	32+000	19.100	40	65	250	200
32+000	52+000	20.000	40	95	250	200
52+000	88+000	36.000	40	65	250	200
88+000	103+020	15.020	40	80	250	200

Note :
1. All Dimensions are in mm
2. The applicable Stretch shall be as per design
3. The parapet wall shall be 2m continuous with 1m gap

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Figure 14: TCS-5 (2 Lane with Fill-Hill section)

6. Pavement Design

97. The general design procedure is based on the prevalent practices in the country. The design of pavement structure has been carried out as per IRC Guide lines and TOR. The detailed design of new pavement and overlays on existing pavement shall be based primarily on IRC-37:2012 and IRC-81: 1997 for flexible pavement and IRC-58: 2011 for rigid pavement. Recommended pavment composition is show in table 25.

Table 25: Recommended pavement Composition for Project Road

Sl. No.	Traffic Homogeneous Section	Chainage (Km)	Length (km)	Design Traffic	Design CBR (%)	Pavement Composition (mm)			
						BC	DBM	WMM	GSB
1	HS-2	0+000 – 5+540	5.540	30	8	40	100	250	200
2	HS-3	5+540 – 12+900	7.360	35*	8	40	100	250	200
3	HS-4.1	12+900 – 32+000	19.100	30	15	40	65	250	200
4	HS-4.2	32+000 – 52+000	20.000	30	10	40	95	250	200
5	HS-4.3	52+000 – 88+000	36.000	30	15	40	65	250	200
6	HS-4.4	88+000- 98+000	10.000	30	12	40	80	250	200
7	HS-5	98+000- 103+020	5.020	30	12	40	80	250	200
8	Spur I	0+000 – 4+150	4.150	2	10	30	50	225	150
9	Spur II	0+000 – 0+800	0.800	2	10	30	50	225	150

7. Design of Service Road

98. Service road has been designed for four-lane sections for design traffic of 5 MSA. Accordingly, the pavement composition for service road, determined as per design chart of IRC: 37-2012.

8. Design of Slip Road

99. Slip roads are designed, where the flyover section is proposed. Design traffic for the slip road is considered as 2 MSA. Pavement composition for slip road, determined as per design chart of IRC: 37-2012

9. At-Grade Intersection / Grade Separated Intersection

100. Considering the importance of the crossroad, turning movement and future traffic projection, Grade Separated structure has not been proposed. However, for smooth merging and diverging of cross road traffic at-grade intersections have been identified at various locations for improvement. Depending upon the present traffic and road type, 9 major and 42 minor type of intersection have been proposed for the Imphal Tamenglong road.

10. Project Facilities

101. **Service Lane/Slip Road**: New Service road/ slip road have not been proposed for Imphal Tamenglong road.

102. **Footpath**: At start of the project, the proposed road passes congested market area. Considering the safety of the pedestrian along the project road, 1.5m width Drain cum footpath has been proposed on either side for a length of 5.54 Km.

103. **Median and Median Opening**: Due to land constraint 1.5m width of raised median with Kerb has been proposed in 4 lane section of the project improvement proposal from 0+000 to 5+540. Median opening of 20 m width has been considered at junction locations for cross passage.

104. **Bus Lay Bye**: To address the need of people living along the project road, bus lay bay have been proposed. Depending upon the terrain three types of Bus bay have been proposed along the project road. The details are as follows:

Sl. No	Terrain	Length of Bus Bay (m)	Total Length (m)	Width(m)
1	Urban	15	85	4.5 (No separator)
2	Rural	15	165	4.5
3	Hilly	15	59	5 (No separator)

105. **Truck lay bye:** Provision of truck lay bye is not required in Imphal Kanchup Tamenglong Road.

106. **Road Signs, Pavement Marking and Lighting:** The various considerations made for different safety features included in the DPR. Indian Road Congress (IRC) codes have been followed in proposing and designing road safety features. At all intersections, shoulder mounted advanced directions signs will be provided. The signs shall be with retro reflective micro prismatic grade conforming to Type XI sheeting of ASTM standards for short, medium and long distance viewing to cater visibility requirement encountered by all road users. All curves shall be properly delineated with single chevrons signs which will be placed on outer edge of the curve, so as to view at least 2-3 chevrons from any given instance of viewing. Absolute speed limit signs and also compulsory “no parking” and “no stoppage” signs also have been proposed at regular interval.

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

11. Proposed Right of Way

108. To minimize landaquisition and impact on existing settlers or section passing through settlements, the improvement proposal from Km 0+000 to Km 12+900, the Proposed Right of Way (PROW) has been proposed as 30m in general. As decided the Proposed Right of Way (PROW) for Hilly section has been kept as 30m in general. But in most of the Hilly section the toe line has been spillover beyond the PROW. Hence additional land has to be required for accommodating the proposed improvement.

Sl. No.	Stretches (Km)		PROW Width (m)
	From	To	
1	0+000	12+840	30
2	12+840	103+020	30*

***Additional land required in stretches where toe line spillover the PROW line in hill section.

12. Land Acquisition

109. The total length of proposed alignment for Imphal Tamenglong Road is 103.000 Km. Out of the above, the available existing ROW from Km 0+0 to Km12+900 is varies from 10 m to 30m. Hence to accommodate the improvement proposal, additional land has to be acquired. The village wise tentative of land to be acquired from Km 0+0 to Km 12+900 are as follows:

Sl. No	District	Village	No. of Affected Plots	Area to be Acquired (in Hect)
1.	Imphal West	1. Uripok	2	0.0084
2.		2. Khwailalambung	95	2.3215
3.		3. Takyemapal	1	0.0120
4.		4. Iroishemba	127	7.1068
5.		1. Taothong	61	5.4589
6.		2. Lamdeng	33	2.6356
7.		3. Laingam Khul	2	0.0417
8.		4. Lamsang	45	4.9239
9.		5. Howrangsabal	16	1.4233
10.		6. Heibongpokpi	18	1.5960
11.		7. Lairemkabi	46	6.7770
12.		8. Khalairenkabi	20	0.9035
13.		9. Kharang Koireng	56	2.5073
14.		10. Kangchupkhul	38	3.1609
Total			**607**	**38.8765**

13. Safety Features

110. The typical provisions that have been considered in design to prevent or minimize accidents are:

- Reflective studs (cats' eyes) on road markings.
- Double Beam Crash barriers in high embankment greater than 3 m and on approaches of bridges and also on valley side.
- Pedestrian crossings with road markings and reflective studs.
- Pedestrian guardrails (in Palin built-up area)

14. Drainage Design Standards

111. The design of drainage structures is carried out in accordance with the following codes:

- IRC: SP: 13 - 2004, "Guidelines for the design of small bridges and Culverts".
- IRC: 5 – 1998 "Standard specifications and code of practice for Road bridges".
- IRC: SP: 84 - 2009, "Manual of Specifications & Standards for Four laning of Highways through Public Private Partnership".
- IRC: SP: 42 – 1994, "Guidelines on Road Drainage".
- IRC: SP: 50 – 1999/IRC: SP: 50 – 2013, "Guidelines on Urban Drainage".
- IRC: SP: 48– 1998, "Hill Road Manual".

15. Recommendation for Bridges

112. As a safety consideration, width of the bridges was proposed to match with the width of the road at approaches. That is 14.8m in urban and 12.9m in rural for the 2lane and 27.5m (12+3.5+12) for 4lane road improvement.

a. New 4-lane bridges in replacement of existing bridges

113. Details of existing bridges proposed to be replaced on the existing alignment with new 4-lane bridges are given in Table 26.

Table 26: Existing 2-lane bridges proposed to be replaced by new 4-lane bridges

Sl. No.	Name of Bridge	Location (Design Chainage)	Proposed 4-Lane / 2-Lane Bridge		
			Span Arrange-ment (m)	Length (m)	Remarks
1.	Luwangli river bridge	5+028	3 x 20	60.05	New 4 lane bridge in replacement of the existing narrow bridge
2.	Nimbul River Bridge	7+261	2 x 20	40.05	New 4 Lane bridge in replacement of the existing narrow bridge

b. New Bridges on proposed realignment

114. In addition to above 13 new 2-lane bridges have been proposed on realigned portion/ new alignment depending upon the site requirement as per details given in Table 27.

Table 27: Details of proposed new 2-lane bridges

S. No.	Design Chainage (Km)	Span Arrangement (c/c of exp. Jt.) (m)	Total Length of Bridge (m)	Remarks
1.	28+000	2x11.5	23.00	Twin cell RCC box
2.	32+197	15+30+15	60.05	
3.	34+410	1x12.40	12.40	Single cell RCC box
4.	34+926	30.736 + 30.347 + 30.000 + 30.385	121.52	
5.	50+240	15+30+15	60.05	
6.	51+916	2x30+15	75.05	
7.	72+179	1x10.00	10.02	
8.	76+154	1x12.00	12.00	Single cell RCC box
9.	76+972	15+ 2x30 + 15	90.05	
10.	78+852	2x8.00	16.00	Twin cell RCC box
11.	80+151	2x8.00	16.00	Twin cell RCC box
12.	81+610	1x10.00	10.02	
13.	82+505	2 x 20	40.05	

16. Summary of New Proposed Bridges / Structures

115. As per the proposed alignment, the following new bridges and structures have been proposed keeping in view the condition of existing bridges, hydrological requirement, proposed improvement / realignment of road, road junctions and road crossings.

a. New 4-lane/2-lane / Additional 2-lane bridges

- New 2-lane bridges on proposed realignment / new alignment : 12 Nos
- New 4-lane bridges to replace existing bridges : 02 Nos
- New 2-lane bridge in replacement of abandoned bridge : 01 Nos

Total 15 nos.

17. Roadside Ditches/Drains

116. Roadside toe drains shall be provided to receive discharge from embankment surface and countryside runoff and carry it safely to the nearest outfall point ensuring safety to the embankment toe, which is the area most vulnerable to erosion / failure.

117. Roadside drains shall generally be provided on both sides of the embankment to safely carry the discharge from the embankment without jeopardizing the safety of the toe.

118. The alignment of the drains shall depend on the topography of the area and the type of drain selected. In plain section U-shaped drains has been proposed on both side. In hilly section u-lined drains has been proposed on hill side.

119. The shape and size of the roadside drains has been decided on the basis of length of embankment being served by the drain up to the nearest outfall point.

120. For stretches passing through urban areas, rectangular covered drains have been recommended for safety reasons.

121. For rural areas, the drains have been open and trapezoidal with 1.5(H):1(V) side slope. As the topography in general is quite flat, optimization of the length of drain, bed width and depth of flow shall be necessary to reduce the top width of the drain (land width required for construction of drain). To reduce the length of drain up to nearest outfall and consequently the section, intermediate balancing culverts shall be provided at suitable locations. These drains may also terminate at local roadside ponds, if feasible. The minimum bed width and depth of flow at starting section shall be 600 mm and 300 mm respectively. The sections shall be gradually increased in terms of bed width and depth of flow up to the outfall point.

122. The section shall be designed to ensure a non-silting / non-scouring velocity in drains.

18. Culverts

123. For improvement of Imphal Kanchup Tamenglong Road, details of culverts to be widened / proposed are as below:

Imphal Kangchup Tamenglong Road			SPUR Haochong	SPUR Kubu Khulen	Junctions
Slab	**Box**	**Hume Pipe**	**Hume Pipe**	**Hume Pipe**	**Hume Pipe**
6	88	270	12	4	6

19. Shifting of Utilities

124. Utilities like telephone cable, electrical lines along with water supply lines may be required to shift during widening. A proper scheme of relocating these shall be worked out once

the widening schemes are approved. Details of the utilities along the project road are given in the inventory. Strip plan showing existing utilities and relocation plan for the affected utilities due to the widening shall be submitted separately.

20. Road Construction Materials

125. Material Survey for road construction materials for the Project roads, i.e. earth, aggregates, water, bitumen etc. has been carried out in the Project corridor and the indicative lead charts have been prepared.

126. Besides, the field in-situ investigations were conducted. The materials samples collected were tested in the laboratory and results data compiled in Material Report of the DPR.

127. The lead involved for the project roads and the investigations are quite representative, but more extensive investigation shall need to be conducted by the contractors at the time of construction, for earth and aggregates available from such sources.

21. Project Cost

128. The cost of civil works including maintenance amounts to about Rs. 7716.5 millions Indian Rupees (US$ 125.5 million) for 103.02 km Imphal-Tamenglong Road including a two spurs. These costs are based on 2014 rates as per analytical rates. The cost has been indexed for escalation till mid-2014 @ 5% per annum. The maintenance component is based on an average 3% of total cost of Civil Works for 5 years. This component shall not be undertaken as part of contract for Civil Works, but to be undertaken separately subsequent to the construction.

22. Construction Packaging and Implementation Schedule

129. It is proposed to carry out construction of the road section under one package with a time period of 36 months. The Project is proposed to be undertaken through International Competitive Bidding (ICB). Currently the project is at bidding stage and scheduled to award contract in the Second quarter of 2015. The project is expected to complete in last quarter of 2017.

130. The following key factors in Construction Contract Packaging are considered in making the recommendation on Contract Packaging:

- Logical sections for construction, worksite access and earthwork balance
- Administrative jurisdiction and administrative efficiency
- Size of contract to attract medium and large size contractors with the required equipment and capability
- Time to completion
- Environmental requirements and constraints to specific segments

23. Project Benefits

131. The implementation of various project items is envisaged to have the following direct benefits:

- improved quality of life for the rural population in the project influence: this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;

- a more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- the facilitation of tourism;
- Reduced distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur;
- Interstate connectivity to Imphal and Tamenglong Districts;
- Shortest connectivity for the State to East West Corridor of National Highways Authority of India, and
- Connectivity to the Asian Highway network.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

132. In order to assess the impacts of the proposed improvement to the project road, field visits were made undertaken by the Consultants to understand environmental profile of the project influence area. This involved field inspections at all the sensitive locations, collection of secondary information for all the environmental components and discussions with the officials, NGO's and local populace. The profile presented below comprises of the following:

- Physical environmental components such as meteorology, geology, topography, soil characteristics, air quality, surface and sub-surface water quality;
- Biological environmental components such as aquatic, biotic and marine flora, fauna and mammals, and
- Land environment in terms of land use, soil composition.

B. Physical Environment

133. Information of various physical parameters was collected from the Guwahati Centre of Indian Meteorological Department, Statistical Department, Gazetteer of Manipur, Forest Department, Department of Environment and other concern Government Departments and discussions with the officials from these agencies.

1. Meteorological Conditions

134. The state has a subtropical monsoon to temperate climate depending on elevation. Rainfall is relatively abundant and widespread. The rainy season starts in June with the onset of the south-west monsoon and last upto September. Intermittent rains continue even upto October along with the retreat of the monsoon. During the rainy season the rainwater in the hills quickly flow down to the valley and all the rivers and small streams rises to the full brim, frequently flooding its embankments. The cold season last from the month of December to February. During the winter months light rainfall occurs under the influence of the north-east monsoon, March and October are by far the most pleasant months in the year. April and May are not hot season followed by occasional thunder storms.

135. The annual rainfall of Manipur is 1435 mm as against the normal rainfall of 2000mm. The state has a salubrious climate. The summer months are never oppressive with the average maximum temperature fluctuating from 32°C to 35°C during April-June, the mercury seldom going beyond 37°C. In December-February with the start of the cold winter months the average minimum temperature fall to 6°C to 4°C.

136. The salient climatic features of the state are as follows:

- Average Annual Rainfall - 1435 mm
- Concentration of precipitation - June to October
- Humidity - 79 to 96%
- Cloudiness - Heavily clouded
- Wind - Generally light except rainy season
- Temperature - Summer 32°C to 35°C
  Winter 6°C to 4°C

137. Based on temperature, rainfall attributes and wind directions, three main seasons are clearly be recognised, these are: (i) winter extending from November to February, (ii) summer from March to May, and (iii) rainy season from May to October.

138. The climatic conditions of the project area (district wise) is summarised in subsequent paragraphs.

139. **Imphal District**: The climate is warm and temperate in Imphal. In winter there is much less rainfall than in summer. The Köppen-Geiger climate classification is Cwa. The average annual temperature in Imphal is 21.1°C. The average annual rainfall is 1589 mm. The driest month is December with 3 mm rainfall. Most precipitation falls in June, with an average of 359 mm. The warmest month of the year is June with an average temperature of 24.6 °C. In January, the average temperature is 14.5°C. It is the lowest average temperature of the whole year in Imphal. The difference in precipitation between the driest month and the wettest month is 356 mm. The average temperatures vary during the year by 10.1°C.

140. **Senapati District**: Senapati district, the climate is warm and temperate. In winter, there is much less rainfall in Senapati than in summer. According to Köppen and Geiger, this climate is classified as Cwa. The temperature here averages 19.5 °C. The rainfall here averages 1655 mm. The driest month is December. There is 7 mm of precipitation in December. With an average of 353 mm, the most precipitation falls in June. With an average of 23.4 °C, August is the warmest month. January has the lowest average temperature of the year. It is 12.8 °C.

141. **Tamenglong District**: The climate is warm and temperate in Tamenglong. In winter there is much less rainfall in Tamenglong than in summer. The Köppen-Geiger climate classification is Cwa. The average annual temperature in Tamenglong is 18.5°C. The average annual rainfall is 3336 mm. The driest month is December with 8 mm. Most precipitation falls in July, with an average of 728 mm. The warmest month of the year is August with an average temperature of 22.2 °C. In January, the average temperature is 12.2°C. It is the lowest average temperature of the whole year. The difference in precipitation between the driest month and the wettest month is 720 mm. The average temperatures vary during the year by 10°C.

2. Rainfall

Figure 15: Average Monthly Rainfall in Manipur

142. The climate of State is sub-tropical monsoon type. The rainy season of the area is quite long starting sometimes in the early part of May and continues up to the middle of October. The annual rainfall varies from 895 mm to 2135 mm in the valley and up to 3148 mm in the hilly area.

143. The average rainfall in the state is around 1435 mm (Figure 16). Monsoon confers upon Manipur a very good rain as seen below.

- South-West monsoon (June-Sept.) - 825 mm
- Post monsoon period (Oct. to Dec.) - 151 mm
- Winter monsoon (Jan. to Feb.) - 52 mm
- Pre monsoon (March – May) - 407 mm
- **Total - 1435 mm**

144. Table 28 and Figure 15 present the month-wise normal rainfall data in Manipur.

Table 28: Monthly Normal Rainfall in Manipur as a whole and Project Districts

Month	Monthly Rainfall (mm)			
	Manipur	**Imphal**	**Senapati**	**Tamenglong**
January	6.9	20.0	22.0	34.0
February	0.3	30.0	28.0	46.0
March	128.1	79.0	77.0	168.0
April	229.5	86.0	98.0	223.0
May	193.7	163.0	172.0	324.0
June	238.4	359.0	353.0	688.0
July	296.1	268.0	304.0	728.0
August	103.6	251.0	254.0	535.0
September	262.3	149.0	167.0	323.0
October	195.0	159.0	146.0	217.0
November	12.6	22.0	27.0	42.0
December	59.2	3.0	7.0	8.0
Annual	**1725.7**	1589.0	1655.0	3336.0

Source: i) Economic Survey Manipur 2010-11, ii) www.en.climate-data.org

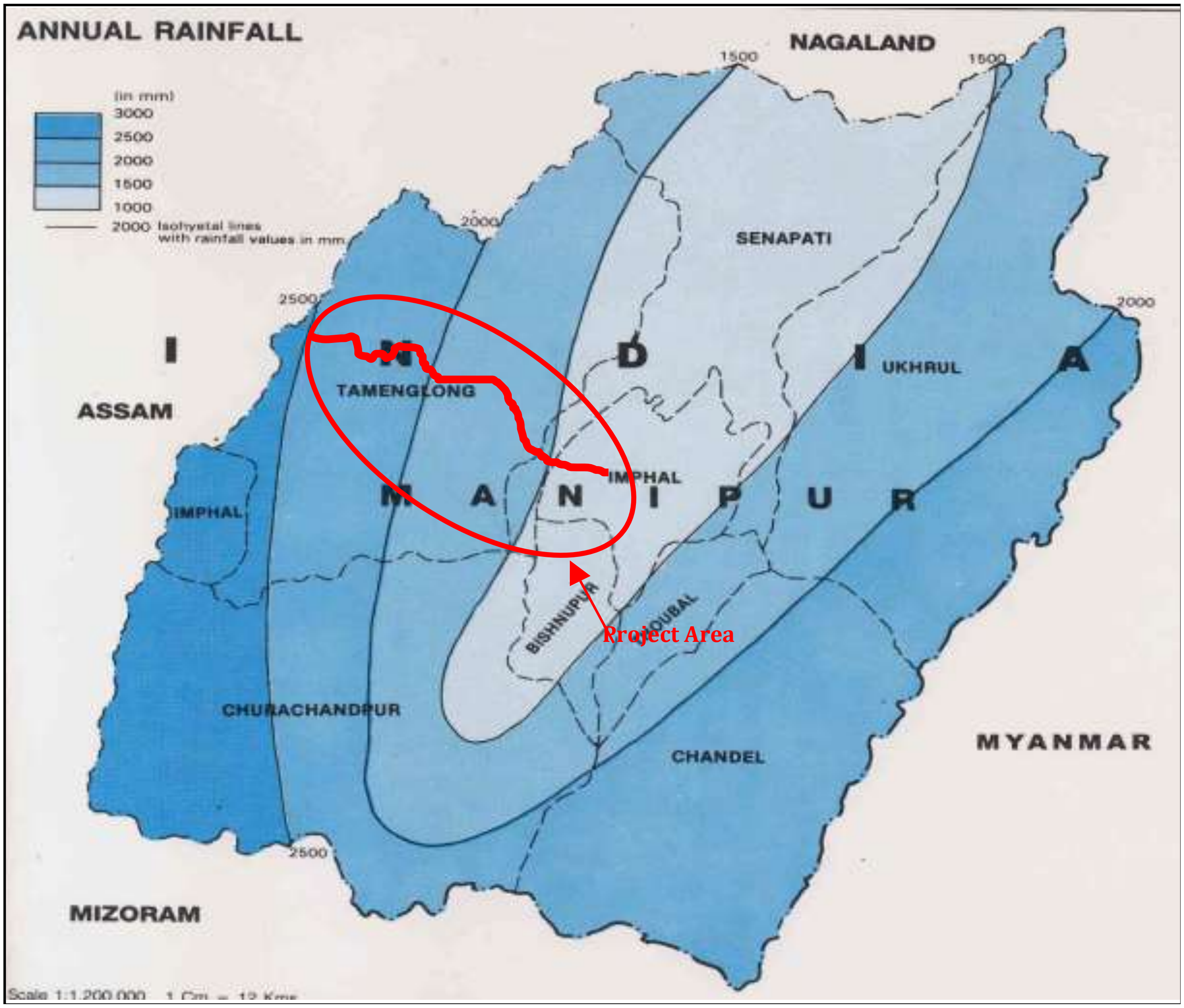


Figure 16: Average Annual Rainfall Map of Project Area

3. Temperature

145. The mean annual temperature of the state ranges from 15.4°C to 25.3°C. The mean monthly temperature rises abruptly with the onset of southwest monsoon in May (23.10C) from April (20.8°C), and it continues high upto October (24°C), until the southwest monsoons have started to retreats. December (17.1°C) and January (15.4°C) are the coldest months. August temperature (25°C) is the hottest in a year.

146. The average minimum temperature of the coldest month of January is 4.3°C; and the average maximum temperature is 26.4°C with the mean temperature 15.4°C. The minimum temperature of the hottest month August is 19.8°C and the maximum temperature is 30.7°C with the mean temperature of 25.3°C. The annual average mean maximum temperature of the state is 36.6°C and minimum mean temperature is 4.2°C with mean temperature of 20.4°C.

4. Relative Humidity

147. The relative humidity curve of the state has little downwards from January (74 %) to March (71 %). It rises abruptly with the increasing atmospheric moisture from April (77 %) to October (84 %) during the monsoon season and it becomes a downward from November (78 %) to December (77 %) with the onset of dry winter season, due to increasing atmospheric moisture. The drier months, November to march have great range between the morning and evening relative humidity than that of the wet months (April- October).

148. Table 29 shows the district-wise monthly mean temperature and monthly mean daily relative humidity in Manipur and project districts.

Table 29: District-wise Monthly Mean Temperature and Relative Humidity

Month	District / Mean Monthly Temperature (^{0}C) and Relative Humidity (%)											
	Manipur			Imphal			Senapati			Tamenglong		
	Max	Min	RH	Max	Min	RH	Max	Min	RH	Max	Min	RH
January	25.1	9.9	-	21.3	7.8	-	19.8	5.9	-	18.6	5.9	24
February	27.6	11.6	-	23.2	9.5	-	21.3	7.8	-	20.0	7.7	29
March	31.3	14.9	-	27.1	12.9	-	25.1	11.3	-	23.8	11.2	29
April	33.2	19.1	-	29.1	16.4	-	27.1	14.8	-	25.8	14.4	90
May	33.9	22.2	-	29.3	19.0	-	27.3	17.4	-	25.9	16.5	30
June	31.8	24.1	-	28.3	20.9	-	27.0	19.6	-	25.5	18.4	32
July	30.8	24.3	-	27.9	21.2	-	26.7	20.0	-	25.4	18.9	-
August	31.0	24.3	-	28.0	21.2	-	26.8	20.0	-	25.5	18.9	-
September	31.4	23.6	-	27.8	20.5	-	26.5	19.2	-	25.1	18.1	-
October	31.6	21.8	-	27.2	18.4	-	25.7	16.7	-	24.2	15.7	-
November	28.4	16.7	-	24.4	13.6	-	22.9	11.6	-	21.6	10.9	-
December	25.6	11.4	-	21.9	9.3	-	20.4	7.4	-	10.2	7.1	-

Source: i) Economic Survey Manipur 2010-11, ii) www.en.climate-data.org

5. Wind Speed

149. The average annual wind speed in project area is 5.55 km/hrs. The mean monthly wind speed varies from as low as 5.55 km/hrs from July to September to high of 7.4 km/day in the month of April. Table 30 and Figure 17 present the monthly mean wind speed in Manipur.

Table 30: Monthly Mean Wind Speed in Manipur as a whole

Month	Wind Speed (km/hrs)
January	5.55
February	7.41
March	7.41
April	7.41
May	7.41
June	7.41
July	7.41
August	7.41
September	5.55
October	5.55
November	7.41
December	5.55

Source: www.windfinder.com

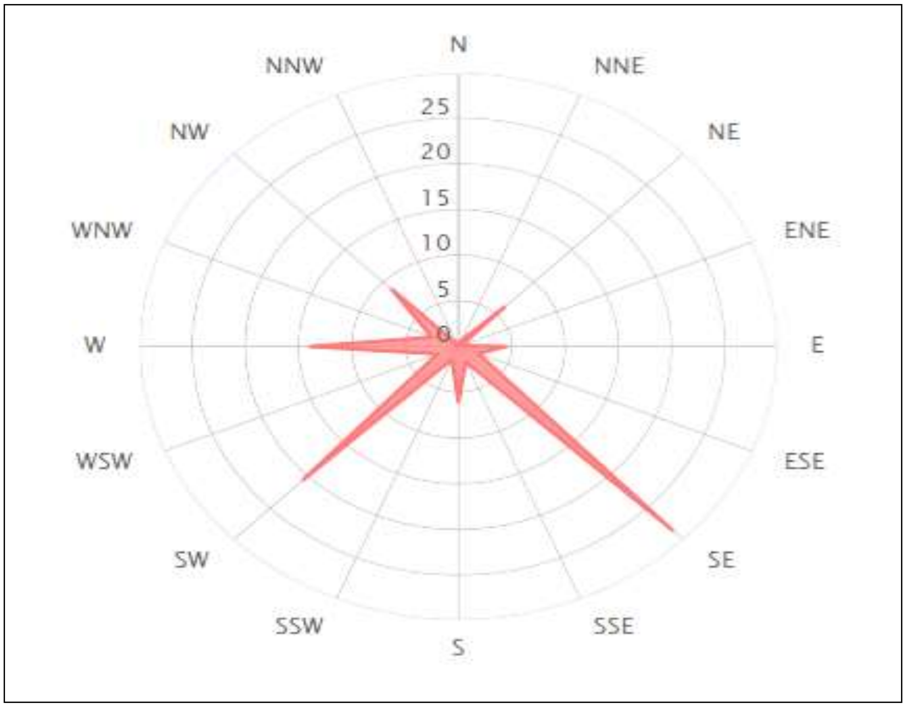


Figure 17: Annual Wind Direction and Distribution (%) in Manipur

6. Topography, Land Use, Geology and Soils

a. Physiography

150. Manipur, one of the eight sisters of the north eastern region in India, is an isolated hill-grit state located between $90^0$03'E and $94^0$42'E longitude and $23^0$50' and $25^0$42'N latitude. The state is encircled by nine hill ranges on all sides with a small oval valley at the centre. The state has 352 km long international border with Myanmar to the south-east and 502 km border with the adjacent states of Nagaland on the north, Cachar district of Assam in the on the west and Mizoram on the south and the south west. The altitude of the state above the mean seal level varies from 790 meters to 2020 meters.

151. The state has a total geographical area of about 22327 sq km. which constitutes 0.7 percent of the total land surface of the country. Ninety percent of the total area of state is covered by hills; remaining area is a small valley. About 68 percent of the area is recorded as under forest. The population of the state stood at 2.39 million in 2001 of which 76 percent is rural.

152. The topography of the project area is mixed type. Imphal-Kanchup section (about 13 km) passes through plain terrain and whereas remaining section from Kanchup to Tamenglong passes though hilly terrain. Small section of the project road also passes through forest area on the hillocks. Land use is mainly agricultural followed by residential. Image 1 and Image 2 shows the typical terrain along the project road, whereas Table 31 and Figure 12 shows that topography and land use along the project road marked on the Google-earth image.

Table 31: Details of the Existing Road Section Terrain

Sl. No.	Chainage (KM)		Length (km)	Urban/ Village Name (Boundary only	Terrain	Land Use	Settlement Name (Structures)	Chainage (KM)	
	From	To						From	To
1.	0+000	3+000	3.0	Imphal City	Plain	Urban	Imphal City	0+000	3+000
2.	3+000	10+000	7.0	Lamdeng, Lamsang, Heibong, Lairenkabi,	Plain	Residential / Agricultural	Lamdeng Lamsang Heibong Lairenkabi	3+400 6+100 7+300 9+100	3+900 6+300 8+300 9+400
3.	10+000	13+000	3.0	Phaiyeng, Kangchup	Plain	Residential / Agricultural	Phaiyeng Kangchup	10+200 12+300	11+500 13+000
4.	13+000	17+800	4.8	Kangchup Chiru	Hilly	Mixed Residential / Agricultural	Kangchup Chiru	13+000	13+600
5.	17+800	24+800	7	Kangchup Bangla	Hilly	Forest (Trees & Shrubs)	Kangchup Bangla	20+300	20+800
6	24+800	32+500	7.7	Songlung	Hilly	Forest (Dense Trees & Shrubs with Grass on hill top)	Kangchup-Makang Reserve Forest	24+000	30+000
7	32+500	34+900	2.4	Wapong	Hilly	Forest/ Agriculture	Wapong	33+900	34+400
8	34+900	40+600	5.7	Yairong	Hilly	Forest/ Agriculture	-	-	-
9	40+600	50+500	9.9	Oktan	Hilly	Forest/ Agriculture	-	-	-
10	50+500	52+300	1.8	Bakuwa	Hilly	Forest/ Agriculture	Bakuwa	51+500	51+900
11	52+300	58+400	6.0	Nagaching	Hilly	Forest/ Agriculture	-	-	-
12	58+400	71+000	12.6	Lukhambi	Hilly	Forest/ Agriculture	-	-	-
13	71+000	70+76 +150	5.15	Wairangba Part II	Hilly	Forest/ Agriculture	Wairangba Part II	72+500	72+800
14	76+150	77+000	0.9	Wairangba Part III	Hilly	Forest/ Agriculture	Wairangba Part III	76+300	76+500
15	77+000	80+050	3.05	Khebuching	Hilly	Forest/ Agriculture	-	-	-
16	80+050	80+500	0.45	Private land(Owner -Kh Panamai)	Hilly	Forest/ Agriculture	-	-	-
17	80+500	97+15	17.15	Bhalok Part III	Hilly	Forest/ Agriculture	Bhalok Part III	88+550	89+200
18	97+15	100+350	3.2	Dailong	Hilly	Mixed Residential Forest/ Agriculture	Dailong	100+500	100+650
19	100+350	102+150	1.8	Gadailung (Tamenglong)	Hilly	Mixed Residential & Agriculture	Gadailung	101+100	101+350

Sl. No.	Chainage (KM)		Length (km)	Urban/ Village Name (Boundary only	Terrain	Land Use	Settlement Name (Structures)	Chainage (KM)	
	From	To						From	To
20	102+150	103.000	0.85	New Salam (Tamenglong)	Hilly	Residential & Commercial	Tamenglong Market	102+350	102+500

Image 1: Typical Terrain along the Imphal-Kanchup Section of Project Road

Image 2: Typical Terrain along the Kanchup - Tamenglong Section of Project Road

153. Map showing physical features of the state is presented in Figure 18 and Figure 19 show the altitudinal zone in the project areas. It can be seen from the map that physiographically the project road sections i.e. Imphal to Kanchup are laying in valley area with marshy land surrounded by inner hill basins. The area in between Kanchup to Tamenglong is mostly on the low and high hill slopes along with piedmont.

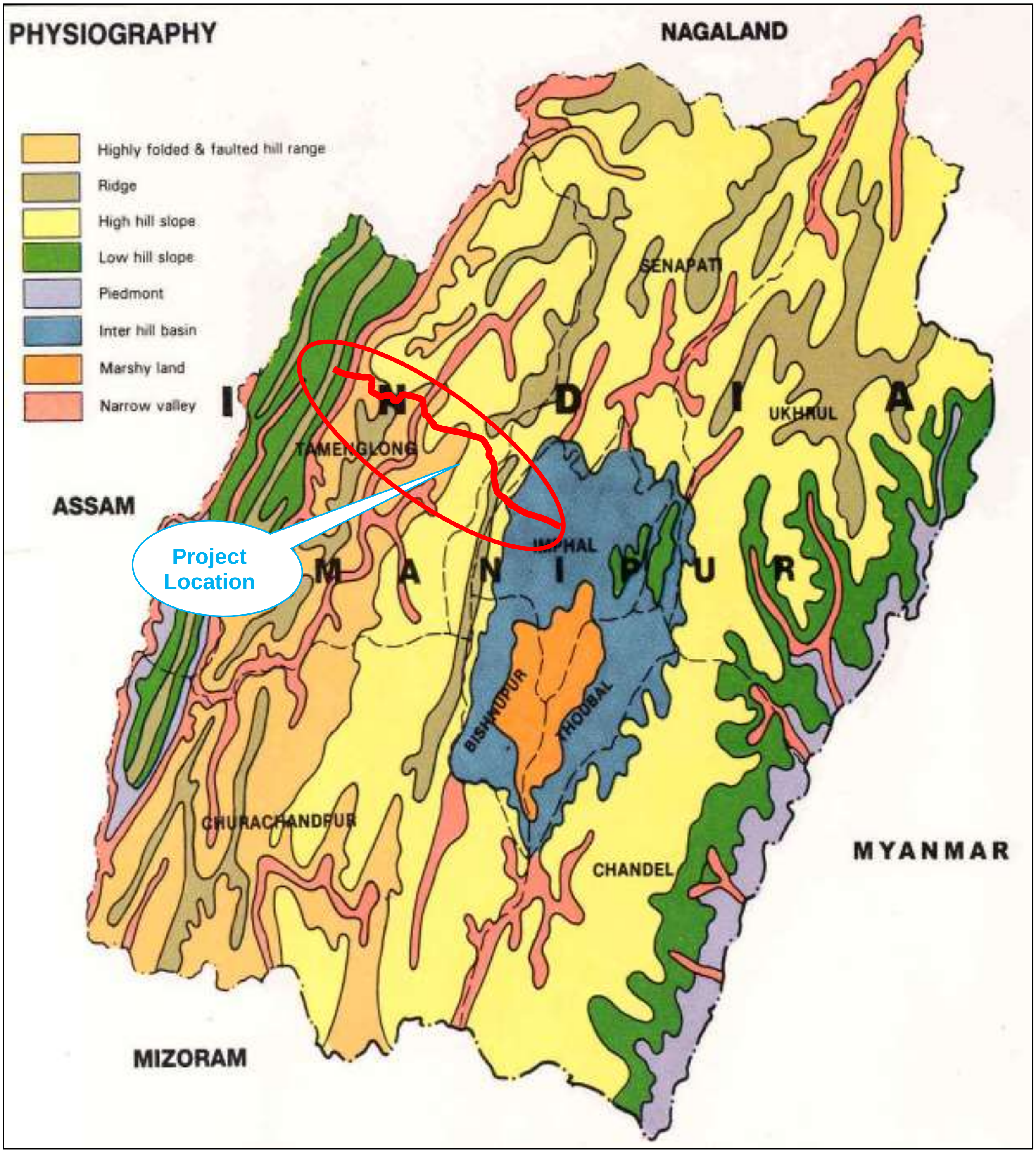


Figure 18: Physiological map showing in the Project Area
(Source: Manipur Science & Technology Council (MASTEC), Imphal)

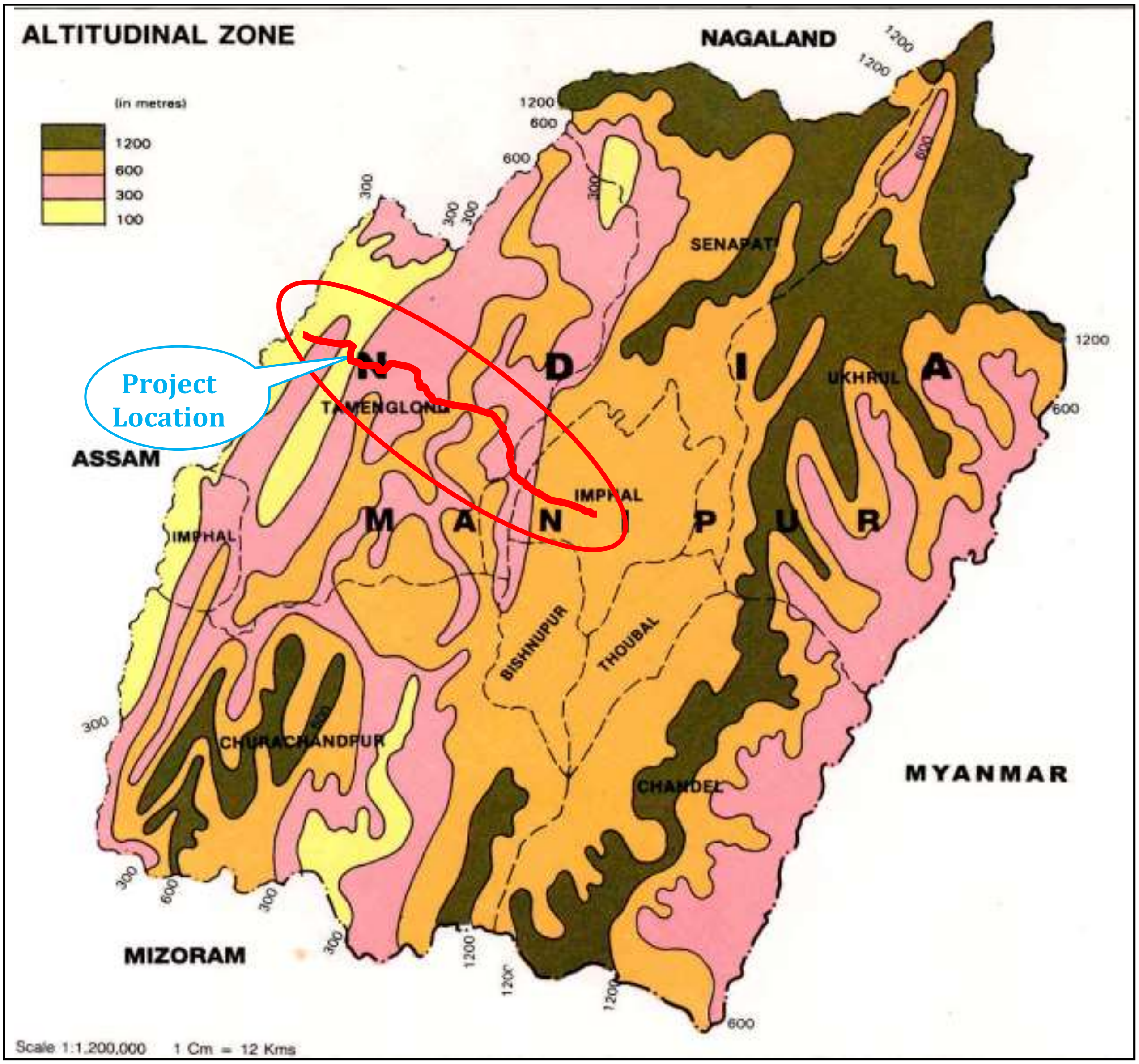


Figure 19: Altitudinal Zone Map of Manipur and Project Area

7. Land Use

154. The existing land use along the project road is mostly agricultural mixed with roadside development in plain terrain and vegetative and forested on hilly terrain. The initial 2.7 km length of Imphal-Kanchup-Tamenglong Road is in urban area and from Km 2+70 to 12+700 (Kanchup) is in rural area. Project alignment beyond Kanchup is predominantly a new alignment along hills. A small section of alignment for approx. 2 km when passing through Imphal town has both residential and commercial settlements on both sides. However, since alignment already is 2 lane with paved shoulder, it would have minimal impact on existing structures on account of geometric and junction improvement. Patches of agricultural activities are also noticed on hills in this section.

155. Data obtained from IRS-P6 LISS-IV 2011 satellite image of the project area shows that about 20% of the project area is covered by thick plantation and 41% by thin plantation followed by degraded forest land (17%), agricultural land (12%), and settlement areas (7%). Water bodies and rivers cover about 3% land area in the project road.

156. Figure 20 and Table 32 show the detailed of the land use distribution along the project road section.

157. Detailed landuse map with the help of IRS-P6 LISS-IV, 2011 Remote Sensing satellite data has been prepared for within 10 km radius on either side of the project road and the breakup of land use is given in Table 32 and shown in Figure 21. This shows that vegetation cover, forest land, and agrable land are the major land use followed by habitation and water bodies.

158. False Colour Composite (FCC) scenes generated from IRS-P6 LISS-IV 2011 for 10 km radius of proposed alignment is shown in Figure 22.

Table 32: Land Use Pattern along the Project Road

Land Use Type	%
Thick Vegetation	20
Thin Vegetation	41
Degraded Forest/ Scrub	17
Agrable Land	12
Human Settlements	7
River/ Water bodies	3
Total	**100**

Source: Data obtained with the help of IRS-P6 LISS-IV, 2011 remote sensing setellite

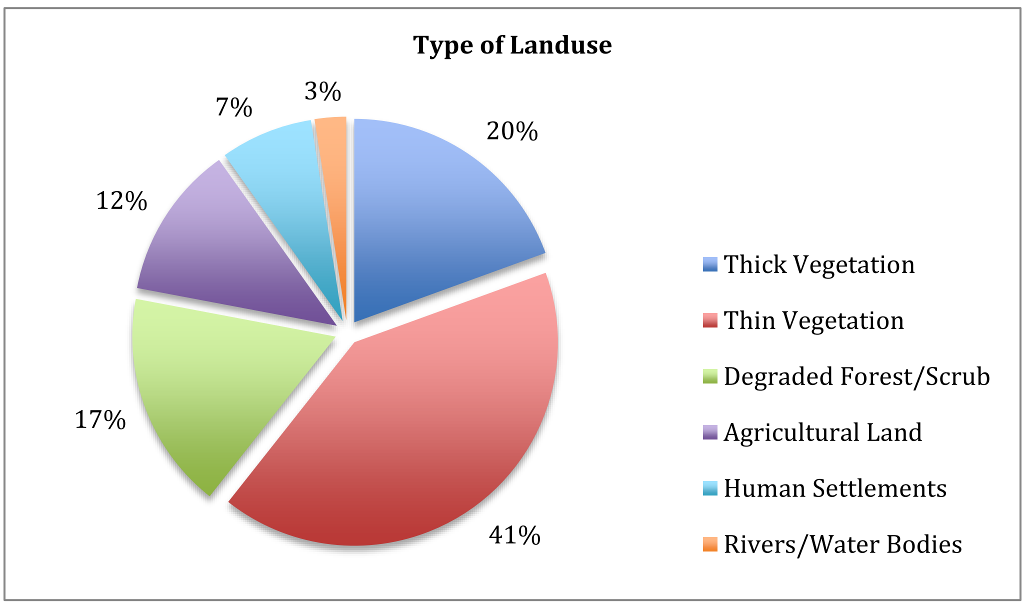


Figure 20: Land Use Distribution along the Project Road

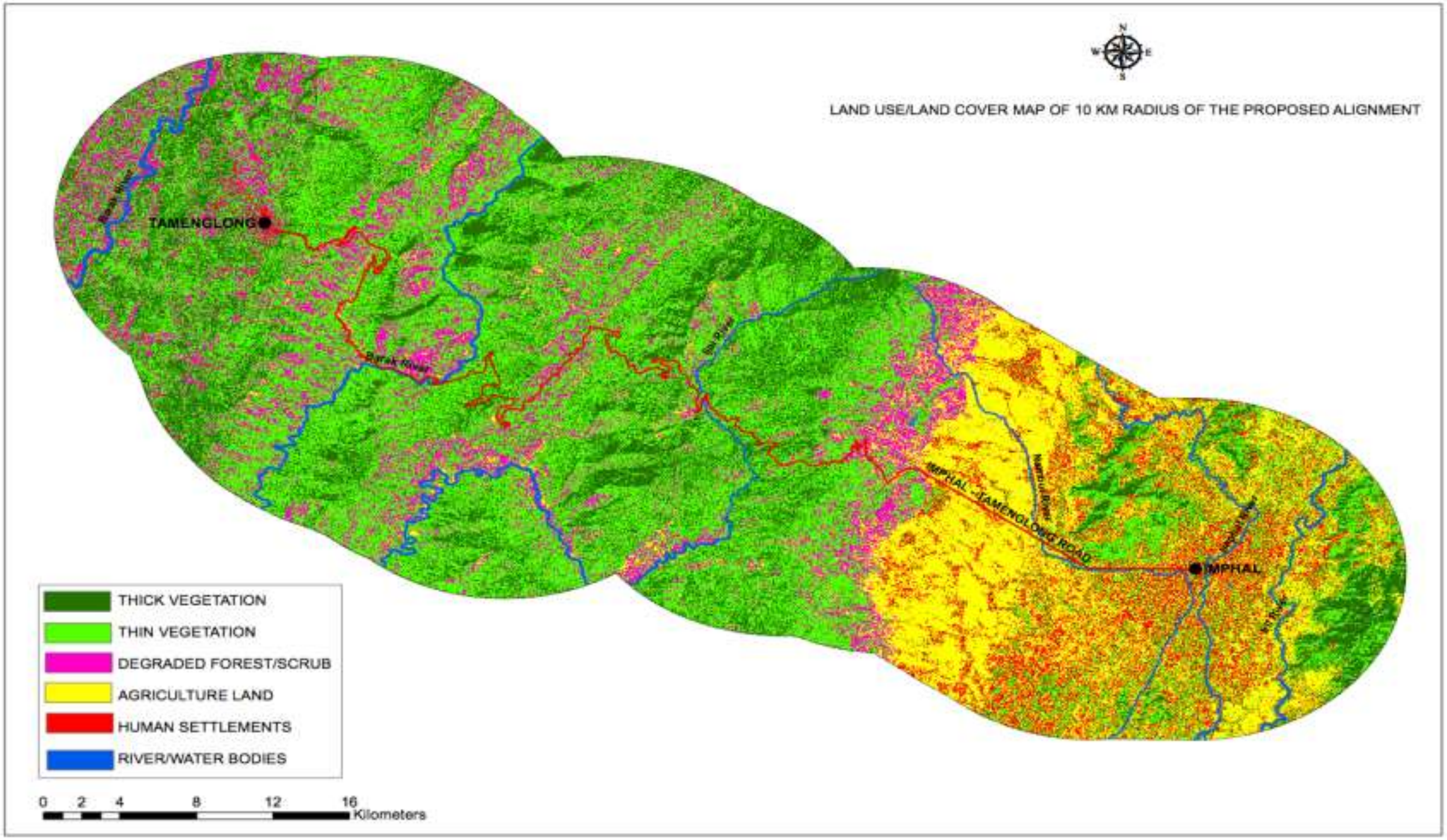


Figure 21: Land use Cover of the Project Area

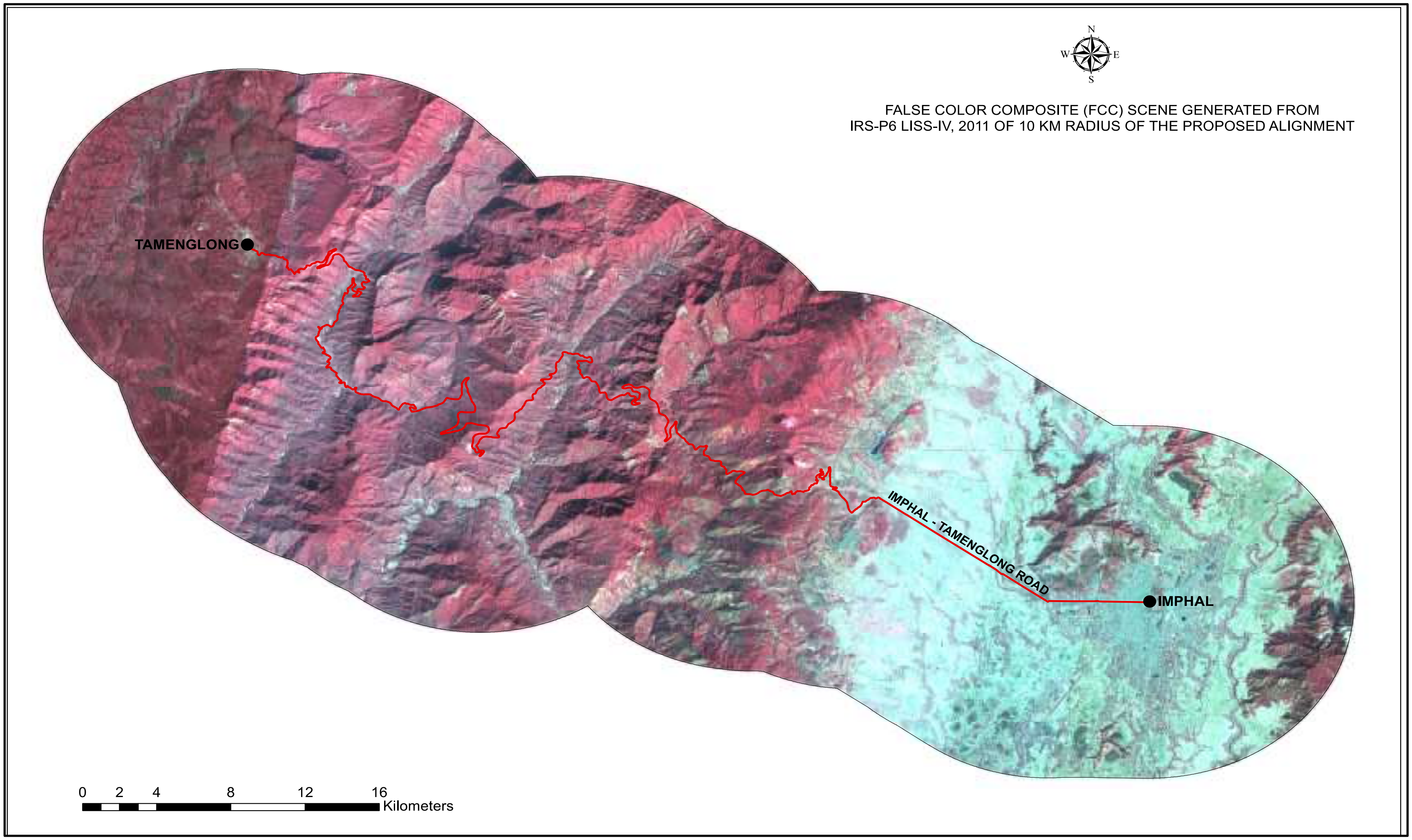


Figure 22: False Colour Composite (FCC) Scene Generated from Satellite Image for Project Area

8. Geology

159. Geologically, Manipur state belongs to the young folded mountains of the Himalayan system. The rocks in the state vary from upper cretaceous to the present Alluvium. The oldest rocks found in Manipur are mainly confined in the eastern part of the State close to Indo-Myanmar border and the rocks are grouped as cretaceous rocks consisting chromite, serpentine etc. availability of Asbestos, Chromite, Copper ore, Coal, Big iron, Lignite, Lime stone, Nickel ore and petroleum is reported in some parts of the state.

160. The limestone deposits found in the Ukhrul district belong to the upper cretaceous period. The sandstone, shale of the Disang group found over the eastern half of the Manipur belong to the Eocene period. The rocks consisting of sandstone, shale, clay, etc. of the Brail Group are confined over the rocks of Disang group and extending along the mid-western portion of the state and they belong to the upper Eocene and Oligocene periods. The shales and sandstone of the Tipam and Surma groups cover the western banks of Manipur and they belong to the Miocene period. Rocks of alluvial deposits found in the Manipur valley portion are of recent origin and further they can be grouped as older and younger alluvium. The state is mainly composed of tertiary rocks. In the Ukhrul area there are igneous rocks which contain quartz, sandstone, limestone, etc. Figure 23 present the map showing geology and stratigraphy of the Project area.

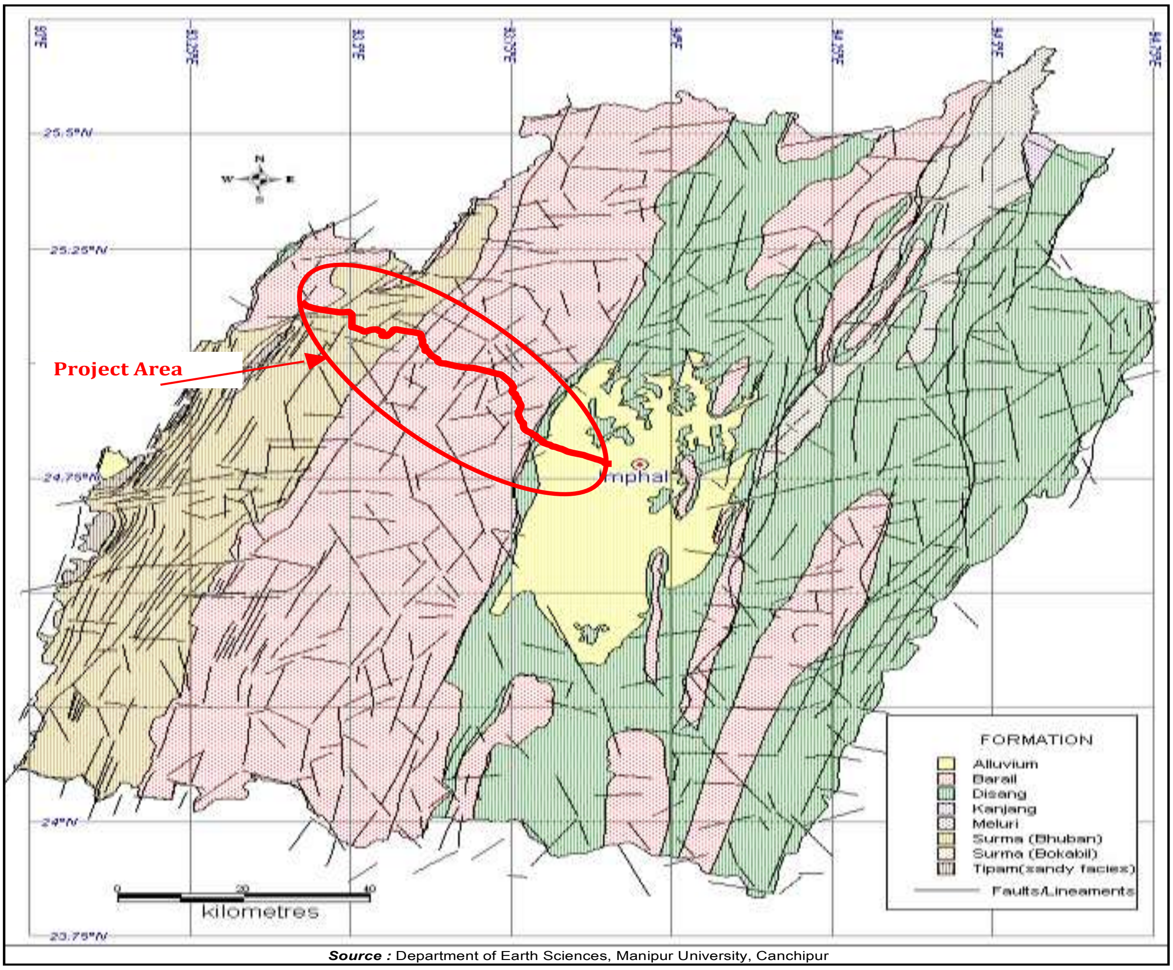


Figure 23: Geology and Stratigraphy of the Project area (Source: SOE Report, Government of Manipur)

9. Seismicity

161. The proposed project road falls under the Seismic Zone V, which is susceptible to major earthquakes as per the seismic zone map of India (IS 1893 - Part I: 2002), shown below in Figure 24.

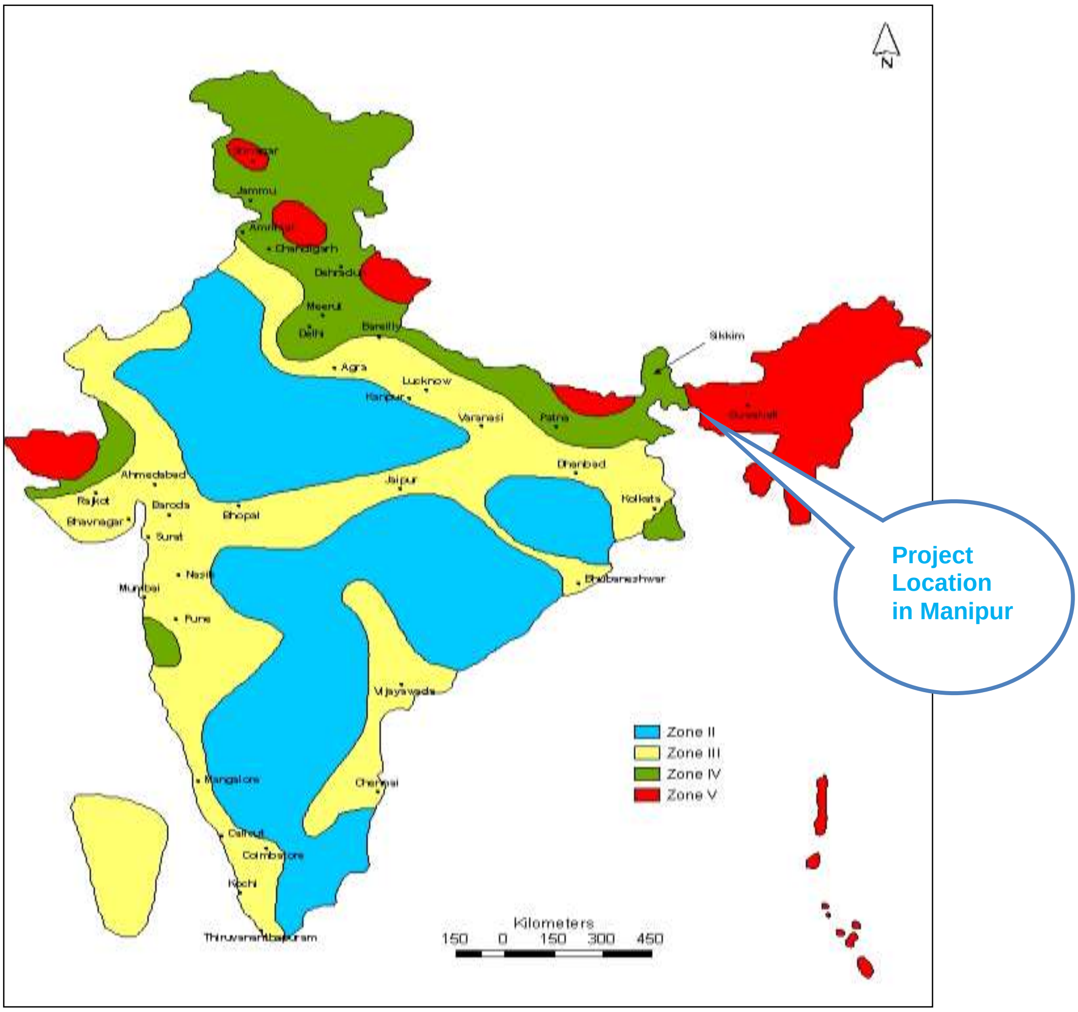


Figure 24: Seismic Zoning Map of India showing Project Location (Source: Envis, Government of Manipur)

162. Earthquakes of low to moderate intensity are recorded here regularly. The state of Manipur, has weathered dozens of large earthquakes the biggest in recent times being the 1988 M7.2 earthquake. Most earthquakes in western Manipur are shallow. But some, especially those recorded in the eastern parts and along and across the Myanmar border have greater depths. Areas in central Manipur are especially vulnerable to damage during earthquakes as they lie in the Imphal Valley, the lowest point of which lies the Loktak Lake. Much of the valley floor provides for strong shaking from even far off quakes as its soft soil amplifies the wave motions.

163. Tectonically, the project area lies on the tertiary sediments on the western side. Figure 25 show the seismotectonic map of Manipur and Project location.

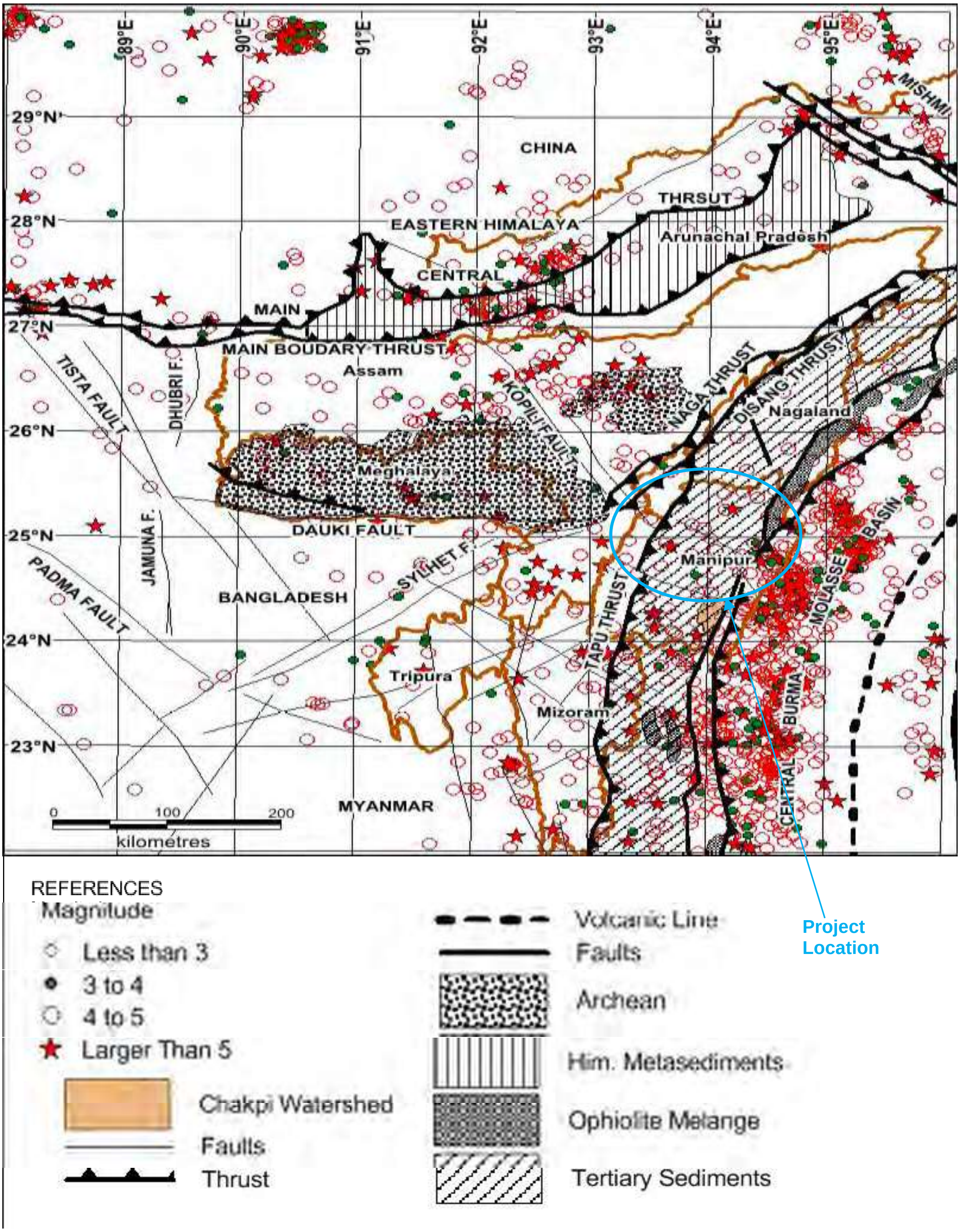


Figure 25: Seismotectonic Map of Manipur showing Project Location (Source: Manipur State Disaster Management Plan, Volume 1, Government of Manipur)

10. Soils

164. The soil in the project area is mostly clay to sandy loam. Near Myanmar border the soil is sandy loam. The soil of the state is of two major types – residual and transported, which cover both the hill and plain of the State. The residual soils are either laterized or non-laterized. The laterized red soils covering an area of 2,500 sq. km. in the Barak drainage on the Western slope of Manipur. It contains rich portion of nitrogen and phosphate, a medium acidity and lesser amount of Potash. The old alluvial is brought down by river Barak basin and Jiri river and their tributaries from their lateritic water ship hills. The compact and less permeable soils contain higher quantity of potash, fair amount of nitrogen and phosphorus with medium acidity.

165. The transported soils are of two types – alluvial and organic. The alluvial soils cover 1600 sq. km. in the valley. These soils have general clayey warm texture and grey to pale brown colour. They contain a good proportion of potash and phosphate, a fair quantity of nitrogen and organic matter and are less acidic. The organic soils cover the low lying areas of the valley. With dark grey colour and clayey loam texture, these peaty soils have high acidity, abundance of organic matter, a good amount of nitrogen and phosphorus but are poor in potash. The hill soils are more or less rich in organic carbon (1 to 3%) in the top soil, but poor in available phosphorus and potash. They are acidic in nature.

166. The soil of Manipur belongs to 4 orders, 8 suborders, 13 greatgroups and 23 subgroups. It is observed that the Inceptisols are the dominant soils followed by Ultisols, Entisols and Alfisols and occupy 38.4%, 36.4%, 23.1% of the total geographical area of the State, respectively. Lakes and marshy lands occupy 1.9 percent. Hill soils being acidic are not suitable for much plant growth and traditional shifting cultivation together with indiscriminate cutting and burning of forest (jhum) over the years have seriously affected the ecological balance leaving the soil barren. In the valley region the deep soils are poorly drained and low in available phosphorus content. They are also susceptible to flood hazards.

167. The characteristics of soil of the project area (Imphal-Kunchuo-Tamenglong Road corridor) vary from place to place due to topographical variations. The soil in general is loamy sand to silty clay loam with a depth of 30 cm to 100 cm and in some cases even more than 120 cm. It has less water holding capacity and is dry in nature. Chemically acidic soil abound resulting from the washing down of the salts in rainwater and also on account of leaching effect. The pH value varies from 7.3 to 7.92. The soils are characterized by low to high organic matter (2.5-4 percent, in some places even more than 5 percent) with low action exchange capacity and high lime requirement. Notwithstanding the relatively high organic matter content, the nitrogen content in the soil is low.

168. Some of the plant nutrient like phosphate gets fixed in soils due to the high acidity and thus does not become available to the growing plants even on application. As such there is remarkable deficiency of micronutrients viz. zinc, boron, copper, calcium, magnesium, manganese etc. in the soils. Figure 26 shows the soil map of the project area. Chemical tests were carried out on soil at selected locations along the project road and the test results are given Table 33.

Table 33: Soil Quality along Imphal-Tamenglong Project Road Section

Location / Chainage	Ph	Sulphates as SO_4(mg/g)	Chlorides (mg/g)	Organic Matter (%)	Total Soluble Solids (mg/g)
Tamenglong	6.15	4.41	2.0	9.51	35.14
Iroisemba	6.83	5.39	-	5.77	24.33
Kangchup	7.52	5.07	-	2.79	48.63

Source: Soil Testing carried out by EIA Team, May 2014

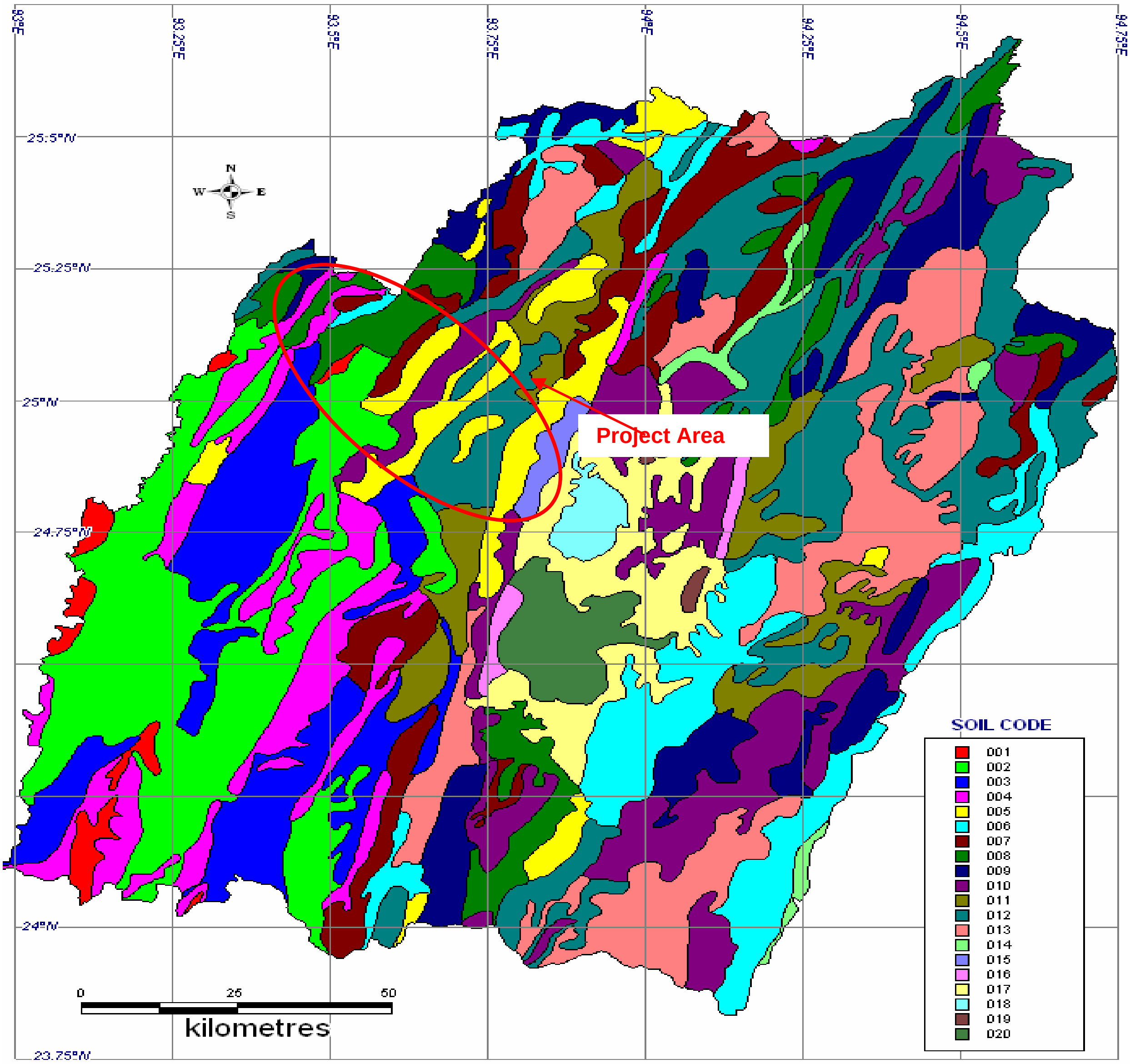


Figure 26: Map showing Soils and Surface Texture Class in the Project Area (Source: SOE Report, Government of Manipur)

11. Water Resources and Hydrology

169. The state has vast water resources in the form of lakes, ponds, rivers and streams, some with marshy areas. It has abundant of water potential both ground as well as surface water. Important rivers that flows through the project region are the Nambul, the Ijei, the Bakua, the Irang, the Dingua, and the Iring. (Image 3). The main rivers flowing in the Tamenglong District which will be transverse proposed alignment are Irang, Iring, Ijei(Aga) river. Till now, the

Image 3: Iring River at km 51+900 on Project Riad in hill section

water of this river are not utilized for irrigation or power production. Table 34 list out the major rivers which cross the project road. Besides these rivers there are several small streams and small ponds exist along the project road.

Table 34: Major Rivers crossing the project road

Sl. No.	River Name	Chainage (Km)	Width of the River Crossings (m)
1.	Luwangli river	3+465	Major
2.	Nambul river bridge	7+700	Minor
3.	Local stream	9+262	Parallel on RHS
4.	Bakhungwa (Iring) river	51+900	Major near Bakuwa village
5.	Local stream	102+205	Minor

170. The ground water aquifers in the region occur in sediments and fractured rocks. Springs are either seasonal or perennial and are often used for irrigation and drinking purposes. There are number of hot springs in the region which are being used by the local communities for domestic and agricultural purposes and also being used by the visiting tourists.

171. The surface water quality in the region is reported to be well within the permissible limits and also found by visual identifications. There are no reports of any water born decease in the region. People are using this water for drinking purpose without any treatment.

172. In case of ground water quality, it is generally good in entire north east region. People use ground water for domestic purposes without any treatment. Overall ground water quality is acceptable.

173. The surface water bodies such as Ijei, Irang and Iring Rivers are close to Project road alignment. The Irang River distance from road varies from 10 to 20 m from the Project road of chainage 65.700 km to chainage 70.000 km. The Ijei River distance from road varies from 10 to 35 m from the Project road of chainage 34.900 km to chainage 36.700 km. In addition to this, many of springs (Jhora) are crossing the Project road.

174. The surface water bodies such as Ijei, Irang and Iring Rivers are close to Project road alignment. The Irang River distance from road varies from 10 to 20 m from the Project road of chainage 71+400 km to chainage 75.400 km. The Ijei River distance from road varies from 10 to 35 m from the Project road of chainage 34.500 km to chainage 35.000 km. In addition to this, many of springs (Jhora) are crossing the Project road. The alignment crosses iring river near to Bakua village at chainage 51+900 km. The major water body crossing are given in below Table 35.

Table 35: Details of water bodies crossed and parallel to proposed alignment

S.No.	Chainage (km)	Name of water body	Remarks
1.	0+000 to 0+750	Imphal River	Parallel to road on LHS
2.	3+200	Luwangli river	Crosses alignment
3.	5+400	Nambul river bridge	Crosses alignment
4.	13+000 to 13+450		Parallel to alignment on LHS
5.	23+500 to 24+000	Bangla Stream	Parallel to alignment on LHS and crosses at 24+000
6.	34+450 to 35+000	Ijei River	Parallel to alignment on LHS and crosses at 34+900
7.	51+200 to 52+000	Iring river	Parallel to alignment on LHS and crosses at 51+900
8.	71+500 to 72+500	Irang River	Parallel to alignment on RHS

S.No.	Chainage (km)	Name of water body	Remarks
			and crosses at 72+400
9.	72+500 to 75+800	Irang River	Parallel to alignment on LHS
10.	76+980	Tributary of Irang River	Crosses alignment
11.	80+500 to 82+500	Digha (Tributary of Irang) stream	Parallel to alignment on RHS
12.	82+500 to 83+000	Digha (Tributary of Irang) stream	Parallel to alignment on LHS

12. Water Quality

175. In order to establish baseline conditions, surface and groundwater samples were collected. The sampling locations were selected after the field reconnaissance and a review of all the water bodies/ resources in the project influence area. Samples were collected as per IS- 2488 (Part I-V).

176. In order to represent the true profile of the project area, samples of ground and surface water of the area through which the project road runs were collected and analysed. Ground water (drinking water) samples were analyses as per IS: 10500-1991. Grab sample were collected from water source and were analysed for various parameters as per the procedures laid down in the APHA and BIS. Atomic Absorption Spectrophotometer and UV/VIS Spectrophotometer were used for analysis of water samples according to the necessity.

Image 4: Ground Water sample collection at Kunchup Bazar

177. The results of the analysed of these samples are presented in Table 36. The results were compared with standards for drinking water quality (Annex 2).

178. It can be seen from Table 36 that the pH of the sampled water in the region is well within permissible limits (6.5 – 7.5). In the ground water samples collected from bore well at Kangchup bazar show highest value of the total dissolved solids of 244mg/l which is well within the permissible standards. Total hardness as CaCO3 in the water sample from Irang river is found at 45.6 mg/l which is highest in all samples but very less than the limit (300mg/l) prescribed for drinking water standard limits. BOD level for all analysed water samples is higher than the permissible standards. Other parameters analysed like chloride, sulphate, fluorides are found well within standards. Overall the ground water quality in the project areas in good.

Table 36: Water Quality Characteristics along the Project Road

Sl. No.	Parameter	Unit	Prescribed Limit as per IS:10500 & IS:2296	Monitored Value			
				Tamenglong	Irang River	Nambol River	Kangchup Bazar
1.	pH	-	6.5 – 7.5	6.21	7.01	7.03	7.02
2.	Total Dissolved Solids (TDS)	mg/l	500 max	144.0	248.0	180.0	244.0
3.	Chloride as	mg/l	250 max	7.99	2.99	4.99	13.99

Sl. No.	Parameter	Unit	Prescribed Limit as per IS:10500 & IS:2296	Monitored Value			
				Tamenglong	Irang River	Nambol River	Kangchup Bazar
	Cl-						
4.	Sulphate as SO_4	mg/l	200 max	5.16	18.31	4.0	4.5
5.	Total hardness as $CaCO_3$	mg/l	300 max	24.7	45.6	39.9	26.6
6.	COD	mg/l	200 max	19.6	39.2	29.4	19.6
7.	BOD 5 day	mg/l	2 max	< 5.0	5.51	5.14	< 5.0
8.	Fluoride as F	mg/l	1 max	<1.0	<1.0	<1.0	<1.0

Source: Water Quality Monitoring carried out by EIA Team, 2014

13. Air Quality

179. Ambient air quality in the state is quite pure compared to other neighbouring states. Except for few urban centres like Imphal, Thoubal and Moreh, the ambient air quality is good. There are no major industrial activities in the State. Dust arising from unpaved surfaces, forest fire, smoke charcoal production and domestic heating, and vehicular pollution are sources of pollution in the region. Firewood burning is the major contributor in the ambient pollution load. Industrial and vehicular pollution is mainly concentrated in the major commercial areas in State capital.

180. Vehicular pollution is a secondary source of pollution in the state as the traffic density is low. Pollution from vehicles is mainly due to use of low-grade fuel, and poor maintenance of vehicles. The level of pollution in rural areas is much lower than that of the urban areas due to lower volume of traffic. The traffic density in the state is very low. There is sudden increase in the number of vehicles in the town area during the last one decade producing a lot of smoke. The use of a large number of second-hand diesel jeeps as transport is another cause of air pollution.

181. Secondary information is not available on ambient air quality of the project road area. The major transport on the project section is the traffic flowing on project road connecting Tamenglong with Imphal and to rest of the country as well as traffic flow towards Moreh from Imphal and from Assam. This might also add to the air pollution load on the project section.

182. The base-line status of the ambient air-quality was assessed using a scientifically designed ambient air-quality monitoring network. The design of this network was based on the following:

Image 5: Air Quality Monitoring Station Setup at Eroisemba Police Post (AQ1)

- meteorological conditions;
- the assumed regional influences on background air quality;
- the areas where impact would most likely be greatest;
- present land use along the proposed alignment; and
- traffic congestion points.

183. To establish the baseline ambient air quality, Ambient Air Quality Monitoring (AAQM) stations were set up at three locations as indicated in Table 37.

Table 37: Details of Ambient Air Quality Monitoring Locations

Sl. No.	Location Code	Name of the Location	Source
1.	AQ1	Imphal: Eroisemba Police Post	Urban/Sensitive
2.	AQ2	Tamenlong Hill Area	Commercial
3.	AQ3	Rural area : Kangchup Bazar Area	Commercial

184. At each of the five locations monitoring was undertaken as per new notification issued by MoEF on 16th November 2009, in the month of May 2014. Data for the following parameters was collected.

- Suspended Particulate Matter (SPM)
- PM 10
- PM 2.5
- Sulphur Dioxide (SO_2)
- Oxides of Nitrogen (NOx)
- Carbon monoxide (CO)
- Hydrocarbons (HC); and
- Lead (Pb)

185. The sampling of SPM, PM10, PM2.5, SO2, NOx & Pb was undertaken on a 24-hourly basis while 8- hourly samples were collected for CO and HC. SPM, RPM, SO2, NOx, & Pb were monitored using M/s Envirotech Instruments Private Ltd; make Respirable Dust Sampler (APM 460) (Figure 4.12) along with gaseous attachment (Model APM 415 & 411). Whatman GF/A filter papers were used for SPM, whereas, Whatman EPM 2000 filter papers were used for monitoring Pb. Carbon monoxide (CO) & Hydrocarbon samples were monitored by using M/s Endee Engineers Pvt. Ltd. make gas detector model No. CO96 & GP - 200P respectively.

186. Methodology adopted for sampling and analysis and instrument used for analysis in laboratory are presented in Table 38.

Table 38: Techniques Used for Ambient Air Quality Monitoring

Sl. No.	Parameter	Technique	Instrument Used	Minimum Detectable Limit (µg/m^3)
1.	Suspended Particulate Matter	Respirable Dust Sampler (Gravimetric method)	Electrical Balance	1.0
2.	PM 10 and PM2.5	Respirable Dust Sampler (Gravimetric method)	Electrical Balance	1.0
3.	Sulphur Dioxide	Improved West & Gaeke Method	Colorimeter	5.0
4.	Nitrogen Oxide	Jacob & Hochheiser modified (Na-Arsenite) Method	Colorimeter	5.0
5.	Carbon Monoxide	Gas Chromatograph		0.01
6.	Hydrocarbons	Gas Chromatograph		0.01
7.	Lead	AAS Method after sampling using EPM 2000 filter paper	Atomic Absorption Spectrophotometer	0.01

187. A summary of results for each location is presented in Table 39. Figure 27 shows the graphically presentation of the existing air quality along the project road at five monitored

locations. These results are compared with the new National Ambient Air Quality Standards prescribed by the MoEF (Annex 3) for respective zones.

Table 39: Summary of AAQM Results (Average Values)

Location	Parameter and Values (μg/m^3)							
	SPM	**PM10**	**PM2.5**	**NOx**	**SO_2**	**Pb**	**CO**	**HC**
GOI Standard for Sensitive	100	100	60	80	80	1.0	4000	1000
GOI Standard for Residential	200	100	60	80	80	1.0	4000	2000
AQ1	207.01	66.48	31.66	30.13	6.85	BDL	0.695	BDL*
AQ2	170.3	54.89	25.22	28.23	5.97	BDL	0.512	BDL
AQ3	196.26	62.06	29.51	29.45	6.43	BDL	0.642	BDL

Note: BDL-Below Detectable Limit

Source: Ambient Air Quality Monitoring carried out by EIA Team, 2014

188. It can be seen from the Table 38 that out of three locations of air monitoring the SPM concentration at AQ1 marginally exceeds permissible limits for residential zone i.e. 200 µg/m3 prescribed by MoEF. While at other locations AQ2 & AQ3 the SPM conc. is well within limits. While PM10 concentration at all the monitored locations less than the new permissible limit i.e. 100 µg/m3 prescribed by MoEF for sensitive areas. Other parameters monitored i.e. PM2.5, NOx. SO2 were found within the permissible limits for all the locations. Overall the air quality in the project area in not an issue. The National Ambient Air Quality Standards (NAAQS) prescribed by MOEF are given in Annex 3.

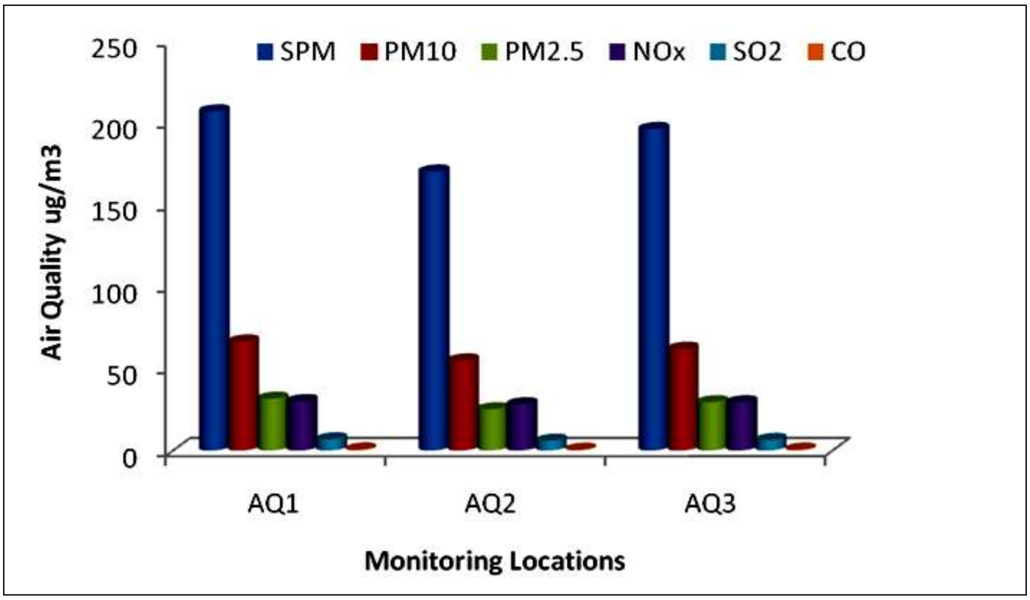


Figure 27: Air Pollutant Concentration in Ambient Air along the Project Area

14. Noise

189. Noise pollution is not a current problem in the region except in commercial location in urban areas where major settlements are along the road, and high traffic flow. However, few commercial locations in Imphal and Tamenglong will experience increase in noise levels but still the ambient noise quality is expected to be higher than the permissible limits.

190. During construction period, temporary increase in the noise levels are expected from the movement of construction machineries and construction activities. Suitable barriers and timely scheduling of construction activities will minimize these impacts.

191. No secondary information was available on noise level in the project area. In order to establish the baseline noise quality in the project area, a reconnaissance survey was therefore undertaken to identify noise generating sources and sensitive receptor such as school, hospitals, temples, built-up areas. Three locations listed in Table 40 were selected for monitoring the noise level.

Table 40: Details of Noise Level Monitoring Locations

Sl. No.	Location Code	Name of the Location	Source
1.	NL1	Imphal: Eroisemba Police Post	Commercial/ Built-up Area
2.	NL2	Near Church at Tamenglong	Sensitive Area
3.	NL3	Rural Area: Market area at Kangchup	Commercial/ Built-up Area

192. **Methodology**: At each of the five locations, Sound Pressure Level (SPL) measurements were taken at an interval of 1 minute using a sound level meter of Lutron make Digital Sound Level Meter. At all these locations, daytime noise levels were monitored during the period 6 am to 9 pm and night-time noise levels during the period 9 pm to 10 pm. Noise readings, with setting at ‘A’ response - slow mode, were recorded. The readings were tabulated and a frequency distribution table prepared from which 24 hourly, hourly, and Average Leq noise levels were calculated.

193. **Presentation of Results**: It can be seen from the table Table 41 that at locations (NL1, 2 & 3) along proposed alignment, the average day time noise level varies from 42.5 dB(A) to 58.2 dB(A), whereas average night time noise level ranges from 28.1 dB(A) to 42.5 dB(A).

194. It is found that the recorded noise level is marginally higher than the permissible limits for residential area prescribed by CPCB and also by World Bank EHS standards of 55 dB(A) and 45 dB(A) for day time and night time respectively. Night time noise level readings were taken upto 10 pm only as after 10 pm no traffic movements were observed. This noise is mainly from vehicular traffic and local domestic/commercial activities.

Table 41: Ambient Noise Level in decibel (A) along the Project Road

Location	Date of Sampling	Noise Level dB (A)						CPCB / World Bank Standard dB(A)
		Day Time			Night Time			
		L_{min}	L_{max}	L_{eq}	L_{min}	L_{max}	L_{eq}	
NL1	21.06.2014 to 22.06.2014	52.6	57.5	55.4	38.2	42.5	39.9	55 for day time and 45 for night time
	28.06.2014 to 29.06.2014	52.4	58.2	55.8	38.6	42.1	40.0	
NL2	22.06.2014 to 23.06.2014	43.2	48.0	45.8	29.2	33.0	31.4	
	29.06.2014 to 30.06.2014	42.5	47.2	45.1	28.1	31.7	30.2	
NL3	24.06.2014 to 25.06.2014	43.7	48.4	46.3	35.8	39.5	37.4	
	01.07.2014 to 02.07.2014	43.2	47.8	45.8	35.0	39.1	36.7	

Source: Noise Monitoring carried out by EIA Team, 2014

C. Biological Environment

1. Forests and Vegetation

195. In spite of its small size, the state's vegetation is rich and varied in character. This is because of its different climatic conditions and peculiar physiography. The forest area of the state falls into four distinct zones viz. i) Burma drainage forests, ii) Urkul pine forests, iii) forests overlooking the valley and iv) Barak drainage forests. In Manipur, the forest area covers about 17219 sq.km land area which is about 78 percent of total geographical area of the state and 2.54 percent of country's forest cover. The areas under reserve forests and protected forests stood at 1467 sq.km and 4171 sq.km respectively. The remaining forest area is unclassed forests. Figure 28 show the distribution of forest area of Manipur.

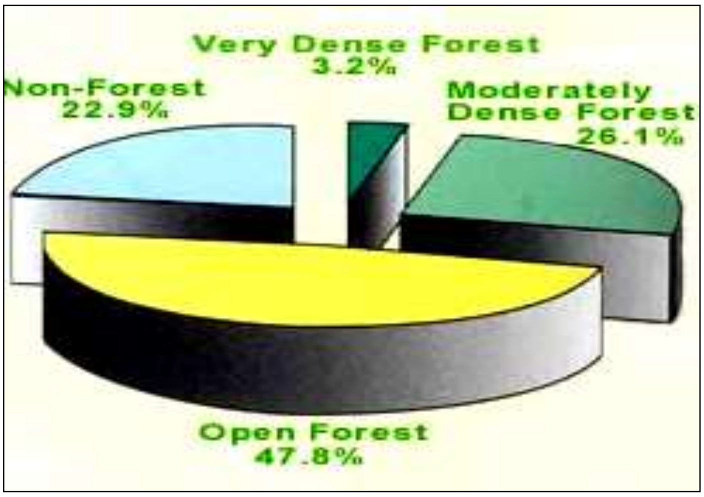


Figure 28: Distribution of Forests in the State

196. According State of Forest report, 2009 by Forest Survey of India the forest cover of Manipur is 17,280 sq.km which is 77.40% of the total geographical area of the State. Out of the total forest area in the State, the area under Reserved Forests including Wildlife Protected Area Network is 1,467 sq. km. (8.4 %) of the total forest area. An area of 4,171 sq. kms. (24 %) of the total forest area is recorded as Protected Forests and the rest 11,780 sq. kms.(67.6%) belong to the category of Unclassed forests. During the year 2010-11 there is no reservation and de-reservation of forest areas within RF. Table 42 and Figure 29 shows area under legal type of forest in the state of Manipur.

Table 42: Area under Forest type in the State of Manipur

S. No.	Forest Type	Area (Sq.km.)	% to Total Forest Area
1	Reserved Forest	1,467	8.4
2	Protected Forest	4,171	24
3	Other Forest	11,780	67.6
4	Total	17,418	100

Source: State of Forest report, 2009

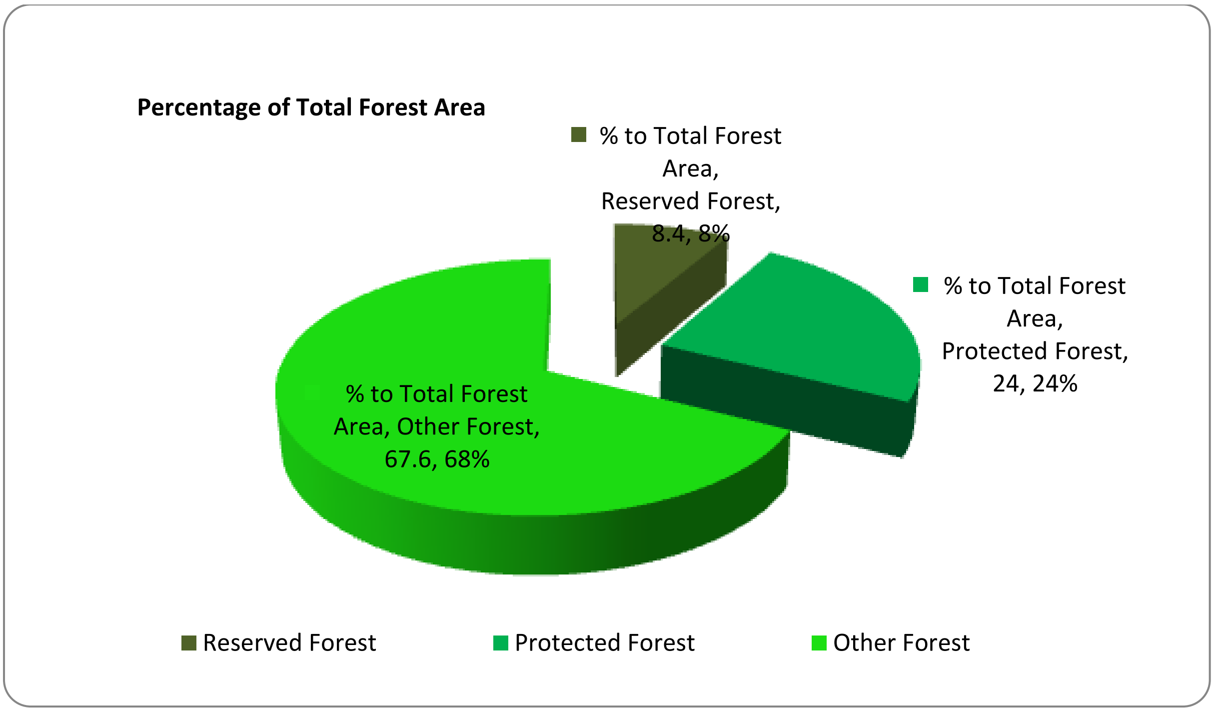


Figure 29: Recorded Forest Land of State

Source: Forest Department, Manipur, Annual Administrative Report, 2010-11

197. Blessed with an amazing variety of flora and fauna, 67% of the geographical area of Manipur is hill tract covered forests. Depending on the altitude of hill ranges, the climatic condition varies from tropical to sub-alpine. The wet forests and the pine forests occur between 900-2700 m above MSL and they together sustain a host of rare and endemic plant and animal life. Coveted the world over as some of the most beautiful and precious blooms, orchids have an aura of exotic, mysteries about them.

198. There are 500 varieties of orchids which grow in Manipur of which 472 have been identified. The major species of vegetation available in the state include Teak, Uninthou, Khasi-pine, Dipterecarpes species, Michelia, Champa, Terminalia, species, Cedrela Toona, Schima Wallichii etc.

199. Classification of forests with the dominant and associated plant species in each zone was given by Deb (1960). According to him the state was divided into four climatic zones as Tropical climate (valley and hill upto 900m), Mountain subtropical climate (area lying between 900-1800m), Mountain temperate climate (area ranging from 1800-2400m), and Sub-alpine (hills ranges above 2400m). Forest Types in Manipur Eastern Himalaya are presented in Table 43.

Table 43: Details of Forest Types in Manipur Eastern Himalaya, India, adapted from Champion and Seth (1968)

Sl. No.	Characteristic species	Altitude Range (m)	Classification code	Forest Types adapted from Champion and Seth (1968)
1.	*Laurus-Melia- Bauhinia association and Michelia champaca, Schima wallichi, Gmelina arborea, Podocarpus nerifolium,*	300–900	2B/C2	Tropical Semi-evergreen forests

Sl. No.	Characteristic species	Altitude Range (m)	Classification code	Forest Types adapted from Champion and Seth (1968)
	Dillenia spp.			
2.	*Tectona grandis, Dipterocarpus turbinatus, Melanorrhoea usitata, Dillenia, Xylia, Lagerstroemia, Terminalia, Gmelina, Bombax spp*	300–900		Moist deciduous forests
3.	*Quercus-Magnolia-Acer and conifers association*	1700-2700	11B/C1	East Himalayan Wet temperate forests
4.	*Prunus, Pyrus, Ligustrum, Taxus, Bucklandia populnea, Acer campbelli, Magnolia campbelli, Castanopsis tribuloides*	Above 2700	-	Sub-Alpine Forests
5.	*Sub-climax state of grassland due to heavy biotic*	-	-	Grassy blanks
6.	*Bambusa manipureana and Dendrocalamus manipureanus*	1,700–2,800	12/DS1	Bamboo brakes
7.	*Calamus tenius, C. leptospadix, C. floribundus and C. erectus*	-	-	Cane brakes

Source: Forest Department, Manipur, Annual Administrative Report, 2010-11

200. Vegetation along the project road sections Imphal-Kanchup-Tamenglong, are mostly covered by the agriculture, think grass and secondary Moist Deciduous Forest as shown in the Vegetation map and Forest map of the Manipur state in Figure 30 and Figure 31, respectively.

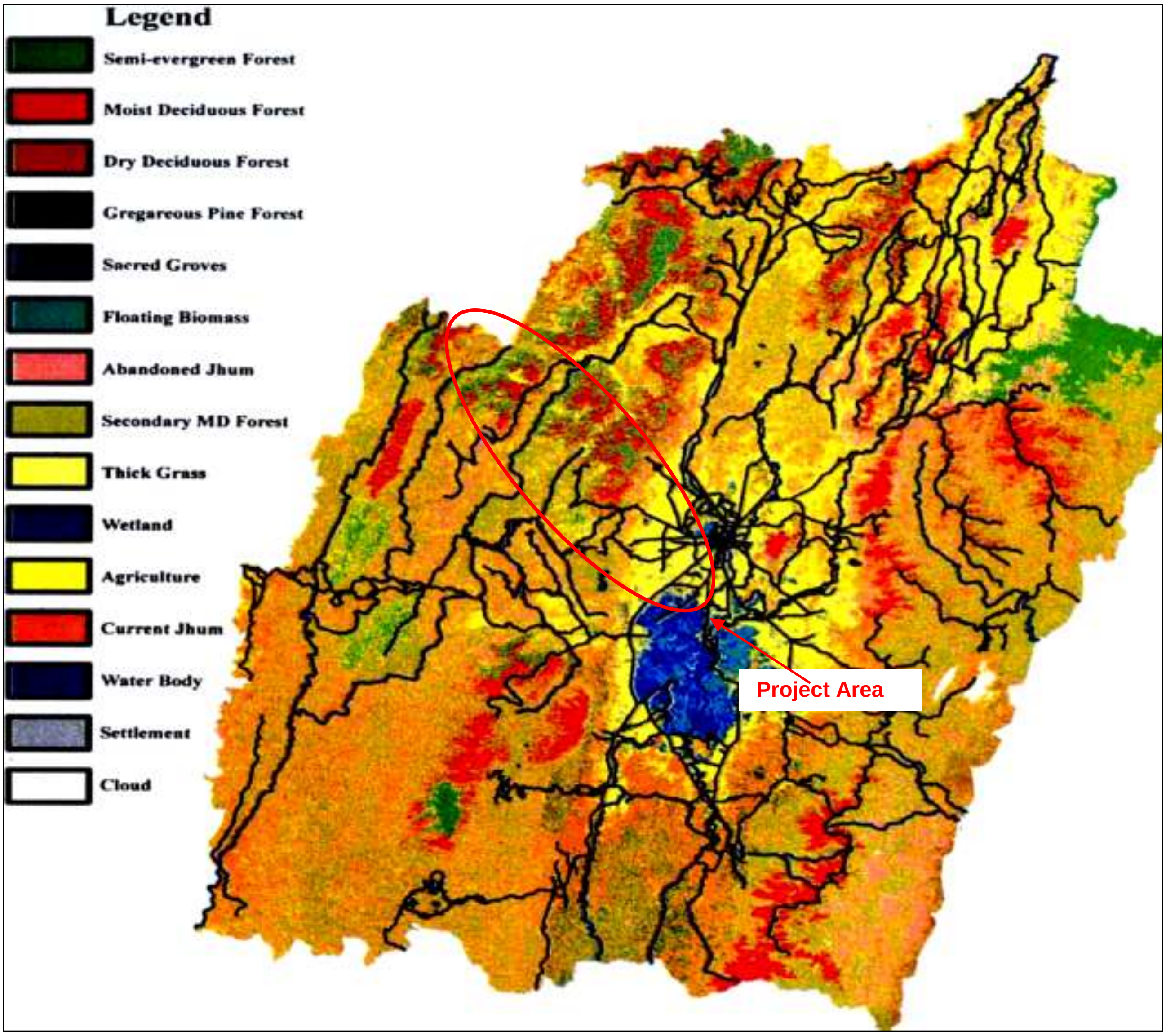


Figure 30: Vegetation Map of Manipur State
(Source: MRSAC, Imphal)

Figure 31: Forest Map of Manipur State
(Source: State of Environment Report, Manipur)

201. Forests along the project road sections in plain terrain (Imphal to Kangchup Bazar) and Hilly terrain (Kangchup Bazar to Tamenglong) are mix of agriculture, non-forest areas, open forest and dense forests as shown in the map (Figure 31).

202. A length of approximate 2.1 km of the proposed alignment passes through Kangchup-Chiru Reserve forest of Senapati district. About 11.0[9]km length of the proposed project road section is in hilly terrain between Kanchup-Tamenglong passes Tairenpokpi-Tamenglong Protected Forest area. Starting from local stream Bangla to boundary of Wapong village (chainage 24+000 to Chainage 32+200, length 6.2 km) alignment transverse through forest area.

[9] The status of the forest is not clear during the survey. Project team is coordinating with State Forest Department to know the nature of forest.

203. In plain terrain from starting point at chainage km 0.000 to 3+000 the land use is of built-up (major settlements Imphal city) and from chainage 3+000 to 13+000 the landuse of mixed type of residential and agriculture. While in hilly terrain at chainage km 13+000 onwards landuse is mixed of built-up (small settlements), agriculture and unclassified protected forests area of Senapati Forest Division and Tamenglong Forest Division.

204. Details of the forest locations along the project road sections are listed in Table 44 and shown in Figure 32.

Table 44: Details of Forest Locations along the Project Road sections

Sl. No.	Name of Reserve / Protected Forest	District	Chainage	
			From (Km)	To (km)
1.	Kangchup-Chiru Reserve Forest	Senapati	17+200	19+300
2.	Tairenpokpi-Tamenglong Protected Forest	Tamenglong	24+000	35+000
3.	Kangchup Leimakhong Irang Protected Forest	Tamenglong	35+000	72+400
4.	Unclassed Forest	Tamenglong	72+500	97+900

Source: Field Survey carried out by the Consultant Team, 2014

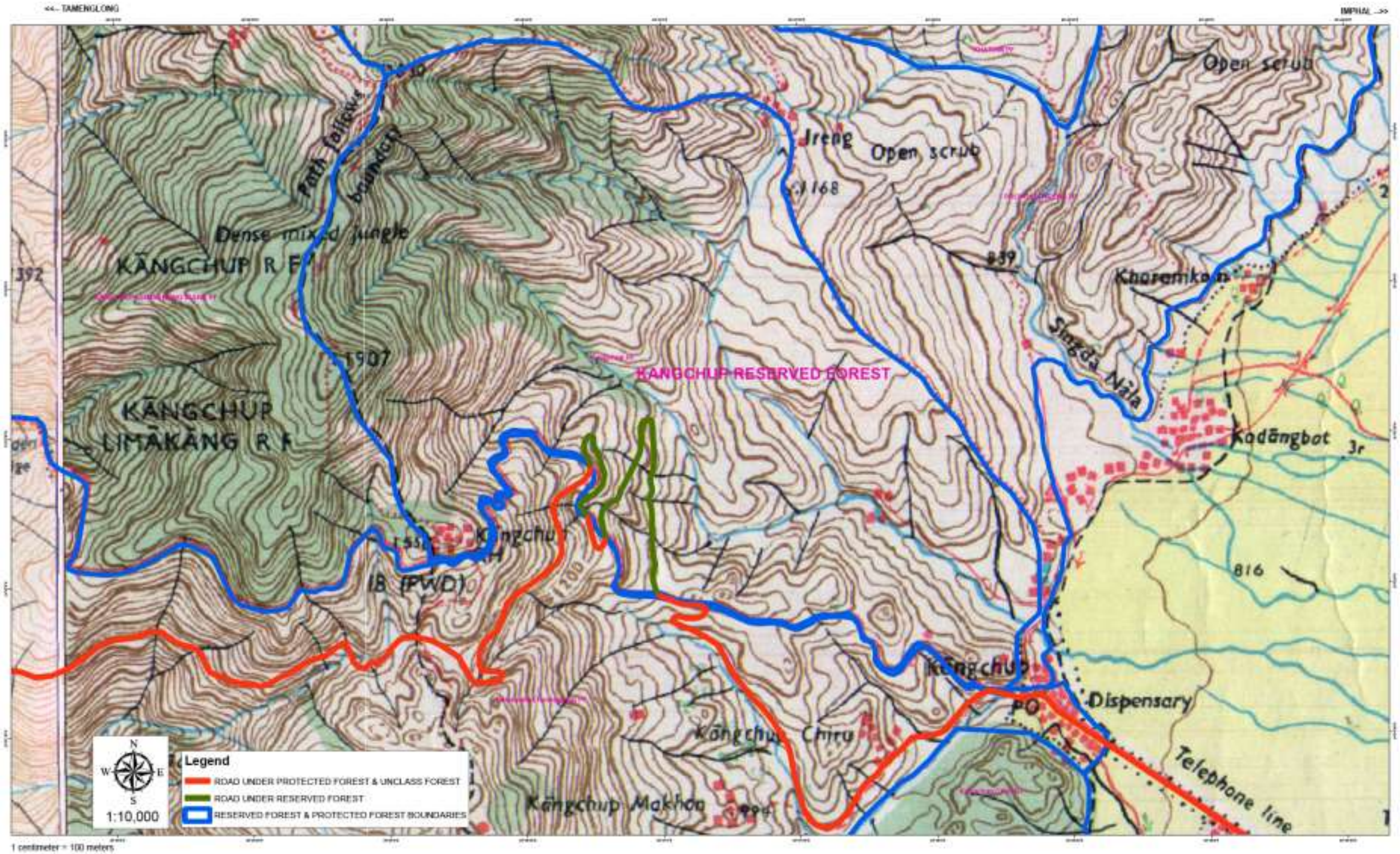


Figure 32: Map showing section of project road in Reserve Forest Area (Source: GIS Unit, Forest Department, Manipur)

205. Field surveys have been carried out to identify the number and type of trees to be affected by the proposed improvement work of main alignment. It is envisaged that about 2732 trees existing within the proposed formation width of the project road. Among these trees 1351 are on left side and 1381 tress are on right side of the road while travelling towards Tamenglong. These trees are likely to cut for proposed widening of the road. Table 45 show details of the trees to be cut.

Table 45: Detail of trees within formation width of the project Road alignment

Section	**Chainage (km)**		**Left Hand Side (LHS)**	**Right hand Side (RHS)**	**Type of Trees (local name)**
	From	**To**			
Imphal to Kangchup Chiru	0.0	13.0	474	494	Nasik, Gulmohor, Boroi, Jam, Baraphi, Heibong, Tairm, Mango, Heikha, Neem, Sorokhi, Tumitla, Khongnang, Heinou, Konbla, Uyumg, Pungton, Jamun, Yongchak, Theibong, Heirik, Ouchan, Teak, Sayee, Kaygay, Kwa, Tera, Thibong, Qurei, Hawaizar Mana Panbi, Lairik Heibi, Kongong Thopki, Bhushlei
Kangchup Chiru to Kangchup Bangla*	13.0	24.0	62	53	
Kangchup Bangla to Khebuching	24.0	68.0	Alignment through green field -mostly forest with dense shrubs & trees in between on hill terrain		
Khebuching to Tamenglong	66.0	103.02	815	834	
	Total trees to be cut (Nos)		**1351**	**1381**	
			2732		

Source: Field Survey carried out by the Consultant Team, 2014

2. Forests and Vegetation along the Project Road

206. In order to establish baseline data on the presence of important floral habitats in the project area, a vegetation assessment study has been carried using field surveys (sampling of flora species and consultations with local forestry officials and communities). The main findings of the vegetation study are summarised herewith. The complate Vegetation Assessment Study is atteched to this Report as Annex 14.

a. Objectives and Methodology

207. The main objectives of the vegetation study was to focus on valuable forest resources and other significant vegetative features along the proposed alignment of the road project. The study has been carried out in the months of December 2014 and January 2015. Efforts were made to lay sample plots in proposed right of way but due to slope in hilly terrain some of the areas were not accessible. Therefore vegetation study for such sloppy areas was taken within the vicinity of the proposed alignment. The assessment was limited to a corridor of 100m along the proposed alignment and specifically areas within the proposed right of way (RoW) of the road or on the both sides along the proposed alignment. The number and location of sample plots were predetermined on the basis of existing diversity and density of floral / vegetation species. Altogether 22 sample plots (20mx20m size) were laid along the proposed alignment.

Image 6: Measuring DBH of tree on existing Imphal -Kangchup road section

Image 7: Determining the sample plot size (left) and taking the data of sample plot (right).

b. Findings

208. Key findings of the vegetation study are presented category wise herewith as i) vegetation and flora of the study area in holistic views, ii) volume of trees, iii) specific observations, and iv) sensitive habitats.

i. Vegetation and Flora of the Project Area

209. Secondary information was used to understand the vegetation and flora of Kangchup Reserve Forest areas in Senapati district; and Tairenpokpi Tamenglong Protected Forest, Kangchup Leimakhong Irang Protected Forest areas and unclass forest in Tamenglong district.

210. **Kangchup Reserve Forest**: The Kangchup Reserved Forest (RF) is situated between $24^0 52'$N to $24^0 54'$N Latitude and $93^0 46'$E to $93^0 49'$E Longitude towards west of Imphal valley on Imphal-Kangchup Road. It covers an area of over 960 hectare with highest elevation of about 1907m above MSL. The Reserve Forest represents low to mid-hill flora, fauna and ecosystems. The Kangchup RF is under jurisdiction of Northern Forest Division, Senapati District.

211. The forests of Senapati District consists of Tropical moist deciduous forests, Northern sub tropical broad leaved hill forests and Northern Montane wet temperate forests. Table 46 describes the major forest types of Northern Forest Division, Senapati District, along with altitude and dominant species.

Table 46: Forest and Vegetation Types in Northern Forest Division, Senapati District, Manipur (as per Champion & Seth Classification)

S.N.	Altitude (m)	Group	Sub-Group	Forest types	Major Species
1	Upto 900	Group-3 (Tropical moist deciduous forests)	Sub-group 3C/3b	East Himalayan moist deciduous forests	*Quercus semiserrata Q. griffithii, Castanopsis hystrix, C. armata, Q. pachyphylla, Schima wallichii, Engelherdtia spp. Alnus nelpalensis, Amoora rohituca, Eugenia precox, Lagestroemia spp., Termanalia myriocarpa, Duabanga grandiflora, Cinnamomum spp., Sterculia villosa, Cedrella serrata. Phyllanthus excelsa, Ficus cunii, Bauhinia purpurea, B. variegata, Callicarpa arborea, Macaranga peltata, Mussaenda frondosa, Ficus glomerata, Celtis australis, Erythrina indica, Pterocarpus acerifolium, Terminalia citrina, Albizzia lebbeck, Mallotus philippensis, Hymenodictyon excelsum, Rhus semialata, Pandanus spp, Aphanomixis polystachya, Canarium strictum, Careya arborea, Chukrassia tabularis, Dillenia pentagyna, D. indica, Macaranga denticulata, Stereospermum personatum, Desmodium, Impatiens, Mimosa, Oxalis, Melastoma malabathricum etc.*
2	1000-1800	Group-8 (Sub tropical broad leave forest)	Sub-group 8b	Northern sub tropical wet hill forests	*Alnus nepalensis, Albizzia spp., Betula alnoides, Castanopsis tribuloides, Cinnamomum glauceseens, Elacocarps spp., Engelherdtia spicata, Erythrenia stricta, Magnolia insignis, Michelia cathcartii, Termanalia myrioacarpa, Schima wallichii, Pheobe hainesiana, Albizzia spp., Rhus semialata, Syzygium Jambos, recea, Balsaminaceae, Bignoniaceae,Commelinaceae, Zingiberaceae, etc*
3	1500-2500	Group-11 (Montane wet temperate forests)	Sub-group C 1	East Himalayan wet temperate forests.	*Acer oblongum, Alnus nepalensis, Betula alnoides, Castanopsis armata, C. castanicarpa, C. pupurella, Cinnamomum, Eleocarpus, braclanus, Engelherdtia*

S.N.	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					spicata, Magnolia insignes, Quercus griffithii, Phoebe hainesiana etc. Prunus cerasoides, Rhododendran arboreum, R. Johnstoneanum, R. triflorum, Vibernum spp., Ardisia depressa, Clerodendron wallichii, Celastrus peniculatus, Panax pseudoginseng, Mountain bamboo, (Yushania maleng) etc.
4	Above 2500		Sub-group 11b	Northen Montane wet temparate forests	*Aconitum elwesii, A nogarum, Berberis manpuana, B. sublevis, Corydalis chaerophyllas, Dichroa febrifuga, Mahonia manipurensis, M. roxburghii. Rhododendrom elliotii, R. macabeanum, R. maddenii, R. wattii, Selinum striatum, Carex manipurensis, Cephalotaxus graffithii, C. manii, Taxus allichiana*

Source: Working Plan of Northern Forest Division Kangpokpi and Senapati Forest Division

212. **Vegetation and Flora of Forests of Tamenglong District**: The vegetation and flora of the forest under forest division of the Indo-Myanmar realm amalgamated with the floral diversity of Eastern Himalayas. The main species like *Michelia champaca, Phoebe hainesiana, Terminalia myriocarpa.* etc. are quite good in the northern areas. *Artocarpus chaplasha* and other miscellaneous species like *Cynometra polyandra, Gmelina arborea, Duabanga sonneratioides,* etc. are found growing particularly in the southern part of the Division.

213. As per Champion and Seth's classification, the forest types of the Western Forest Division (Tamenglong) may be categorized in following three categories as described in Table 47.

a. Cachar Tropical Semi Evergreen Forest (2B/C2),
b. East Himalayan Moist Mixed Deciduous Forest (3C/C3b), and
c. Assam Sub-Tropical Pine Forest (9/C2).

Table 47: Forest and Vegetation Types in Western Forest Division, Tamenglong District, Manipur (as per Champion & Seth Classification)

S.N.	Altitude (m)	Group	Sub-Group	Forest types	Major Species
1	Upto 760	Group-2 (Tropical Semi-Evergreen Forests)	Sub-group 2B/C2	Cachar Tropical Semi Evergreen Forest	*Michelia champaca, Phoebe hainesiana, Terminalia myriocarpa, Artocarpus chaplasha, Palaquium polyanthum, Bombax ceiba, Stereospermum personatum, Anthocephalus cadamba, Duabanga sonneratioides, Trewia nudiflora, Cordia odoratissima, Canarium resiniferum, Podocarpus neriifolia, Bischofia japonica, Alnus nepalensis,*

S.N.	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					Machilus bombycina, Cynometra polyandra, Eugenia species, Vitex peduncularis, Pterospermum acerifolium, Pterygota alata, Protium serratum, Albizzia procera, Premna bengalensis, Gmelina arborea, Mesua ferrea, Dillenia indica, Melocanna baccifera, Dendrocalamus hamiltonii, Ficus cunea, Bauhinia purpurea, Aquilaria agallocha, Terminalia bellirica, Trema orientalis, Lagerstroemia speciosa, Sterculia vilosa, Aralia armata, Moubi/Muli (Malocanna baccifera), Hydrocotyle javanica, Eryngium foetidum, Andrographis paniculata, Cardamine hirsuta, Polygonum hpeceui, Amaranthus spinoses, Ophiopogon intermidims, Prunella vulgaris, Cyperus tegetum, Heliotropium indicum, Blumeopsis flora, Cymbopogon flexuosus, Fragaria species, Gerardiana heterophylla, Ranunculus seleratus, Primula species, Butea minor, Achyranthes aspera, Spilanthes acmella, Lycopodium indicum, Arisaema tortuosum, Hedychium flavum, Asclepias curassavica, Solanum nigrum, Amomum aromaticum, Linaria ramosissima, Desmodium microphyllum, Asperagus sps, Alpinia allughas, Begonia picta, B. palmata, Gynura cusimbua. Thysanolaena maxima, Plantago erosa, Polygonum barbatum, Scutellaria discolor, etc.
2	500-650	Group-3 (Tropical Moist Deciduous Forests)	Sub-group 3C/C3b	Moist Mixed Deciduous forest	*Quercus serrata, Q. griffithii, Castanopsis hystrix, Schima wallichii, Acer oblongum, Engelhardtia spicata, Alnus nepalensis, Syzygium cuminii, Eugenia praecox, Xanthoxylum budrunga, Cinammomum species, Bombax ceiba, Albizzia procera, A stipulata, Garuga pinnata ,Lannea grandis, Litsaea sebifera, Melia azaderach, Garcinia xanthochymus, Juglans*

S.N.	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					regia, Celtis australis, Sapindus mukorossii, Kydia calycina, Litsaea polyantha, Albizzia lebbeck, Toona ciliata, Stereospermum chelonioides, Baccaurea raniflora, Bauhinia purpurea, Macaranga peltata, Erythrina indica, Terminalia citrina, Mallotus phillipensis, Rhus semialata, Ficus hispida, Spondiaz mangifera, Elaeocarpus floribundus, Syzygium jambos, Ficus auriculata, Trema orientalis, Emblica officinalis, Ficus semicordata, Microcos paniculata, Murraya paniculata, Canthium gracilipes, Symplocos paniculata, Zanthoxylum alatum, Wendlandia glabra, Oroxylum indicum, Magnolia pterocapa, Eurya japonica, Saurauja roxburghii, Morus alba, Melocanna baccifera and Dendrocalamus hamiltonii
3	800-1600	Group-9 (Subtropical Pine Forests.)	Sub-group C 2	Assam Sub-Tropical Pine Forest	*Pinus insularis, Syn. P. khasya, Syn. P. kesia, Quercus griffithii, Q.serrata, Q.species, Castanopsis species, Betula alnoides, Acer oblongum, Schima wallichii, Rhus species, Salix tetrasperma, Engelhardtia spicata, Lyonia ovalifolia, Rhododendron arboretum, Eurya japonica, Pittosporum, Photinia, Myrsine, Viburnum, Rubus, Indigofera, Agrotis, Brachypodium sylvaticum, etc.*

Source: Working Plan of Western Forest Division, Manipur

214. **Vegetation and Flora along the Project Road**: Primary data were analyzed to describe the vegetation in the forests affected due to proposed alignment in Senapati & Tamenglong districts. While tree inventories were done along the Imphal-Kangchup existing road, vegetation surveys were perfomred in the forest area of Kangchup Reserve Forest of Senapati district. A total of 22 sample plots were laid in Reserve, Protected & Unclass forest areas leading to active survey for 90 km long alignment from Kanchup to Tamenglong.

215. **Flora along the project road in Kangchup Reserve Forest Area**: Two sampling plots of 20x20 sq.m. size were laid in the forest area where proposed alignment passes thought Kanchup Reserve Forest (RF). First sample plot was laid at (km 19+300), the entry point proposed alignment in the Kangchup RF area, and second was laid at (km 21+600). In total about 1.6 km length (19+100 to 21+700) of project road passes through this reserve forest area.

216. Although the land use for this section of the project road is classified as reserve forest, it is being used by local communities for agriculture purpose with patches of shrubs & trees in between. Taibangngou is most abundant shrub grown in the forest area.

217. *Schima wallichii* (Usoi), *Eucalyptus citriodora Hook (Nasik) and Psidium guajava (Pungdon)* are dominant tree species of Kangchup RF area with a tree density of 125, 88 and 75 plants per hectare respectively. *Quercus lamellosa (Uyung) and Parkia timoriana (Yongchak) are* the major associated species in this area. All three dominant species are homogenously distributed along the proposed alignment in the reserve forest area (Table 48).

Table 48: Population parameters of major trees in Kangchup RF area

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	*Usoi*	*Schima wallichii*	125	29.41	100	18.18
2	*Nasik*	*Eucalyptus citriodora Hook*	87.5	20.59	50	9.09
3	*Pungdon*	*Psidium guajava*	75	17.65	50	9.09
4	*Uyung*	*Quercus lamellosa*	25	5.88	50	9.09
5	*Yongchak*	*Parkia timoriana*	25	5.88	50	9.09
6	*Kurao*	*Erythrina strica Roxb.*	25	5.88	50	9.09
7	*Nobab*	*Citrus maxima.*	25	5.88	50	9.09

Source: Field survey

218. **Flora along the proposed alignment in Protected Forest Area**: A total of twenty sampling plots (20x20 sq.m. sized) were laid in Senapati and Tamenglong districts in the protected (unclassed) forest along the proposed alignment. Out of these twenty plots, fourteen plots were laid in protected forest areas of Tairenpokpi Tamenglong and Kangchup Leimakhong Irang, seven sample plots in each forest area and other six were laid in unclassed forest of Wairangba-Bhalok area under Tamenglong district. Vegetation along the protected forest area consists of bushes and shrubs with Jhum cultivation activities in between low slope hills and hillside. Wa (Bamboo) is grown naturally and also planted by local communities. While in agriculture fields Komla (Citrus sinensis) and Banana are commonly cultivated plants in this region.

219. *Schima wallichii* (Usoi), *Cinnamomum zeylanicum (Ushingsha)* and Nakaything were dominant tree species of Tairenpokpi Tamenglong Protected Forest area with the density of 168, 65 and 47 plants per hectare respectively. *Wendlandia tinctoria* (Fheija), *Cedrela loona* (Tairen) and *Rhus sinensis/Semialata* (Heimang) are the major associated species along the project road. Among the listed species, *Schima wallichii* (Usoi) and *Cinnamomum zeylanicum (Ushingsha) are* the most common and uniformly distributed plant species in the area (Table 49).

Table 49: Population parameters of major trees in Tairenpokpi Tamenglong Protected Forest area

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	Usoi	*Schima wallichii*	167.86	30.13	71.43	15.63
2	Usingsha	Cinnamomum zeylanicum	64.29	11.54	14.29	3.13
3	Tairen	Cedrela loona	14.29	2.56	28.57	6.25
4	Fheija	Wendlandia tinctoria	25.00	4.49	14.29	3.13

S N	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
5	Nakaything	-	46.43	8.33	14.29	3.13
6	Heimang	Rhus sinensis/Semialata	17.86	3.21	14.29	3.13
7	Jonding	-	21.43	3.85	14.29	3.13
8	Uthum	Bischofia javanica	10.71	1.92	14.29	3.13
9	Uree	Symplocos cochinchinensis	17.86	3.21	14.29	3.13
10	Heikru	Emblica officinalis	7.14	1.28	14.29	3.13
11	Kurao	Erythrina strica Roxb.	3.57	0.64	14.29	3.13
12	Theibong	Artocarpus intergrifolia	3.57	0.64	14.29	3.13

Source: Field survey

220. *Gmelina arborea (Wang) and Schima wallichii* (Usoi), were dominant tree species of trees in Kangchup Leimakhong Irang Protected Forest area with the density of 375 and 65 plants per hectare respectively. *Cedrela loona* (Tairen), *Pinus khesia (Uchan)* and Khalam are the major associated species in this protected forest area. Among the listed species, *Gmelina arborea (Wang)* is the most common and uniformly distributed plant species in the area (Table 50).

Table 50: Population parameters of major trees in Kangchup Leimakhong Irang Protected Forest area

SN	Local Name	Scientific Name	Density	Relative Density	Frequency	Relative Frequency
1	Wang	*Gmelina arborea*	375.00	59.32	57.14	13.33
2	Usoi	*Schima wallichii*	64.29	10.17	57.14	13.33
3	Shahee		28.57	4.52	14.29	3.33
4	Tairen	*Cedrela loona*	14.29	2.26	42.86	10.00
5	Uyung	*Quercus lamellosa*	7.14	1.13	28.57	6.67
6	Khalam		25.00	3.95	28.57	6.67
7	Uchan	*Pinus khesia*	17.86	2.82	14.29	3.33
8	Chigonglei		3.57	0.56	14.29	3.33
9	Neem	*Azadirachta indica*	7.14	1.13	14.29	3.33
10	Uthangjing		7.14	1.13	14.29	3.33
11	Thangjee		10.71	1.69	14.29	3.33
12	Urhinga		3.57	0.56	14.29	3.33

Source: Field survey

221. **Flora along alignment in Unclassed forest of Tamenglog**: A total of six 20 x 20 m^2 sized sample plots were laid along the proposed alignment in the unclass forest area of Tamenglong district. Vegetation along this area consists of Wa (*Arundinaria clarkei*; Bamboo) as dominant plant in the region.

222. *Gmelina arborea (Wang) and Heiret*, were dominant tree species of unclass forest area of Tamenglong district with the density of 192 and 42 plants per hectare respectively. *Quercus lamellosa* (Uyung), *Schima wallichii* (Usoi) *and Parkia timoriana (Yongchak)* are the major associated species in the protected forest area. Among the listed species, *Gmelina arborea (Wang)* is the most common and uniformly distributed plant species in the area (Table 51).

Table 51: Population parameters of major trees in Unclass Forest of Tamenglong

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	Wang	*Gmelina arborea*	191.67	57.50	66.67	25.00
2	Heiret		41.67	12.50	50.00	18.75
3	Ushoi	*Schima wallichii*	16.67	5.00	33.33	12.50
4	Uyung	*Quercus lamellosa*	25.00	7.50	33.33	12.50
5	Yongchak	*Parkia timoriana*	16.67	5.00	16.67	6.25
6	Heining	*Sapondius pinnata*	4.17	1.25	16.67	6.25
7	Ubram		12.50	3.75	16.67	6.25
8	Shahee		12.50	3.75	16.67	6.25

Source: Field survey

223. **Species Richness along the Proposed Alignment**: Altogether 50 plant species were recorded during vegetation survey in the different sections along the proposed alignment. Species richness is least recorded in 1st sample plot surveyed in the protected forest with only one species. Species richness in Knagchup RF; in the 2nd & 3rd sample plot taken was recorded with 10 species. The plots in Kangchup RF were taken at the pocket area of *Angiosperm conyzoides Linn* (Khongjainapi) a shrub dominantly grown in the area. Highest species richness was recorded from 3rd and 9th sample plot along the alignment, with 8 and 9 different types of species (Figure 26).

224. Similarly, highest numbers of plants were recorded from 13th sample plot with 99 plants, followed by 32 plants in the 5th sample plot. Least number (3 nos.) of plants was recorded from the 19th sample plot with only one tree species (Figure 33). It is because of the presence of Wa (Bamboo) in that particular plot.

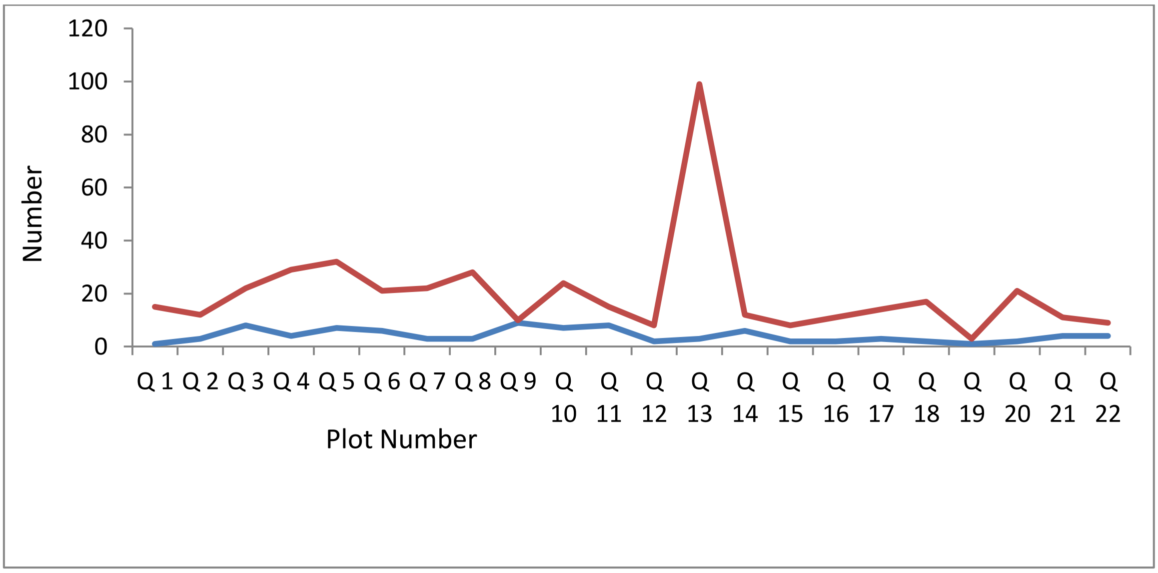


Figure 33: Species richness along the sample plots

ii. Volume of Trees in Different Sample Plots

225. Volume of trees was calculated in different sample plots. Maximum tree volume was recorded in plot 13th sample plot at Tairenpokpi Tamenglong Protected Forest area with the value of 1260 cu. m per hectare followed by 8th sample plot at Kangchup Leimakhong Irang Protected Forest with the value of 1255.27 cu. m per hectare. Similarly, least tree volume was recorded in the 20th plot of unclass forest of Tamenglong district which have only 55.12 cu. m per hectare (Table 52 and Figure 34).

Table 52: Volume of trees in each sample plot (formula used from FAO Forestry)

Plot No	Vol. per ha Volume in cubic meter per hectare	Ranking of volume in different plots
Q1	184.275	18
Q2	0	21
Q3	259.875	15
Q4	0	22
Q5	308.7	14
Q6	426.825	9
Q7	889.875	4
Q8	1255.275	2
Q9	418.95	10
Q10	1047.375	3
Q11	848.925	5
Q11	848.925	5
Q12	376.425	13
Q13	1260	1
Q14	220.5	17
Q15	385.875	12
Q16	609.525	6
Q17	439.425	8
Q18	559.125	7
Q19	149.625	19
Q20	55.125	20
Q21	242.55	16
Q22	406.35	11

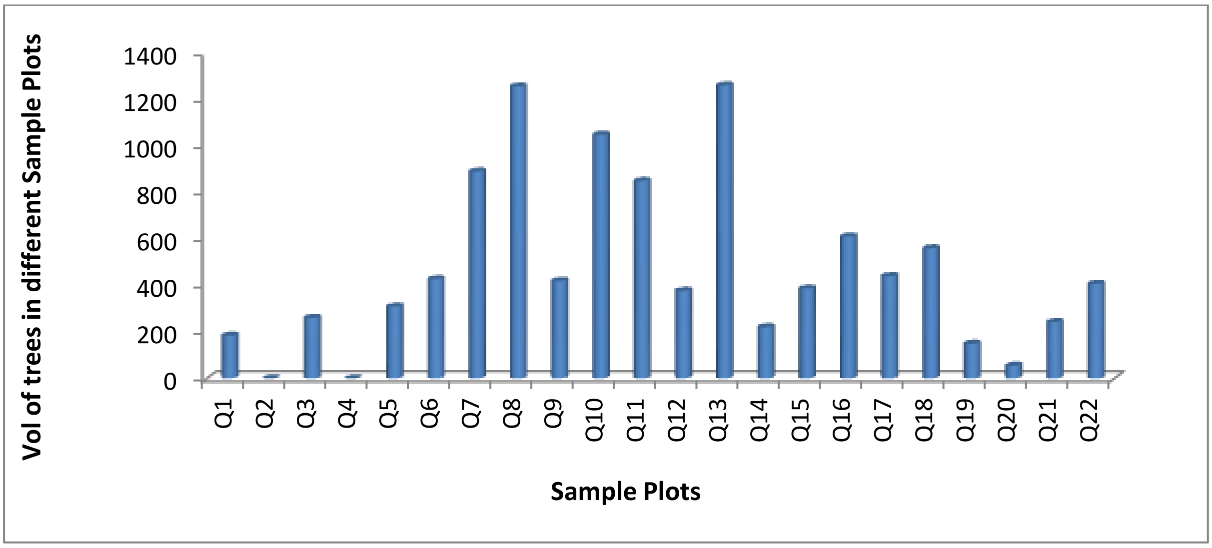


Figure 34: Volume of tress in different sample plots

226. As shown up earlier, a total of 22 sample plots were laid along the alignment in the forest areas. Two sample plots were laid at Kangchup RF area and average tree volume for

the reserve forest is 129.93 cu m per hectare. The area has plenty of open grasslands and bushes therefore tree volume is low. A total of 14 sample plots were laid on the Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest region. Number of sample plots taken in this region was higher because the proposed alignment will be mostly through green fields in this region. Average volume in cubic meter per hectare of trees within the 7 sample plots on Tairenpokpi Tamenglong Protected Forest is 497.7. The figure is 678.3 for average volume in cubic meter per hectare of trees in 7 sample plots on Kangchup Leimakhong Irang Protected Forest. Similarly 6 sample plots were laid in unclass forest area of Tamenglong district. Average volume of trees in unclass forest area is 308.7 cu m per hectare.

227. **Volume of Individual trees in Kangchup RF Area:** Volume of *Schima wallichii* in Kangchup RF area was 366.75 cu m per hectare, followed by *Parkia timoriana* with 50.12 cu m per ha. (Table 53).

Table 53: Volume of major trees in Kanchup RF Area

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Schima wallichii*	2.934	366.75
2	*Quercus lamellosa*	1.722	43.05
3	*Parkia timoriana*	2.005	50.125
4	*Erythrina strica Roxb.*	0.85	21.25

228. **Volume of Individual trees in Protected Forest area**: Volume of Schima wallichii was maximum in Tairenpokpi Tamenglong forest area with 492.5 cu m per ha. Volume of Nakaything and Cedrela loona is 66.85 & 34.53 cu m per ha., respectively. (Table 54).

Table 54: Volume of major trees in Tairenpokpi Tamenglong Protected Forest

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Schima wallichii*	2.934	492.50
2	*Cedrela loona*	2.417	34.53
3	*Wendlandia tinctoria*	0.661	16.53
4	*Nakaything(Local Name)*	1.44	66.85
5	*Jonding (Local Name)*	0.834	17.87
6	*Emblica officinalis*	1.058	2.69
7	*Erythrina strica Roxb.*	0.85	3.03
8	*Artocarpus intergrifolia*	1.26	4.49

229. Volume of *Gmelina arborea* maximum was in Kangchup Leimakhong Irang Protected Forest area with 690 cu m per hectare, followed by *Schima wallichii* with 188.62 cu m per ha. (Table 55).

Table 55: Volume of major trees in Kangchup Leimakhong Irang Protected Forest

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Gmelina arborea*	1.84	690
2	*Schima wallichii*	2.934	188.62
3	*Quercus dealbata.Hook*	1.789	51.11
4	*Cedrela loona*	2.417	34.53
5	*Quercus lamellosa*	1.722	12.29
6	*Acacia nilotica*	3.96	14.16
7	*Azadirachta indica*	0.945	6.47

230. **Volume of individual trees in Unclassed Forest area:** Volume of *Gmelina arborea* was maximum in unclass forest area with 352.67 cu m per ha, followed by *Schima wallichii* & *Ficus cunia* of 48.8 & 44.08 cu m per hectare, respectively. As anticipated, the volume of trees per hectare was less as in compared to protected forest areas area (Table 56).

Table 56: Volume of major trees in unclass forest area of Tamenglong

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Gmelina arborea*	1.84	352.67
2	*Ficus cunia*	1.058	44.08
3	*Schima wallichii*	2.934	48.9
4	*Quercus lamellosa*	1.722	43.05
5	*Parkia timoriana*	2.005	33.42
6	*Ubram (Local Name)*	1.854	23.17
7	*Quercus dealbata.Hook*	1.789	22.36

iii. Specific Observations

231. It was observed that the whole forest areas trees are cleared in patches for Jhum cultivation by communities. The large sized trees were mostly on hills with stiff slope where cultivation activities not performed.

232. Most common plant species found along the forest area are *Gmelina arborea (Wang), Schima wallichii* (Usoi), *Cinnamomum zeylanicum (Ushingsha), Eucalyptus citriodora Hook (Nasik), Psidium guajava (Pungdon), Wendlandia tinctoria* (Fheija), *Cedrela loona* (Tairen) and *Rhus sinensis/Semialata* (Heimang) and *Ficus cunia (Heiret)* etc.

iv. Status of Protected, Endangered and Rare Species

233. List of protected plant species enlisted by different organizations is given in table 57. Altogether six species, two groups (Anacardiaceae and Orchidaceae) were recorded in the project areas that falls under different conservation categories. Four species were protected by Government of India, one species by IUCN, and five species by CITES. Among the protected species, *Cycas pectinata* was kept under conservation category by all three i.e. GoI, IUCN and CITES.

Table 57: Protected, Endangered and Rare Species at Different Category

Species	Local Name	IUCN	GoI	CITES	Local Availability	Remarks
Renanthera imschootiana	Red vanda	NA	VI	A I	R	
Vanda coerulea	Blue vanda	NA	VI	A I	R	
Paphiopedilum spicerianum	Ladies slipper orchid	NA	VI	A I	R	
Cycas pectinata	Cycad	V	VI	A II	R	
Taxus wallichiana Zucc	Common yew or Birmi leaves	NA		A II	C	
Heimang	Rhus sinensis/Semialata	NA			R	VUN

Abbreviations:
- **IUCN**: T = Threatened, R = Rare, V = Vulnerable, LC = Least Concern
- **GoI:** (Government of India, THE WILDLIFE (PROTECTION) ACT, 1972): Schedule VI = specified plants: Willfully pick, uproot, damage destroy, acquire or collect any specified plant from any forest land and area specified,

- **CITES:** A I & II = Appendix I & II =species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled)
- **Local Availability:** (Observation by vegetation survey team): A = abundant, C = common, R = rare.

234. The orchid species listed as threatened on the International Union for Conservation of Nature (IUCN) Red List than species from any other plant family found in Manipur state. North East region of India is also considered as one of the mega biodiversity spot in terms of richness of flora and fauna diversity. In this region it is estimated about 876 orchid species in 151 genera are available.

235. The population of orchids is declining due to ruthless commercial exploitation, by the Convention on International Trade in Endangered Species (CITES) of wild flora and fauna, it is observed that habitat destruction is the major factor involved. Orchids prefer to grow in undisturbed forests area either in tree trunks i.e. epiphytes, or on the forests floor i.e. terrestrial or semi terrestrial, a large number of orchid species, which were once abundant in the forests, are now at the verge of extinction. Some of them have become so rare that it has become impossible to trace them in their natural habitat.

3. Wildlife and Protected Area Network

236. Within the 50-km radius of the project road are two legally protected areas, the Keibul-Lamjao National Park (KLNP) and the Intanki National Park (INP). KLNP is located southeast of the proposed road alignment while the INP is located northwest. KLNP is known as the only natural habitat of Brow Antlered Deer (Sangai) and a Category I-II IUCN siteas as critically endangered, it is also known as the only Floating National Park in the World, and hosts to a number of rare and migratory birds. The INP is located in Nagaland and is known to harbor hoolock gibbon, golden langur, hornbill, palm civets, black stork, tiger, white-breasted kingfisher, monitor lizard, python and sloth bear.

237. There are no key biodiversity areas within the buffer distances of 1- and 10-km. Within a 50km buffer zone from the road alignment there are 3 key biodiversity areas, these are:

- Zeiland Lake Sanctuary - significant population of *Cairina scutulata* or White-winged Duck an endangered species due to a very small and fragmented population.
- Jiri-Makru Wildlife Reserve – an important area for the endangered species *Cairina scutulata* White-winged Duck and *Pavo muticus* Green Peafowl, and vulnerable species *Aceros nipalensis* Rufous-necked Hornbill
- Loktak Lake and Keibul Lamjao National Park – important areas for the vulnerable species *Aquila clanga* Greater Spotted Eagle and *Leptoptilos javanicus* Lesser Adjutant due to extensive habitat loss and persistent persecution, and near threatened *Pelecanus philippensis* Spot-billed Pelican.

238. Along the road alignment is an area that is known to harbor various wildlife species and based on distribution maps there are 79 species (Table 58) known to occur whose native range coincides with the road impact area. Of the species known to occur in the project area, 5 are critically endangered and 8 are endangered.

Table 58: Distribution of Species Known to Occur Along the Project Road by IUCN Classification

Taxonomic Group	IUCN Red List					
	Total	**CR**	**EN**	**VU**	**NT**	**DD**
Amphibians	4	0	0	1	0	3
Birds	37	5	2	15	15	0
Invertebrate	2	0	0	0	2	0
Mammals	31	0	6	14	5	6
Reptiles	5	0	0	2	0	3
Total	**79**	**5**	**8**	**32**	**22**	**12**

239. The critically endangered species are: *Aythya baeri* Baer's Pochard, *Gyps bengalensis* White-rumped Vulture, *Gyps tenuirostris* Slender-billed Vulture, *Houbaropsis bengalensis* Bengal Florican, and *Sarcogyps calvus* Red-headed Vulture. While the endangered species are: *Cairina scutulata* White-winged Duck, *Sterna acuticauda* Black-bellied Tern, *Axis porcinus* Hog Deer, *Hadromys humei* Hume's Rat, *Hoolock hoolock* Western Hoolock Gibbon, *Manis pentadactyla* Chinese Pangolin, *Prionailurus viverrinus* Fishing Cat, and *Rucervus eldii* Eld's Deer.

a. Protected Area Network of Manipur

240. The State has rich wildlife and has long network of protected area. In order to protect the rich flora and fauna of Manipur from the poacher, the Government has established parks and sanctuaries. The state's protected area network comprises of five wildlife sanctuaries and two national parks. Recognizing the importance of this region as one of the hot spots, majority of the biodiversity rich areas of the state has been placed inside the protected area network system comprising mainly of the National Park and Sanctuary.

241. In the State, conservation of wildlife is carried out in two categories as ex-situ conservation and in-situ conservation.

242. **Ex-Situ Conservation.** The wildlife is located/ transported from their natural habitat to an area well protected from outside elements and preserved there. An example of this category is the Manipur Zoological Garden at Iroishemba, Orchid Preservation Centre at Khonghampat, Arboretum etc.

243. **In-Situ Conservation.** Areas having adequate natural flora and fauna are declared as National Parks and Wildlife Sanctuaries. They are known as the Protected Areas Networks (PAN). The entry of human and cattle inside the area is strictly under control. No dead, dying or diseased plants can be removed from such areas. The examples of this category are the Keibul Lamjao National Park and Yangoupokpi Lokchao Wildlife Sanctuary.

244. The details of sites are given in Table 59 and Figure 35 show the protected area map of the Manipur. The total area under the protected area network is 1 percent of total geographical area of state and that of under national parks is 0.2 percent

Table 59: Protected Area Network in the State of Manipur

Sl.	Protected Area	Location (District)	Area in sq.km
A.	**In-situ Conservation Sites**		
1	Keibul Lamjao National Park	Keibul Lamjao (Bishnupur Dist.)	40.00
2	Yangoupokpi Lokchao Wildlife Sanctuary	Lokchao (Chandel Dist.)	184.80
3	Shiroi Hill National Park	Ukhrul (Ukhrul Dist.)	41.00

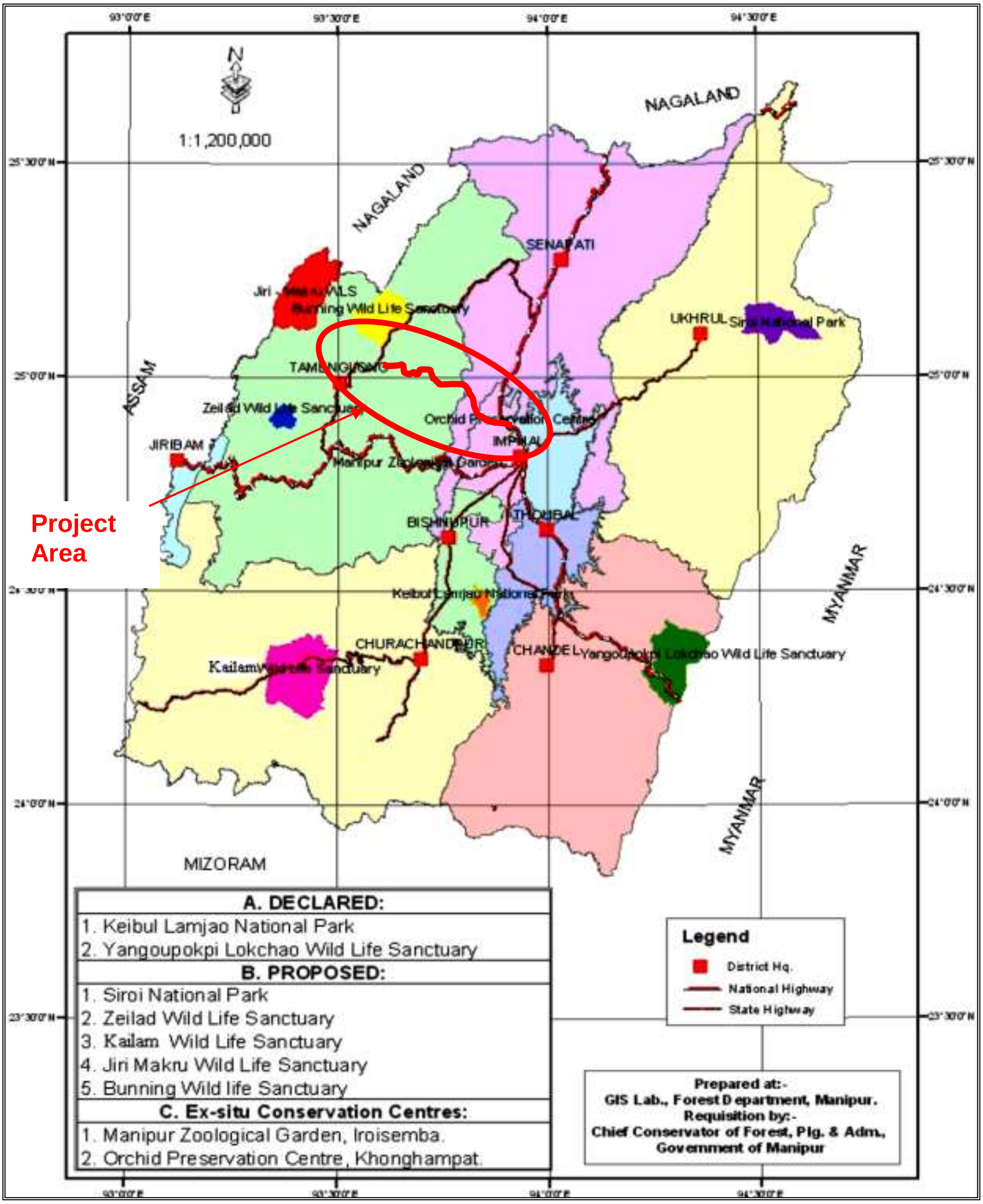
Sl.	Protected Area	Location (District)	Area in sq.km
4	Kailam Wildlife Sanctuary	Churachandpur Dist.	187.50
5	Jiri-Makru Wildlife Sanctuary	Tamenglong Dist.	198.00
6.	Bunning Wildlife Sanctuary	Tamenglong Dist.	115.80
7.	Zeliad Wildlife Sanctuary	Tamenglong	21.00
B.	**Ex-site Conservation Sites**		
1	Manipur Zoological Garden	Iroisemba, Imphal West	0.08
2	2nd Home SANGAI	Iroisemba, Imphal West	0.60
3	Orchid Preservation Centre	Khonghampat, Imphal West	0.50

Source: Statistical Booklet of Manipur Forest (2008-2009), Wildlife Wing, Forest Department, Government of Manipur

245. In the state, in spite of its rich vegetation, due to the absence of any forest worth the name within the district wild animals are not found abundantly. Deer and Jungle fowl are some of the varieties found at present occasionally along the slope of eastern hills adjoining the district. But the lakes support a variety of wild birds such as partridge, snipe, duck, geese, etc. particularly in winter months. These birds are mostly migratory in character. Some of them are seen coming from far off Siberia. With the gradual conversation of the lakes into agricultural lands these migratory birds are seen in increasingly fewer members in recent times.

246. It can be seen from the map (figure 35) that the project road sections Imphal to Kangchup and Kangchup to Tamenglong, neither encroaches nor passes by any of the protected areas of Manipur. However, the section in Kangchup Chiru village boundary passes through Kangchup-Chiru Reserve Forest. Pocket of forests area is from chainage km 17+200 to 19+300 for this section.

247. Informal interviews were held with the local villagers, livestock herders to gather information on the presence of wildlife and their habitats along the project rods. Officials from Wildlife division including Chief Wildlife Warden and Chief Conservator of Forests were also consulted in the process. Office of the Chief Conservator (Widlife) informed that there are no notified protected area along the proposed alignment of the Imphal-Tamenglong Road Section.



Source: Wildlife Wing, Forest Department, Government of Manipur

Figure 35: Protected Area Map of Manipur State

4. Assessment of Wildlife along the Project Road

248. In order to establish baseline data on the presence of important wildlife and faunal habitats in the project area, a Wildlife Assessment Study has been carried using field surveys (walkover transect surveys and consultations with local forestry and wildife officials and local communities). The main findings of this Wildlife Study are summarised herewith. The complate Wildife Assessment Report is atteched to this Report as Annex 15.

a. Objectives and Methodology

249. The main objectives of the wildlife study was to assess and document wildlife and faunal habitats in the project area and along the proposed alignment in particular. The study has been carried out in the months of December 2014 and January 2015. Several methods including literature review, direct field sightings by transact walk, discussions with local communities, consultations with local (field level) forest officials etc. were used to collect data on presence of wildlife in the project area. Altogether 22 random line transects of varying lengths were set up in and along the project road alignment in order to document any direct wildlife observations encountered.

b. Key Findings

i. Forest Fuana in project areas reported in Working Plans

250. The state is in the junction of two ecological hotspots, the North Eastern India Hotspot and Malayan Hotspot, and due to transitional effect, most of the species of wildlife typical of Himalayan Region and Malayan region are found in the state.

251. Due to presence of hills, plains, and swamps and other wetlands, resulting diversity in climatic and floristic conditions provide habitat to multifarious types of fauna. So much of faunal diversity is available here that the state is regarded as a treasure box of rare wildlife. The analysis of faunal diversity reveal nearly 2601 species belonging to various categories in 1261 genera of 368 families. According to Zoological Survey of India (2005), among these faunal groups, insects dominate the number with 1220 species followed by birds with 586 species, fishes with 141 species and molluscs 127 species. Mammals are of 75 species, Amphibians of 14 species and reptiles of 9 species.

252. Based on secondary sources, there are 33 species of mammals, 100 species of birds, 55 species of raptiles, 13 species of amphibians and 82 species of fishes have been recorded in the forest areas along project road. Reported Wildlife in the forests of the project area is given in Table 60.

Table 60: Details of Wildlife found in project affected forest areas

Sl.No.	Common Name	Scientific Name
Mammals		
1	Clouded leopard	*Neofelis nebulosa*
2	Fishing cat	*Felis viverrina*
3	Golden cat	*Felis temmincki*
4	Hog badger	*Arctonyx colaris*
5	Hoolock gibbon	*Hylobates hoolock*
6	Leopard or Panther	*Panthera pardus*
7	Leopard cat	*Felis bengalensis*
8	Tiger	*Panthera tigris*
9	Pangolin	*Manis crassicaudata*
10	Serow	*Capricornis sumatraensis*
11	Slow loris	*Nycticebus coucang*
12	Spotted linsang	*Prionodon pardicolor*

Sl.No.	Common Name	Scientific Name
13	Assamese macaque	*Macaca assamensis*
14	Bonnet macaque	*Macaca radiata*
15	Ferret badgers	*Melogale moschata M. personata*
16	Rhesus macaque	*Macaca mulatta*
17	Stump-tailed macaque	*Macaca speciosa*
18	Wild dog or, Dhole	*Cuon alpinus*
19	Large Indian Civet	*Viverra zibetha*
20	Flying squirrel	*Hylopetes alboniger*
21	Himalayan black bear	*Selenarctos thibetanus*
22	Jungle cat	*Felis chaus*
23	Yellow throated Marten	*Martes flavigula*
24	Common otter	*Lutra lutra*
25	Barking deer or, Munjac	*Muntiacus muntjak*
26	Goral	*Nemorhaedus goral*
27	Sambar	*Cervus unicolor*
28	Wild pig	*Sus scrofa*
29	Hedge hog	*Hemiechinus auritus*
30	Indian porcupine	*Hystrix indica*
31	Small Indian Civet	*Viverricula indica*
32	Toddy cat	*Paradoxurus hermaphroditus*
33	Bay bamboo rat	*Cannomys badius*
	Birds	
1	Assam bamboo partridge	*Bambusicola fytchii*
2	Great Indian hornbill	*Buceros bicornis*
3	Humes bar-backed pheasant	*Syrmaticus humiae humiae*
4	Indian pied hornbill	*Anthracoceros malabaricus*
5	Tragopan pheasant	*Tragopan blythii*
6	Darter or, Snake bird	*Anhinga rufa*
7	Purple heron	*Ardea alba*
8	Night heron	*Nycticorax nycticorax*
9	Paddybird or, Pond heron	*Ardeola grayii*
10	Cattle egret	*Bubulcus ibis*
11	Little bittern	*Ixobrychus minutus*
12	Bittern	*Botaurus stellaris*
13	Lesser whistling teal/Tree duck	*Dendrocygna javanica*
14	Pintail duck	*Anas acuta*
15	Common teal	*Anas poecilorhyncha haringtoni*
16	Common pochard	*Aythya ferina*
17	White-eyed pochard	*Aythya nyroca*
18	Sparrow-hawk	*Accipiter nisus*
19	Tawny eagle	*Aquila vindhiana*
20	Crested serpent eagle	*Spilornis cheela*
21	Pied harrier	*Circus melanoleucos*
22	Red-legged or, Amur falcon	*Falco amurensis*
23	Common or, Grey quail	*Coturnix coturnix*
24	Little bustard-quail	*Turnix sylvatica*
25	Black partridge	*Francolinus pictus*
26	Red junglefowl	*Gallus gallus*
27	White-breasted waterhen	*Amaurornis phoenicurus*
28	Indian moorhen	*Gallinula chloropus*
29	Purple moorhen	*Porphyrio porphyrio*
30	Coot	*Fulica atra*
31	Large Indian pratincole or, Collared swallow plover	*Glareola pratincola*
32	Little tern	*Sterna albifrons*
33	Purple wood pigeon	*Columba punicea*
34	Spotted dove	*Streptopelia chinensis*

Sl.No.	Common Name	Scientific Name
35	Little brown dove	*Streptopelia senegalensis*
36	Indian red-breasted parakeet	*Psittacula alexandri*
37	Lorikeet	*Loriculus vernalis*
38	Cuckoo	*Cuculus canorus*
39	Red-winged crested cuckoo	*Clamator coromadus*
40	Indian drongo cuckoo	*Surniculus lugubris*
41	Koel	*Eudynamys scolopacea*
42	Lesser coucal	*Centropus toulou*
43	Barn or, screech owl	*Tylo alba*
44	Grass owl	*Tylo capensis*
45	Forest eagle owl	*Bubo nipalensis*
46	Brown wood owl	*Strix leptogrammica*
47	Bay owl	*Phodilus badius*
48	Blue-eared kingfisher	*Alcedo meninting*
49	White-breasted kingfisher	*Halcyon smyrnensis*
50	Chestnut-headed bee-eater	*Merops leschenaulti*
51	Blue-bearded bee-eater	*Nyctyornis athertoni*
52	Hoopoe	*Upupa epops*
53	Indian golden-backed three-toed woodpecker	*Dinopium javanense*
54	Blue-throated barbet	*Megalaima asiatica*
55	Himalayan great barbet	*Megalaima virens*
56	Long-tailed broadbill	*Psarisomus dalhousiae*
57	Sand lark	*Calandrella raytal*
58	House martin	*Delichon urbica*
59	Black drongo or, King-crow	*Dicrurus adsimilis*
60	Racket-tailed drongo	*Dicrurus paradiseus*
61	Crow-billed drongo	*Dicrurus annectans*
62	Indian Myna	*Acridotheres tristis*
63	Jungle Myna	*Acridotheres fuscus*
64	Pied Myna	*Sturnus contra*
65	Green magpie	*Cissa chinensis*
66	Yellow-billed blue magpie	*Cissa flavirostris*
67	Himalayan tree pie	*Dendrocitta formosae*
68	Jungle crow	*Corvus macrorhynchos*
69	Pied flycatcher-shrike	*Hemipus picatus*
70	Large cuckoo-shrike	*Coracina novaehollandiae*
71	Long-tailed minivet	*Pericrocotus flammeus*
72	Black-headed bulbul	*Pycnonotus atriceps*
73	Black-headed yellow bulbul	*Pycnonotus melanicterus*
74	Red-vented bulbul	*Pycnonotus cafer*
75	Spotted babbler	*Pellorneum ruficeps*
76	Red-capped babbler	*Timalia pileata*
77	Yellow-breasted babbler	*Macronous gularis*
78	Quaker babbler	*Alcippe poioicephala*
79	White-headed shrike-babbler	*Gampsorhynchus rufulus*
80	Red-billed leiothrix	*Liothrix lutea*
81	Neck-laced laughing thrush	*Garrulax moniligerus*
82	Black-gorgeted laughing thrush	*Garrulax pectoralis*
83	Brook’s flycatcher	*Muscicapa poliogenys*
84	White-browed fantail flycatcher	*Rhipidura aureola*
85	Streaked wren-warbler	*Prinia gracilis*
85	Thick-billed warbler	*Acrocephalus aedon*
87	Dull green leaf warbler	*Phylloscopus trochiloides*
88	Large-billed leaf warbler	*Phylloscopus mangirostris*
89	Rubythroat	*Erithacus pectoralis*
90	Blue chat	*Erithacus brunneus*

Sl.No.	Common Name	Scientific Name
91	Magpie robin	*Copsychus saularis*
92	Jerdon's bush chat	*Saxicola jerdoni*
93	Fire-breasted flowerpecker	*Dicaeum ignipectus*
94	Forest wagtail	*Motacilla indica*
95	White wagtail	*Motacilla alba*
96	Yellow-backed sunbird	*Aethopyga siparaja*
97	Little spider hunter	*Arachnothera longirostris*
98	Black-breasted weaver bird	*Ploceus benghalensis*
99	Streaked weaver bird	*Ploceus manyar*
100	Black-headed Munia	*Lonchura malacca*
Raptiles		
1	Diard's blind snake	*Typhina diardi diardi,* Schlegel
2	Indian rock python	*Python molurus molurus,* Linn
3	Laurentis earth snake	*Cylindrophis rufus burmanus,* Smith
4	Dhaman (Rat Snake	*Ptyas mucosus,* Linn
5	Indo-Chinese rat snake	*Ptyas korrs,* Schlegel
6	Manipur green snake	*Opheodrys doriae,* Boulenger
7	White-striped kukri snake	*Oligodon albocinctus,* Cantor
8	Common kukri snake	*Oligodon arnensis,* Shaw
9	Spot-tailed kukri snake	*Oligodon dorsalis,* Gray
10	Wolf snake	*Lycodon jara,* Shaw
11	Collared black-headed snake	*Sibynophis collaris,* Grey
12	Green rat snake	*Zaocys nigromarginatus,* Blyth
13	Himalayan keelback	*Natrix himalayana,* Gunther
14	Checkered keelback	*Xenochrophis piscator*
15	Common keelback	*Natrix punctulata*
16	Red-necked keelback	*Rhabdophis subminiata,* Schlegel
17	Tawny cat snake	*Boiga ochracea,* Gunther
18	Indian gamma	*Boiga trigonata,* Schneider
19	Large spotted cat snake	*Boiga multimaculata,* Boie
20	Eastern gamma	*Boiga gokool,* Gray
21	Whip snake	*Ahaetula prasinus,* Boie
22	Bronze-backed snake	*Ahaetula subcularis,* Poulenger
23	Mock viper	*Psammodynastes pulverulentus,* Boie
24	Iridescent snake	*Blythia recticulata,* Blyth
25	Striped-neck snake	*Liopeltis frenatus,* Gunther
26	Trinket snake (Copperhead)	*Elaphe radiata,* Schlegel
27	Banded krait	*Bungarus fasiatus,* Schneider
28	Blue krait	*Bungarus caeruleus,* Schneider
29	King cobra (Monocellate)	*Naja naja kauthia,* Linn
30	Hamadryad (King cobra)	*Ophiophagus hannah,* Cantor
31	Russell's viper	*Vipera russelli,* Shaw
32	Blotched pit viper	*Trimeresurus monicola,* Gunther
33	Bamboo pit viper	*Trimeresurus gramineus,* Shaw
34	Green pit viper	*Trimeresurus albolabris,* Gray
35	Spot-tailed pit viper	*Trimeresurus erythrurus,* Cantor
36	House lizard	*Gekko gecko,* Linnaeus
37	House lizard	*Hemidactylus bowringi,* Gray
38	House lizard	*Hemidactylus garnoti,* Dumeril & Bibon
39	House lizard	*Cosymbotus platyurus,* Schneider
40	Flying lizard	*Draco norvilli,* Aloock
41	Garden lizard	*Calotes versicolor*
42	Garden lizard	*C. mystaceus,* Dumeril & Bibon
43	Garden lizard	*C.jerdoni,* Gray
44	Garden lizard	*C. microlepis,* Boulenger
45	Scin lizard	*Mabuya multifaciata,* Schneider
46	Scin lizard	*M. macularia,* Dumeril & Bobin

Sl.No.	Common Name	Scientific Name
47	Scin lizard	*M. novemcarinata,* Anderson
48	Scin lizard	*M. quadricarinata,* Boulenger
49	Scin lizard	*Dasia olivacea,* Gray
50	Scin lizard	*Lygosoma maculatum,* Blyth
51	Monitor lizard	*Varanus bengalensis,* Daudin
52	Monitor lizard	*Varanus salvador,* Laurenti
53	Water turtle	*Cyclemys dentata,* Gray
54	Box turtle	*Cuora amboinensis,* Daudin
55	Roofed turtle	*Kachunga tentoria,* Gray
Amphibians		
1	Common toad	*Bufo melanostictus,* Schneider
2	Toad Yazdani & Chanda	*Bufoides species,*
3	Indian Bulfrog	*Rana tigrina,* Doudin
4	Indian cricket frog	*Rana limnocharis,* Boie
5	Indian burrowing frog	*Rana breviceps,* Schneider
6		*Amolops afganus, Gunther*
7		*Micrixalus borealis, Annandale*
8	Tree frog	*Hyla annectan,* Jerdon
9	Narrow mouthed frog	*Microhyla ornata,* Dumeril & Bibon
10	Narrow mouthed frog	*Kaloula pulchra,* Gray
11	Tree frog or, Banana frog	*Polypedates leucomystax,* Gravenhorst
12		*Ichthyophis species*
13	Salamander or Himalayan Newts	*Tylototriton verrucosus,* Anderson
Fishes		
1	Nganap	*Acantophthalmus pangia*
2	Nganap	*Acantophthalmus longpinnis*
3	Ngaril Laina	*Anguilla bengalensis*
4	Ngachou	*Aorichthys aor*
5		*Aspidoparia morar*
6		*Aspidoparia ukhrulensis*
7	Ngarel	*Bagarius bagarius*
8	Ngarel	*Bagarius yarrelli*
9		*Balitora brucei*
10	Khabak	*Bangana dero*
11	Ngawa	*Barilius barila*
12	Ngawa	*Barilius barna*
13	Ngawa	*Barilius bendelisis*
14	Ngawa	*Barilius chatriensis*
15	Ngawa Phuri Thungbi	*Barilius dogarsinghi*
16	Ngawa	*Barilius ngawa*
17	Ngawa	*Barilius tileo*
18	Ngarang	*Batasio tengana*
19	Sareng Khoibi	*Botia berdomorei*
20	Sareng Khoibi	*Botia dario*
21	Sareng Khoibi	*Botia histrionica*
22	Nung-nga	*Brachydanio acuticephala*
23	Katla, Bao	*Catla catla*
24	Thang-gol Pubi	*Chagunius chagunio*
25	Ngarang	*Chagunius nicholsi*
26		*Chela laubuca*
27	Mrigal	*Cirrhinus mrigala*
28	Khabak	*Cirrhinus reba*
29	Ngakra	*Clarias batrachus*
30	Ngaroi	*Crossocheilus burmanicus*
31	Grass Carp (Napi Chabi)	*Ctenopharyngodon idellus*
32	Puklaobi	*Cyprinus carpio*
33	Nung-nga	*Danio aequipinnatus*

Sl.No.	Common Name	Scientific Name
34		*Danio devario*
35		*Danio naganensis*
36		*Danio yuensis*
37	Ngasang, Belunpaibi	*Esomus danricus*
38	Ngahei	*Eutropichthys vacha*
39		*Exostoma stuarti*
40	Ngarang, Ngayek	*Gagata cenia*
41	Silver carp	*Hypopthalmichthys molitrix*
42	Ngaton. Khabak	*Labeo bata*
43	Ngathi	*Labeo calbasu*
44	Ngathi	*Labeo fimbriatus*
45	Kuri	*Labeo gonius*
46	Ngatin	*Labeo pangusia*
47	Rou	*Labeo rohita*
48	Ngakrijou	*Lepidocephalus berdmorei*
49	Nganap Nakuppi	*Lepidocephalus irrorata*
50	Ngasep	*Mystus cavasius*
51	Nganan	*Mystus microphthalmus*
52		*Mystus pulcher*
53	Nganan	*Nangra viridiscens*
54	Ngara	*Neolissochilus hexagonolepis*
55	Ngara	*Neolissochilus stracheyi*
56	Ngatin	*Ompok bimaculatus*
57	Pengba, Tharak	*Osteobrama belangrei*
58	Ngaseksha	*Osteobrama cunma*
59	Nung-nga	*Poropuntius burtoni*
60	Nung-nga	*Poropuntius clavatus*
61		*Pseudechenis sulcatus*
62		*Psilorhynchus balitora*
63		*Psilorhynchus microphthalmus*
64	Phabou Nga	*Puntius chola*
65	Phabou Nga	*Puntius conchonius*
66	Japan Puthi	*Puntius javanicus*
67	Heikak Nga	*Puntius jayarami*
68	Ngakha Meingaangbi	*Puntius manipurensis*
69	Nganoi, Ngahou	*Puntius sarana orphoides*
70	Nganoi, Ngahou	*Puntius sarana sarana*
71	Phabou Nga	*Puntius sophore*
72	Phabou Nga	*Puntius stoliczkanus*
73	Ngakha Meingaangbi	*Puntius ticto ticto*
74	Ngawa	*Raiamas bola*
75	Ngawa Thangong	*Raiamas guttatus*
76	Nung-nga	*Rasbora rasbora*
77		*Salmostoma sladoni*
78	Sana-nga	*Schizothorax richardsonii*
79	Ngakoi	*Semiplotus manipurensis*
80	Ngara	*Tor putitora*
81	Ngara, Ngakreng	*Tor tor*
82	Sareng	*Wallago attu*

Source: Working Plan for Western Forest Division Tamenglong and Bishnupur, Central & Thoubal Forest Divisions and Working Plan of Senapati District

253. On account of decimation of the game animals and birds carried out through the ages due to hunting for meat and trophy and intolerance of the people to wildlife and the progressive destruction of habitat, several species like Clouded Leopard (*Neofelis nebulosa)*, Barking Deer (*Muntiacus muntjak)*, Sabeng etc. once abundant have now

become extinct from forests in the project area. The forests in the project area have been the habitat, from times immemorial, of large variety of mammals, birds, reptiles and fishes. Besides monkeys, gibbons, wild-cats, goats, pigs, porcupines, pangolins, foxes and wild dogs, these forests were noted for its black bears which were found in the hills adjoining the valley. The Malayan species such as Slow Loris (*Nycticebus coucang)* and a variety of pheasants were also found. The bears, leopards, civet cats are no longer seen in these forests. Table 61 present species listed in schedules of the Wildlife (Protection) Act, 1972 from the project affect forest areas.

Table 61: List of species listed in schedules of The Wildlife (Protection) Act, 1972

S. No.	Common Name	Scientific Name	Local Name	Family
Schedule I				
Mammals				
1	Clouded Leopard	*Neofelis nebulosa*		Felidae
2	Leopard cat	*Felis bengalensis*	*Keisal*	Felidae
3	Golden Cat	*Felis timminki*	Tokpa	Felidae
4	Hoolock	*Hylobates hoolock*		
5	Pangolin	*Manis crasiscaudata*	Saphu	Manidae
6	Slow loris	*Nycticebus coucang*		
Birds				
1	Great Indian hornbill	*Buceros bicornis*	Langmeidong	Bucerotidae (Hornbills)
Schedule II				
Special Game				
1	Bison	*Bos gaurus*		
2	Hog badger	*Arctonyx collaris*		Mustelidae
3	Python	*Python molurus vivitatus*	Lairen	
4	Serow	*Capricornis sumatraensis*	Sabeng	Bovidae
5	Stump tailed macaque	*Macaca speciosa*	Yong Meikakpi	Cereopithecidae
Schedule III				
Big Game				
1	Barking deer	*Muntiacus muntjak*	Shaji	Cervidas
2	Himalayan black bear	*Selenartos thebetanus*	Sawom Amuba	Ursidae
3	Sambar	*Cervus unicolor*	Saajal	Bovidae
4	Wild pig	*Sus scrofa*	Lamok	Suidae
Schedule IV				
Small Game				
1	Otter	Lutra lutra	Sanamba	Mustelidae
2	Mrs. Hume's bar backed pheasant	*Syrmaticus humiae humaie*	Nogyin	Phasinidae
3	Burmese ring dove	*Strepto peia decaocto*		
4	Indian moorhen	*Gallinula chlorophus*	Pat uren	Raffidcae
5	the Bar tailed dove	*Macropygis unchail tusalia*		Columbidae
6	Pheasant tailed Jacana	*Hydro phasia nuschirargus*		Jacanidae

Source: *Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Divisions*

ii. Results of Field Surveys

254. **Avifauna (Birds species).** Altogether 11 species of birds were observed during the wildlife survey in forest areas along the project road alignment. Black-headed bulbul (*Pycnonotus atriceps),* Black-headed yellow bulbul (*Pycnonotus melanicterus*), Purple wood pigeon (*Columba punicea*) and Batek were most commonly observed avifauna in the all

forest areas. The species of Blue-eared kingfisher (*Alcedo meninting*) and White-breasted kingfisher (*Halcyon smyrnensis*) were seen in forest areas adjoining to Ijei and Irang rivers. Besides these birds, Purple wood pigeon (*Columba punicea*), Forest eagle owl (*Bubo nipalensis*), Tawny eagle (*Aquila vindhiana*), Indian golden-backed three-toed woodpecker (*Dinopium javanense*) were also observed. The birds observed in the project area along transect lines are given in below Table 62.

Table 62: Birds species observed in transect line studies

S. No.	Common Name	Scientific Name	Location	Remarks
			Transect Line	
1	Black-headed bulbul	*Pycnonotus atriceps*	*TL-4,5,6,7,8,9,11,12,13,14,16,17, 18,19,21, 22*	
2	Black-headed yellow bulbul	*Pycnonotus melanicterus*	*TL-6,7,8,9,13,14, 16,17,18*	
3	Forest eagle owl	*Bubo nipalensis*	*TL-10*	
4	Tawny eagle	*Aquila vindhiana*	*TL-22*	
5	Indian golden-backed three-toed woodpecker	*Dinopium javanense*	*TL-5, 11*	
6	Blue-eared kingfisher	*Alcedo meninting*	*TL-11*	
7	White-breasted kingfisher	*Halcyon smyrnensis*	*TL-11*	
8	Batek	-	*TL-4,6,8,9,11,12, 14,16,18,19,21*	
9	Orngkothon	-	*TL-19*	
10	Eabao	-	*TL-12,14*	

S. No.	Common Name	Scientific Name	Location	Remarks
			Transect Line	
11	Charoi	-	*TL-11*	

Source: Wildlife Field survey along proposed alignment

255. Altogether 11 species of birds were recorded from fifteen transects line (*TL- 4,5,6,7, 8,9,11,12,13,14,16,17, 18,19,21, 22*) set up at different locations in the forest areas along project road.

256. Transects line 1, 2 & 3 were set up at Kangchup Reserve Forest area within walking distance of settlement areas named Kangchup Chiru and Kangchup Bangla village. Cultivation activities were performed in the area along the proposed alignment. The areas are under human and livestock pressure with movement of human beings. Goat, Cow and Buffalo dung and grazing goats & buffaloes were commonly observed in this Kangchup RF. The sign of forest fire were observed during the survey. Similar to Kangchup Reserve Forest area conditions were noted in the unclass forest area of Tamenglong with signs of hunting were also found. The human movement pressure is comparatively low in protected forest areas of Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest.

257. **Threatened Bird Species.** Based on the secondary source the proposed alignment affected forest areas are possible habitat for one globally threatened species (Great Indian hornbill) and five nationally vulnerable (Mrs. Hume's bar backed pheasant, Burmese ring dove, Indian moorhen, the Bar tailed dove, Pheasant tailed Jacana) birds species. (Table 63).

Table 63: Birds species in Project affected the Forest Area listed in IUCN red list & Wildlife Protection (Act) 1972

S. No.	Common Name	Scientific Name	Family	Category	
				Schedule	IUCN Status
1	Great Indian hornbill	*Buceros bicornis*	Bucerotidae (Hornbills)	I	Near Threatened
2	Mrs. Hume's bar backed pheasant	*Syrmaticus humiae humaie*	Phasinidae	IV	NA
3	Burmese ring dove	*Strepto peia decaocto*	Columbidae	IV	NA
4	Indian moorhen	*Gallinula chlorophus*	Raffidcae	IV	NA
5	the Bar tailed dove	*Macropygis unchail tusalia*	Columbidae	IV	
6	Pheasant tailed Jacana	*Hydro phasia Nuschirargus*	Jacanidae	IV	NA

Source: Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Division

258. As per local community discussion during wildlife survey one globally near threatened species of bird (Great Indian hornbill) was recorded from the forest areas in the project areas.

259. **Wild animals.** The transects no. 2, 3 & 4 were laid along the proposed alignment in Kangchup Reserve Forest area to survey the signs of wild animals movement. None was recorded along in these transects.

260. Total six transect line (TL no. 1, 5,6,7,8 & 9) were set up in Tairenpokpi Tamenglong Protected Forest. In this area signs of animal (footprints & fresh droppings) at transect line no. 5 & 6) of barking deer *(Munitacus muntjak)* and droppings of Jungle/Wild Cat (*Felis chaus)* at transect line no. 5 were observed. The animal sign (droppings) of Clouded leopard (*Neofelis nebulosa)* was found in transect line no. 7, which was near to existing IB road observed with the help of local community. Flying squirrel (*Hylopetes alboniger*) was sighted in the transect line no. 8.

261. In Kangchup Leimakhong Irang Protected Forest area seven transects line (TL no. 10, 11, 12, 13, 14, 15 & 16) were studied. The animal sign (footprints & digging) of wild pig (*Sus scrofa)* were noted in transect no. 10.

262. The remaining six transects were set up in unclassed forest area of Tamenglong in between the chainage km 72+500 to end point of alignment. Slow Loris (*Nycticebus coucang)* and black Squirrel (*S. carolinensis)* was directly sighted in transect line no. 17 & 22, respectively. The details of wild animals observed are presented in Table 64.

Table 64: Details of wild animals observed during survey

S. No.	Common Name *(Local Name)*	Scientific Name	Family	Identification	Location
1	Barking Deer *(Saji)*	*Munitacus muntjak*	Cervidae	P &F	TL-5 & 6
2	Jungle/Wild Cat (*Keijenglang)*	*Felis chaus*	Felidae	P	TL-5
3	Clouded Leopard	*Neofelis nebulosi*	Felidae	P	TL-7
4	Slow Loris	*Nycticebus coucang*	Lorisidae	V & F	TL-17
5	Squirrel *(Kheiroi)*	*S. carolinensis*	Scuridae	V & F	TL- 22
6	Flying Squirrel	*Hylopetes alboniger*	Scuridae	V	TL- 8 & 22
7	Wild Pig*(Wild Boar)*	*Sus scrofa*	Suidae	F & D	TL-10
8	Snake	-	-	F	TL-17

Note: Identification: V=Direct Sighting, P=Pellet, F=Footprint, S=Scat, Sc=Scent, D=Digging;

263. Altogether 7 mammalian species were recorded in and around the project road alignment through direct sighting and sign survey technique. The 7 species belonged to 5 families. Of these two species, Slow Loris (*Nycticebus coucang*) and Flying Squirrel *(Hylopetes alboniger)* were recorded by direct sighting in protected forest area of Kangchup Leimakhong Irang. Signs (droppings & footprints) of Barking Deer *(Munitacus muntjak)* were found in the protected forest area of Tairenpokpi Tamenglong and signs of hunting of Barking Deer were also observed near to transect line no. 5 at chainage km 26+800 to 27+000 (approx.). Clouded Leopard (*Neofelis nebulosa*), Jungle/Wild Cat (*Felis chaus) &* wild pig *(Sus scrofa)* were recorded on the basis of animal signs (droppings) located in transect line no 5 & 7 during field survey.

264. **Animal movement tracks**. In between chainage km 26+000 to 29+800 of proposed alignment there was possible movement of wild animals (barking deer, wild pig & sabeng) across proposed alignment as animals track from hill towards local stream (water source) was found with less slope area of the forest. In this region of Tairenpokpi Tamenglong protected forest area was with minimum human movement due to no track in this region.

265. As per local community observations there was movement of barking deer and wild pig in between chainage km 40+000 to 42+000.

266. In Kangchup Leimakhong Irang protected forest area at km 62+000 to 65+000 of proposed alignment there was possible barking deer movement track across the road section. This region has Irang River to serve as water source for wild animal on the hills.

267. In Bhalok village boundary under unclassed forest area of Tamenglong possible route of wild animal movement from hills to fields across alignment at chainage km 79+000 to 80+000. As per local community from Bhalok settlement there was a movement track for wild animals (tiger, leopard, barking deer & wild pig) crossing proposed alignment at chainage km 90+700 to 91+000.

268. Table 65 shows typical wildlife movement tracks across the proposed alignment of the project road. Locations of the animal tracks and also different wildlife habitats are shown on map in Figure 36.

Table 65: Locations of possible animal movement tracks crossing proposed alignment

Animal tracks from km 26+000 to 29+800 possibly for Barking Deer, Wild Pig & Sabeng

Animal movement track at km 28+700

Route movement for wildboar (pig) between chainage at Km 41-42 km

Possible animal movement route from hill to agriculture fields cross the alignment at chainage km 79 to 80

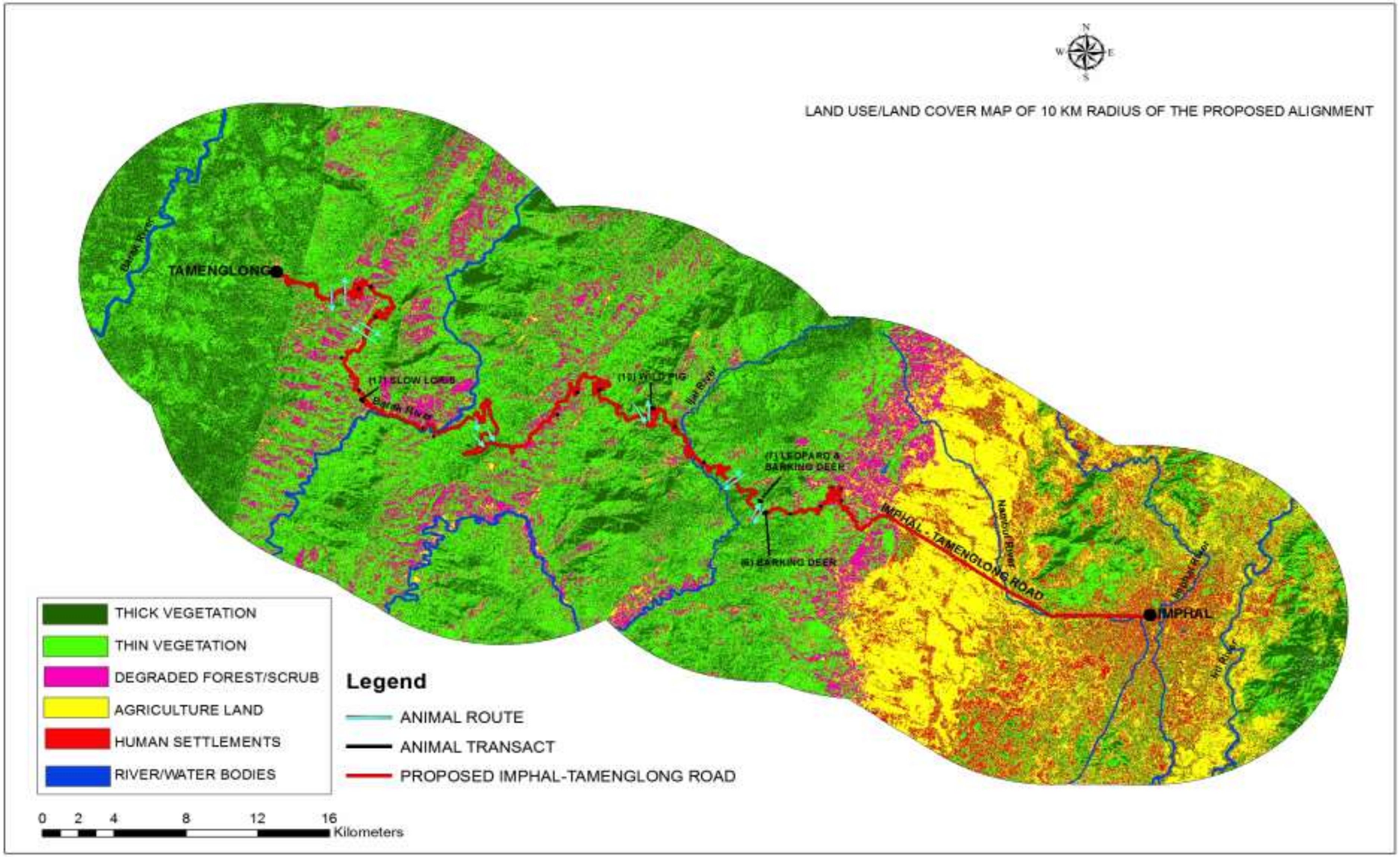


Figure 36: Map showing different Habitats and Wildlife Movement Tracts in the Project Area

269. **Threatened and Endangered Wild Animals.** The working plans of forest divisions recorded that the area along proposed alignment provides shelter to 16 species of wild animals listed in Schedule of Wildlife Protection (Act) 1972 of India. Of these the Hoolock (*Hylobates hoolock)* is endangered, Hog badger (*Arctonyx collaris*) and Otter (*Lutra lutra*) are threatened. Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Serow (*Capricornis sumatraensis*), Sambar (*Cervus unicolor*) are considered vulnerable. Least concerns animals list includes Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*). Table 66 present the list of wild animals reported in the project affected forest area that are listed in IUCN red list and in the Schedule of the Wildlife Protection (Act) 1972 (GoI).

Table 66: Wild Animals in the project affected forest area listed in IUCN red list & Wildlife Protection (Act) 1972

S. No.	Common Name	Scientific Name	Family	Category	
				Schedule	IUCN Status
1	Clouded Leopard	*Neofelis nebulosa*	Felidae	I	Vulnerable
2	Leopard cat	*Felis bengalensis*	Felidae	I	NA
3	Golden Cat	*Felis timminki*	Felidae	I	
4	Hoolock	*Hylobates hoolock*	Hylobatidae (Gibbons)	I	Endangered
5	Pangolin	*Manis crasiscaudata*	Manidae	I	NA
6	Slow loris	*Nycticebus coucang*	Lorisidae	I	Vulnerable
7	Bison	*Bos gaurus*	Bovidae	II	Vulnerable
8	Hog badger	*Arctonyx collaris*	Mustelidae	II	Threatened
9	Serow	*Capricornis sumatraensis*	Bovidae	II	Vulnerable
10	Stump tailed macaque	*Macaca speciosa*	Cereopithecidae	II	NA
11	Barking deer	*Muntiacus muntjak*	Cervidas	III	Least Concern
12	Himalayan black bear	*Selenartos thebetanus*	Ursidae	III	NA
13	Sambar	*Cervus unicolor*	Bovidae	III	Vulnerable
14	Wild pig	*Sus scrofa*	Suidae	III	Least Concern
15	Otter	*Lutra lutra*	Mustelidae	IV	Threatened
16	Python	*Python molurus bvivitatus*	Pythonidae	II	NA

Source: Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Division

270. Of these species of wild animals Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*) are recorded during site survey in the forest areas. Detailed assesment of these species is provided in Annex 16.

271. **Fishes.** There are three main river and their tributaries will be crossed by proposed alignment. Iring, ijei and Irnag are annual following rivers which are habitat of various species of fishes. The information on names and availability of fishes were collected from local community in these rivers. The details are given below in Table 59.

c. Community Discussion

272. Discussions with local community chiefs and local peoples were carried out to know about sighting of wildlife in the forest around their settlements. The wildlife listed in the categories of IUCN and schedules of Wildlife Protection (Act), 1972 were specifically targeted in discussion and information was collected about location of sighting, possible movement tracks, habitats and season of sighting. Barking deer, leaopard, junle cat,

Sabeng, wildpig and sajaan are animals frequently sighted in the forest. Community informed that the frequency of sighting of animals (Hoolock Gibbon, Clouded Leopard, Leopard Cat, Golden Cat, Bear, Great Indian hornbill) is decreasing in the region.

D. Socio-economic Environment

1. Demography

273. Manipur is one of the sisters' states in north eastern state a population of 2.38 million with about more than 75 percent of the population living in the rural areas. The human population density is very less (only 107 persons/km2) compared to 149 persons/km2 for the north eastern region. Sex ratio is 978 against the 936 in the region. The demographic feature of north eastern states is unique in that there are more than 29 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The major minority groups in the state namely Aimol, Anal, Angami, Chiru, Chothe, Hmar, Kabui, Kacha Naga, Mizo, Mao, Lusai etc. The majority of the people survive on subsistence economy based mainly on the agriculture, supplemented with limited horticulture, animal husbandry, crafts/handloom, etc. Table 67 presents the demographic features of the state and the North eastern region.

Table 67: Demographic Features of Manipur and North Eastern Region as per 2001 census (p)

State	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
Manipur	22327	1818224	570410	2388634	107	978
NE Region	262179	33008703	5809395	39041167	149	936
All India	3287263	741660293	285354954	1027015247	312	933

Source: 1) Census of India, 2001 (Provisional), 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, 3) Where do we stand in 2003, Meghalaya & North East and India & The World, Directorate of Economics & Statistics, Government of Meghalaya

274. The Net State Domestic Product at constant (1993-94) prices in the year 2001-02 was Rs.19350 million, with annual growth of around 6 per cent. Per capita income at constant prices in 2001-02 was Rs.7976 (against Rs.10754 for the country as a whole). Agriculture continues to be a major contributor for the economy.

275. The progress on industrial front has been constrained by many factors particularly the lack of appropriate infrastructure, lack of raw materials and trained manpower.

2. Land Resources

276. The area available for land utilization in the state is about 19052 sq.km out of the total geographical area of 22327 sq.km. This means about 85 percent of the area in the state in available under various land uses. Major portion of the land use is under forest cover covering about 70 percent of the land use area. About 8 percent area is under gross cropped area. Agriculture is the second major land use in area. The area under various land uses in the region is presented in the Table 68.

Table 68: Land use pattern in North East Region (Figure in thousand hectare)

State	Reporting area for land utilization	Forest area	Not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Gross cropped area	Net area sown	Area sown more than once	Total
Manipur	1905.2	1741.8	269.5	82.6	3.3	182	140	42	2461.2
NE	21754.5	13379	3296.8	1624	913.6	5448.6	3891.1	1557.5	30110.6

Region									
Source: www.neportal.org (Directorate of Economics and Statistics, NE states and NEC, Shillong).									
Statistical Abstract (2001-02), Sikkim, Directorate of Economics and Statistics, NE States.									

3. Agriculture and Forestry

277. Agriculture is the mainstay of the people. It contributes major shares in the state domestic product and provides employment to about 63 percent of total working force in state. Total net sown area is 160,000 hectares. Rice is principal food grain followed by maize and millets. An annual production of 366,000 tons of rice was registered in 2000-01. Sugarcane is another cash crop.

278. The socio-economic life of people centres on the forests. As mentioned earlier they cover about 70 per cent of the total geographic area of the state. Wide varieties of bamboos, orchids, aromatic and medicinal plants are found in the State.

4. Fisheries

279. Though the state has no marine fishery, it has vast inland fishery resources like ponds, tanks, naturals lakes, marshy areas, swampy areas, rivers, reservoirs, submerged cropped land, paddy field etc. The largest source of fish is the Loktak Lake. The production of fish in Manipur for the year 2001-02 was estimated to be 16.5 thousands tones as against the 16.05 in thousand tons in the year 2000-01 showing an increase of 2.8 percent over the previous years.

280. The important fishes commonly found in the region's plain and river basins are *Catla catla, Labeo rohita,* Labeio *calbase, Cirrihinus mirigale, Clarius, batrachus, Rita rita, Heteropneuptus fonilis, Notopterus nontopterus, N. Chitala, Macrobrachum rosenbergii, M. malconsoni, M. Chapral, Channa punetatus C. gaehua, C. striatus.*

5. Transportation

281. Transportation system is a key factor in the socio-economic development of any state. There is practically no railway network in the state. Two rail heads – one at Dimapur in Nagaland (215 km away from Imphal) and the other at Jiribam (225 km away from Imphal) serves the state. The state has one airport at Imphal, which connects up with the rest of the country. Waterways are also not feasible. Roads, therefore, constitute the only means of transport system in the state for movement of men, materials and services within and outside the state. The total road network stands at around 7200 km, of which 2600 km are unsurfaced roads.

6. Mineral Resources

282. The state has endowed with mineral resources. The main mineral reserves in the state includes lime stone (14.8 thousand tons), clay (2.5 thousand tons), and chromite (0.1 thousand tons). For exploiting the mineral resources, it is important to provide a good road and rail infrastructure. Mineral resources of the Manipur are shown in Figure 37.

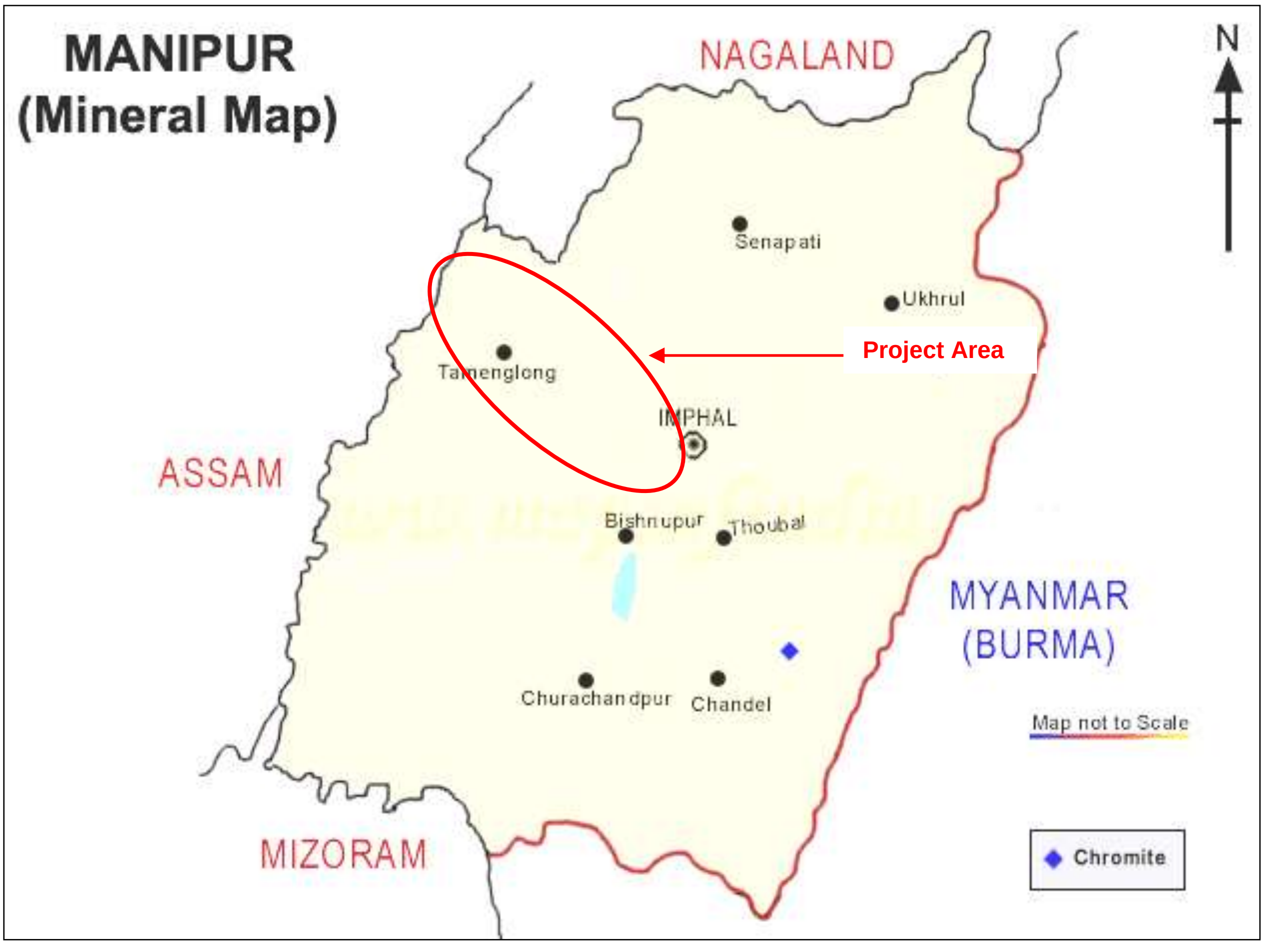


Figure 37: Mineral Map of Manipur State

7. Industrial Situation

283. The State is industrially backward compared to the rest of the country. There is no large scale industry. It has 1 industrial estate, 12 medium scale and 8771 small scale units (2001) giving employment to about 2 lacs people. Lack of roads, power and transport are the major constraints impeding the industrial growth.

8. Aesthetic and Tourism

284. The state has immense scope for promotion of tourism. It has a salubrious climate, exotic greenery and rich flora and fauna besides the rich culture. Keibul Lamjo National Park, the only habitat of Brow Antlered Deer, on the bank of Loktak Lake (the biggest fresh water lake in north eastern India), Khongjom War Memorial are few major tourist spots in the region. During the year 2001, 409 foreign tourists and 10385 thousands of domestic tourists came to the state. The state offers unique opportunity for eco-tourism development.

9. Cultural Resources

285. The state has great cultural value. Festivals and cultural activities are being celebrated throughout the year in the state. The department of arts and cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The state has great cultural value for Buddhism. To promote and preserve the

rich cultural heritage of the state, the department has been organising a number of programmes annually.

10. Energy and Electric Power Potential

286. The state has an installed capacity of 117 MW of power including the power from central sector. It is just able to meet the current demand. With increase in socio-economic development, more power will be required. It is, therefore, necessary to increase power availability in the state.

11. International Trade & Commerce

287. The north eastern region has the potential to emerge as a strategic base for domestic and foreign investors to tap the potential of the contiguous markets of China, Myanmar, Lao PDR, Nepal, Bhutan and Tibet. This calls for converting the unauthorised trade into authorised trade, at the policy level as well as at the ground level. The BIMST-EC (Bangladesh-India-Myanmar-Sri Lanka-Thailand Economic Cooperation) initiative is creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry, technology, human resource development, tourism, agriculture, energy, infrastructure and transportation.

12. Hotspots along the Project Road

288. Inventory of various physical features existing along the project road has been carried out as presented in Table 49. This also includes information about physical features, sensitive zones, sinking areas etc.

289. The various physical features including settlements and senstive areas along the project road are described in Tables 69, 70 and 11.

Table 69: Physical /Sensitive Features along the project road

Location / Chainage (Km)	Features
0-3	Urban - Imphal City, residential settlement continues along the road & commercial area , Plain terrain, River Crossing
3-10	Semi-urban & Rural, Agriculture mixed with residential & commercial landuse at village Lamdeng, Lamsang, Heibong, Lairenkabi, Plain Terrain
11-12	Rural, Agriculture mixed with residential & commercial landuse at village Phaiyeng, Kangchup, Plain Terrain
12-17.8	Rural, Agriculture mixed with forest & residential landuse, village Kangchup Chiru, Hilly Terrain, Stream along the alignment
17.8-25.5	Forest with dense shrubs, trees & in between agriculture, Hilly terrain , residential settlement Kangchup Bangla
25.5-32.95	Dense Forest with Grass on hill top, Kangchup-Chiru (Makang) Reserve Forest, hilly terrain, local stream crossing
32.95-35.4	Forest (with shrubs mixed with trees) & agriculture mixed landuse, hilly terrain, Waphong is residential settlement
35.4-622.35	Mixed Forest & agriculture landuse, hilly terrain, Ijei river, &Iring (Bakhungwa) river crossing, passing through Bakuwa village settlement
62.35-69.4	Forest with shrubs and trees in between agriculture, Hilly terrain, along Irang river, Songphhei, Khaochangpung and Lukhambi settlement
69.35-89.65	Mixed Forest & agriculture landuse, hilly terrain, DuigaThok local

Location / Chainage (Km)	Features
	stream, passing near to Bhalok settlement
89.65-103.2	Mixed forest, agriculture & residential, hilly terrain, Tamenglong and outside development

Table 70: List of Settlement Areas along the Project Road

Sl. No.	Chainage (KM)		Settlement Name
	From	To	
1.	0+000	3+000	Imphal City
2.	3+400 6+100 7+300 9+100	3+900 6+300 8+300 9+400	Lamdeng Lamsang Heibong Lairenkabi
3.	10+200 12+300	11+500 13+000	Phaiyeng Kangchup
4.	13+000	13+600	Kangchup Chiru
5.	20+300	20+800	Kangchup Bangla
6.	33+900	34+400	Wapong
7.	51+500	51+900	Bakuwa
8.	72+500	72+800	Wairangba Part II
9.	76+300	76+500	Wairangba Part III
10.	88+550	89+200	Bhalok Part III
11.	100+500	100+650	Dailong
12.	101+100	101+350	Gadailung
13.	102+350	102+500	Tamenglong Market

Table 71: Location of Sensitive area along alignment

Left Hand Side	Chainage	Right Hand Side
Community Hall & Kangchup Road Young Physical & Sports Association	0.4	
Yumnam Kesho Singh Community Hall	0.5	
	0.6	
Waiting Shed	0.7	
Waiting Shed	0.8	
	1.2	Play Ground
	1.5	Meira Paibi Cum Sintha Shanglen
	1.6	Ch. Thamboumacha Govt. Aided High School
Thodhachandra Market & PHSC Iroisemba National	2.1	
Police Station	2.9	
Lamsang Police Station	3.5	
Lamsang Sport Complex &Lamsang football Club	4.2	Temple
	4.5	Lamdenkhuman Lampak
	4.8	The Public Girls High School (7m)
Praja High School	5.1	
Anganwadi Centre at 8m	5.2	
Youth Centre Lamsang	5.4	
Lamsang Keithel	5.5	
Sana Mahi Temple	6.3	

Left Hand Side	Chainage	Right Hand Side
	7.6	Water Industries at 4m
Heibongpokpi High School	8.1	
Temple (8.6m)	8.4	
Heibongpokpi Lairenkabi School	9.2	
	11.2	Stadium
Phayeng Awang Leikai Bazar	11.5	
	12.5	Don Bosco School Phayeng
U Yaibi School	13.9	
	100	Common Service Centre
Gadailong Primary School	100.1	
	100.2	Hotel & Shops
Electric Department	100.3	
	101.9	Tandai Fellowship Dailong, Dialong Chruch
UBC Church	102	
	102.2	DC Office & Hill police Entrance
DC Banglow Hill	102.3	Hindu Temple
Forest IB Banglow	102.4	
Market (Tamenlong Town)	103	

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

232. This chapter presents key environmental issues associated with various aspects of the proposed project. The environmental impacts caused due to the development of the project road sections can be categorised as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project where as the secondary impacts are those which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action. Interaction of the project activities with environmental attributes is presented as Activity-Impact matrix in Table 72.

Table 72: Activity-Impact Identification Matrix

Sl. No.	Activities	Type of Impact							
		Air	Water	Noise	Flora	Fauna	Drainage	Soil	Topography
1.	Labour camp activities		- ve/t						
2.	Quarrying	-ve/t		- ve/t	- ve/t		- ve/t		- ve/p
3.	Material transport and storage	- ve/t		- ve/t					
4.	Drilling, blasting and hill cutting	- ve/t		- ve/t	- ve/t	- ve/t			
5.	Earthwork						- ve/p	- ve/t	- ve/t
6.	Payment works	- ve/t	- ve/t	- ve/t	- ve/t			- ve/t	- ve/p
7.	Use of construction equipments	- ve/t	- ve/t	- ve/t		- ve/t			
8.	Plantation	- ve/p		- ve/p	- ve/p				
9.	Drainage work						- ve/p		
10.	Culvert and bridge construction		- ve/t	- ve/t			- ve/p		
11.	Stripping of top soil							- ve/p	
12.	Debris generation						- ve/t	- ve/t	
13.	Oil and grease							- ve/t	
14.	Construction in forest and sensitive areas	- ve/t	- ve/t	- ve/t	- ve/t	- ve/t	- ve/p	- ve/p	- ve/p

Notes: t – temporary, p – permanent. Impact indicated in bold letters indicates significant impacts.

233. Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at four different stages, namely:

- the project location;
- design and pre-construction;
- construction; and
- operation stages.

234. A few permanent as well as short-term and long-term adverse effects, mainly at the construction and operation stages, are, nonetheless, anticipated. Temporarty shortl term impacts can be kept in check through proper planning and adopting environment friendly road construction methods and the appropriate regulatory measures.

B. Positive Environmental Impacts due to improvement of subproject road sections

235. The positive impacts expected from the improvement of the Imphal-Kanchup-Tamenglong road section includes:

- improved quality of life for the rural population in the project influence: this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;
- a more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- the facilitation of tourism;
- Reduced distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur;
- Interstate connectivity to Imphal and Tamenglong Districts;
- Shortest connectivity for the State to East West Corridor of National Highways Authority of India, and
- Connectivity to the Asian Highway network.

C. Adverse Environmental Impacts due to improvement of subproject road sections

236. The adverse environmental impacts anticipated from the improvement of the project road section are:

- Change in topography and land use due to acquisition of land for new alignment
- Loss of productive soil and agriculture land,
- Cutting of road side trees that falls within formation width i.e. 10-30 m may reduce the ecological balance of the area and also increase soil erosion problem.
- Noise, air and water pollution and disposal of construction waste, during construction, will adversely impact both local residents. These latter effects should, however, only be temporary/reversible.
- A number of quarries and other sources will be established which will change the landscape. However, the operation of quarries is an independent and already regulated activity. Adverse impacts on water quality of rivers crossing or running parellel to the proposed alignment (i.e. Ijai at chainage km 34.9, Iring at km 51.9 and again at km 72.4, Digha at km 81.5 and again at km 72.5, other local stream/rivers) in the form of silt deposition and runoff during construction are expected. However, this is short term and will be taken care of by controlled construction activities.
- Improvement on existing road and construction of new road and bridges, although limited, may enhance soil erosion, landslips and reduce the micro-level ecological balance of the area. Construction may also disturb the habitation of fauna living in this area. These should, however, be only temporary/reversible effects. The improvement will also require the cutting of about 2732 trees.
- Minor impacts of noise and air quality for those now living and workings close to the project road (mainly at Imphal, Kanchup, and Tamenglong) will deteriorate during the construction period and afterwards during operation.

D. Impacts Related to Project Location, Preliminary Planning and Design

1. Land Acquisition and Loss of Productive Land

237. Except intial 13 km section, project road alignment will pass through hilly terrain and it is a greenfield alignment which would require construction of new roads. This will require acquisition of about 270 hectare (30 m ROW for 90 km length) of land for road right of way. Although land acquisition requirement has been kept to minimum level, it will have impacts on topography and change in land use in the region. Loss of agriculture land and productive soil is also anticipated due to additional land acqusition. To minimize land acquisition and soil productivity, the following mitigation measures have been /will be adopted during the detailed design and construction stage of the project:

- Alignment will be adjusted to avoid and minimize acquisition
- Topsoil management during construction.
- Use of existing tracks to the extent possible.

2. Forest Clearing and Tree Felling

238. Most of the project road (except Imphal to Kanchup section) passes though hilly terrain with patches of forest areas. About 2.1 km length of subproject road passes through Kanchup reserve forest area. Adverse impacts due to diversion of about 6.3 hectares of forest land are anticipated. Also land clearing will involve cutting of about 2732 trees. Problem of soil erosion is expected in some locations. To minimize loss of trees, the following mitigation measures have been /will be adopted during the detailed design and construction stage of the project:

- Widening proposal considered option with minimal tree cutting.
- Widening is restricted to minimum width in the length passing through forest areas.
- Adequate measures are included in the design to minimize any unforeseen impacts on flora and fauna in the forest areas.
- Land stabilization measures were included in identified areas prone to erosion.
- strictly enforce the environmental conditions put as part of the environmental clearance by the MoEF and SPCB.
- adopting Environmental Friendly Road Construction (EFRC) methods.

239. The improvement of the proposed road in greenfield area willl involve cutting, filling, and the need to cut vegetation along most of the project road length. This will have more significant impact and this matter is discussed in the following sections.

240. In forests areas (particulary about 2.1 km section on Kunchup-Tamenglong road - Table 51), it is particularly important that the road improvement works should minimise environmental impacts from inadequate drainage and/or slope failures and should assist in maintaining, or repairing, forest cover. Table 73 list out the locations of the forest area along the project road.

Table 73: Sections of Subproject Road Passing through Forest Area

Sl. No.	Name of Reserve / Protected Forest	District	Chainage	
			From (Km)	To (km)
1.	Kangchup-Chiru Reserve Forest	Senapati	17+200	19+300
2.	Tairenpokpi-Tamenglong Protected Forest	Tamenglong	24+000	35+000
3.	Kangchup Leimakhong Irang Protected Forest	Tamenglong	35+000	72+400
4.	Unclassed Forest	Tamenglong	72+500	97+900

241. Based on the tree inventory carried out during the field surveys in July-October 2014, the total number of trees to be cleared along Imphal-Tamenglong section is 2732. Table 74

present details of the trees to be cut due to proposed road improvement. As per compensatory afforestation requirement, the tree plantation will be done three times of tree cutting (1:3 of tree cutting). At sensitive locations such as schools, colleges and hospitals along the project road noise barrier shall need to be provided.

Table 74: Detail of trees within formation width of the proposed alignment

Section	Chainage (km)		Left Hand Side (LHS)	Right hand Side (RHS)	Type of Trees (local name)
	From	To			
Imphal to Kangchup Chiru	0.0	13.0	474	494	Nasik, Gulmohor, Boroi, Jam, Baraphi, Heibong, Tairm, Mango, Heikha, Neem, Sorokhi, Tumitla, Khongnang, Heinou, Konbla, Uyumg, Pungton, Jamun, Yongchak, Theibong, Heirik, Ouchan, Teak, Sayee, Kaygay, Kwa, Tera, Thibong, Qurei, Hawaizar Mana Panbi, Lairik Heibi, Kongong Thopki, Bhushlei
Kangchup Chiru to Kangchup Bangla*	13.0	26.0	62	53	
Kangchup Bangla to Khebuching	26.0	71.0	Alignment through green field -mostly forest with dense shrubs & trees in between on hill terrain		
Khebuching to Tamenglong	71.0	103.2	815	834	
	Total trees to be cut (Nos)		**1351**	**1381**	
			2732		

Source: Field Survey carried out by the Consultant Team, 2014
Note: The exact number of trees to be cut might vary from these figures. Joint inspection with forest range officers shall be carried out to estimate the number and type of trees to be cut by improvement proposals. In case of any change, numbers will be updated and accordingly compensatory plan be updated.

242. The compensatory plan is being developed in consultation with local forest department. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting) as detailed in Table 75.

Table 75: Details of Trees to be Cut and Planted

Road Section (From / To)	Length (km)	Tree to be cut in the project road	Proposed tree to be planted in the project area in consultation with Forest Dept. (1:3 of tree cutting)
Imphal-Kanchup-Tamenglong	103.02	2732	8196

3. Borrow Pits and Quarries Operation

243. There is a need to establish construction camps and related facilities, such as borrow pits and quarries. These must be located in environmentally sound and socially safe areas. It is expected that construction materials for the road works will be mined mostly from approved quarries. The following criteria is applied for locating the borrow areas:

- Borrow areas are not established in ecologically sensitive areas;
- Villagers are consulted in regard to the design and location of all borrow areas – these should ensure the safety of local communities and, if possible, should incorporate beneficial post construction features for the villages;
- Located away from the road and hill slopes as well as settlements facing the road, so as to minimise visual impacts;

- In case of protected areas/ reserve forest areas, construction facilities such as temporary workers camp, hot mix plants, and concrete batching plant and stone crushers should not be established in stretches that passes through reserve / protected forests. Local forest department / village forest management committees should be consulted before locating these temporary project facilities;
- Construction camps for labourers should be located at least 500 m away from settlements and 1 km away from forest/protected areas;
- Living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer-in-Charge; and
- Toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard.

4. Cultural Heritage

244. There are no adverse impacts anticipated on historical places/monuments. However, there are few small shrines along the road. Care must be taken to avoid any damage to these structures. Earthworks, as associated with the road construction/improvement works, or deriving from secondary sites such as quarries or borrow pits, may reveal sites or artifacts of cultural/archaeological significance. In the event of such discovery, the concerned authorities should be informed and the requirement to take such action should be incorporated in contract documents.

5. Other Impacts deriving from the Project Planning and Design Process

245. During preliminary planning and design of this project, the Consultant has taken into account the need for:

- optimum sitting and control of borrow areas;
- reduced incidence of slope failures due to inadequate drainage;
- providing adequate culverts/drains;
- providing side-drainage structures;
- mechanised construction methods and thereby, for example, reduced use of firewood for heating bitumen;
- maximising safety and thereby reducing traffic accidents;
- reducing travel times and, thereby, fuel consumption and emissions;
- adequate signages for wildlife protections,
- increased accessibility for residents to education and health facilities, markets etc., and for others who might come for tourist or other purposes; and
- improving the socio-economic conditions of residents in the project areas of influence.

246. As part of the engineering works for this work, the following guiding principles have been used in determining the alignments:

Environmental Issue	Measures taken
Alignment	Final alignment has been determined so as to minimise land take, tree removal, air pollution and the impact on people and animals and to avoid unfavourable geological condition and cultural relics.
Balancing cut and fill	The design attempted to equalise cut and fill. The centreline has been aligned so that on all slopes below 60 degrees, half cut and half fill is achieved.
Soil erosion	Temporary and permanent drainage systems have been designed to minimise the soil erosion.

Environmental Issue	Measures taken
Dust and air pollution	Borrow sites, waste disposal sites and asphalt mixing sites have been identified – keeping in mind environmental issues such as dust.
Cultural heritage	Any archaeological sites identified along the alignment should be excavated prior to construction.
Wildlife Habitat	Care has been taken in preservation of wildlife and construction workers should be educated on wildlife protection.

E. Environmental Impacts - Construction Stage

1. Permits and Clearances

247. As a requirement of Environmental Impact Assessment Notification, 2006, by Government of India, any development activities should not be taken in any part of the Country unless it has granted environmental clearance by the Ministry of Environment and Forests, Government of India.

248. Highways are classified as one of the project, listed in said notification, which require prior clearance. However, an amendment to this notification clarifies, that the highway improvement projects are excluded from purview of this notification. Some of the relevant applicable sections are:

i) Although the proposed project interventions are primerly limited to the improvement of exisiting state highway section and village/districts roads/tracks and the alignment does not pass through any environmentally sensitive areas, part of the project road between Kanchup and Tamenglong is located at an altitude of > 1000 m above MSL. Also majority of the proposed alignment between Kanchup and Tamenglong is new greenfield alignment in hilly terrain. Therefore it falls in the purview of Notification no. S.O. 195(E) dated 19 January 2009 by the Ministry of Environment and Forests on amendment to the EIA Notification, which states that 'All State Highway projects and State Highway expansion projects in hilly terrain or in ecologically sensitive areas' need to get environmental clearance prior to construction activities. It is further defined that hilly terrain is defined as 'All projects located at altitude of 1000 meter and above'. Accordingly, for the proposed road improvement project, implementing authority has to apply for environmental clearance from the State Level Environmental Impact Assessment Authority (SEIAA).

ii) As per the Forest Conservation Rules (1981, amended 2003) a forestry clearance from Department of Forests is required for diversion of forest land for non-forest purpose. Processing of the forestry clearance entails two stages: stage I and stage II. Amongst other requirements stage I clearance requires the applicant to make payments for compensation of forestry land that will be acquired and trees that will be cut under the project. Accordingly timely allocation of budget for this purpose by the applicant is necessary to expedite the clearance process. Although there are no notified protected areas along the proposed Imphal-Kanchup-Tamenglong road subproject, about 2.1 km long section passes through Kanchup Chiru Reserve Forest. Also road section between Kanchup and Tamenglong (hill section) is declared as protected forest and it does require diversion of forest land. Therefore forest clearance is required as per Government of India requirements.

iii) Cutting of trees in non forest land require a tree cutting permit from the local forestry department. All trees cut under a project must be compensated by compensatory afforestation as required by the State Forest Department.

iv) As per Office Memorandum (OM) issued by MOEF on 19 March 2013 the grant of environmental clearance for linear projects including roads has been delinked from the forestry clearance procedure. Hence, after receipt of environmental clearance construction works may commence on sections/parts of a linear project that do not require forestry clearance. Construction works may commence on sections requiring forestry clearance only after receipt of the respective clearance.

v) Placement of hot-mix plants, quarrying and crushers, batch mixing plants, discharge of sewage from construction camps requires No Objection Certificate (Consent to Establish and Consent to Operate) from State Pollution Control Board prior to establishment.

vi) Permission from Central Ground Water Authority is required for extracting ground water for construction purposes, from areas declared as critical or semi critical from ground water potential prospective by them.

249. Before the start of civil works for any section of subproject the project proponent (State PWD) must obtain necessary clearances / permits from the regional office of the Ministry of Environment and Forests and State Pollution Control Board. Table 5.5 outlines the applicable clearances and permits and the authorised bodies that issue them along with the procedures involved. The status of the permits / clearances has also been presented in this Table 76.

Table 76: Clearances and Permits Required for the Subprojects

Sl. No.	Clearance/ Permit	Authorised body	Procedures involved	Time involved	Responsibility
1.	Environmental Clearance	SEIAA, Manipur	Submission of detailed documents including Form 1, Environmental Impact Assessment Report, Alignment Plan and feasibility report. Since this is State highway project EC will be given by EAC of SEIAA.	Approx. 6 months or more	PWD
2.	Forest Clearance	Regional Office of MoEF, Shillong	Detailed proposal in appendix specified in Forest (Conservation) Act, 1980 along with project report and necessary details of tree felling. Local division office will forward after joint verification of site and preliminary scrutiny of proposal to PCCF office for approval. Joint verification and enumeration of trees to be cut shall be done by division office and after approval shall be allowed to cut.	Approx. 6 months or more	PWD
3	Clearance for quarry sites	Department of Geology and Mines,	Submission of application for quarry site to mining department. Department of	Takes between 3	Contractors

Sl. No.	Clearance/ Permit	Authorised body	Procedures involved	Time involved	Responsibility
		Govt. of Manipur, Imphal	mines and geology after scrutiny of application and consultation with forest department and revenue department together with site verifications will give approval with specific conditions.	months and six months.	
4	Clearance for blasting	State Mining Department, Imphal	Detailed application with blasting locations and amount of blasting shall be submitted to DoM. Mining department may issue the conditional approval.	2 to 6 months	Contractors

250. Any felling of trees requires forestry clearance and appropriate permits. The procedures necessary to obtain such permits will require liaison with local territorial forestry offices and their head office in Imphal. Joint verification and making of trees to be cut is being carried out jointly with divisional forest departments of districts involved. No clearance is required for the use of surface sand and stone from the river banks as for commercial purposes they can only be purchased in an open auction carried out by the forestry office. It is imperative that all necessary clearances and permits be obtained before commencement of work.

2. Physical Environment

a. Topography, Geology and Soil

251. During the improvement works for the road section, the cutting of hill slope, filling, the cutting of trees, stone quarrying, and construction of structures, the micro-level topography may change. With proper planning, these topographical impacts can be kept within acceptable limits and sometimes even used to enhance local aesthetics. Any negative impacts on topography (existing or new), particularly soil erosion due to a lack of drainage facilities, will be minimised with the provision of proper drainage facilities such as culverts, causeways etc.

252. The terrain and geological conditions of area are such that, even with reasonable care exercised during final design, during construction the interaction between proposed road features and existing land features may reveal/result in significant land instabilities.

253. During the construction phase following restrictions should be imposed:

- existing vegetation including shrubs and grasses along the road (except within the strip directly under embankments or cuttings) should be properly maintained;
- sites for quarrying, borrowing and disposal of spoils are to be confirmed according to the applicable laws and regulations in the state and the practices followed in recent/ongoing internationally funded road projects should be continued;
- controlled and environmentally friendly quarrying techniques should be applied to minimise erosions and landslides;
- blasting should not be carried out during busy periods; and
- cut material should be disposed of in suitable depressions.

254. It is also important to:

- maintain adequate vegetative cover above and below the road;
- maintain the natural course of water bodies (that is as far as possible) and avoid throwing debris into stream courses;
- construct proper drainage structures to avoid erosion; and
- minimise the construction of hair-pin bends that are close to each other: as this often adds to instability.

255. Given the existence of high slope and high rainfall in almost entire project area and weak geology in some areas, it is inevitable that some sites will face problems of erosion, mostly debris slides.

b. Erosion, Silt Run-Off and Landslides

256. Contraction work in Kanchup to Tamenglong section of the project road will be virtually through mountainous terrain with steep and unstable slopes. Much of areas in this section are geologically young, resulting in soft/fragile substrates. Another complicating factor is the high monsoon rainfall throughout most parts of the project road. These factors mean that project area conditions are amongst the most difficult in the region for road construction. Landslides frequently caused by inappropriate construction techniques, slope instability, and inadequate drainage are major problems and are associated with all types of road construction. It should be noted that a significant number of landslides that occur in the vicinity of road are caused by factors/features only indirectly linked to the road itself – frequently, irrigation channels, logging, quarrying and cultivation practices. To control these, following measures are suggested by local environmental authorities:

- logging immediately above road should be restricted to reduce erosion/landslide potential;
- quarrying along road ROW should be restricted;
- excavated material should be properly disposed of and not simply dumped downhill;
- adequate reclamation (e.g. fertilisation and reseeding) along denuded ROW should be implemented;
- particular care should be given to providing adequate drainage;
- careful supervision/training of blasting technicians is required; and
- to the largest extent possible, care should be taken to avoid sacred and religious sites.

257. Previous studies by the Border Road Organisation and CRRI indicate the need to incorporate the following measures:

- balance cut and fill: with a prohibition on the dumping of spoil over the road edge – thus minimising erosion;
- more frequent use of retaining walls - to control landslips;
- improved drainage - again so that erosion is minimised;
- controlled blasting in rock-cut areas - to minimise erosion; and
- use of bioengineering technique for slope protection: use of native species of plants and shrubs for slope stabilisation.

258. Unstable, uncompacted road embankment materials and exposed material can result to soil erosion, clogging of side drains and the spill-over of rainwater runoff onto the road surface and down slopes. These cause landslides and hinder traffic movement. These problems can be mitigated by maintaining the batter gradients as specified in the MoRTH guidelines. The existing vegetation on slopes outside the immediate area of construction must remain undisturbed during construction and/or upgrading. Bioengineering techniques will be used to prevent barren slopes and to stop soil erosion and to protect the animals from

grazing animals. Support structures will be installed where slope failures are anticipated or may have occurred previously. Slope failures should be monitored and remedial actions initiated at the earliest possible time.

259. Construction involving rock/soil cutting of hillsides may render hill slopes unstable and increase vulnerability to landslides. Blasting of rocks may also result in landslides.

260. All hill/soil cutting areas should be revegetated as soon as construction activities are completed. At more vulnerable locations, selected bioengineering techniques should be adopted - a combination of bioengineering techniques and engineering solutions such as rock bolting and the provision of bank drains may be required. Solutions will, however, need to be individually tailored by the geo-technical/ environmental experts of the Supervision Consultant. Figure 28 below shows the typical geologically weak zone along the project road.

Image 8: Landslide Prone Location along Tamenglong-Bhalok road

261. Excavation and earthworks should be undertaken during the dry season when the risks from erosion and silt run-off are least. The materials used for surface dressing will consist of aggregates and gravel which do not contain silt. Internationally accepted best practice engineering approaches to minimise landslide and erosion risks and silt run-off will be incorporated into contract documents and monitored during construction.

262. In order to minimise erosion, silt run off and landslides, it will also be important to:
- ensure all embankment grades are not too steep and prone to erosion;
- waste material is not thrown into nearby rivers (Ijai, Iring, Duiga) and cross cutting water bodies;
- temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies;
- topsoil of borrow areas is preserved and used for re-vegetation;
- borrow areas are provided with gentle side slope that are re-vegetated and connected to the nearest drainage channel to avoid the formation of cess pools during the rainy season; and
- control the disposal and ensure the vegetative stabilisation of spoil.

c. Climate

263. The proposed improvement/construction works will be localised activities and the Project will not have significant impact on climatic conditions, such as rainfall, temperature and humidity in the project area. A climate change impact and risk analysis has been carried out using TEEMP model (Chapter 6: Climate Change Impact and Risks) and appropriate adaptation measures are incorporated in the subproject design.

d. Surface and Ground Water, Drainage and Hydrology

264. Given the presence of rivers and streams in the project area and some of them crossing and /or running parallel to project road; improvement of road may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.

265. The natural courses of rivers/streams will be maintained. Appropriate temporary diversions of streams will be made and brought back to their natural course as soon works

are completed in that section. No disposal of construction debris in streams and rivers is allowed.

266. Minor impacts on water resources are expected during the construction phase. The rehabilitation of existing bridges may also cause soil erosion and turbidity in downstream water bodies. To mitigate this, river-bank slope stabilities will be monitored and, if necessary, appropriate remedial measures applied throughout the construction period. Construction work at bridges during rainy season will be minimized to avoid erosion and sedimentation.

267. The likely impacts of surface water movements are changes in the natural drainage systems, downstream scour, and erosion due to constriction in flows. If suspended solid concentrations in the water are affected, this could also affect aquatic river ecology.

268. To mitigate these impacts the following measures should be implemented:

- chemicals and oils are stored in secure, impermeable containers, and disposed of well away from surface waters;
- no vehicle cleaning activity is allowed within 300 m of water bodies/ drains;
- construction camps are equipped with sanitary latrines that do not pollute surface waters;
- the work on bridges and culverts is limited to dry seasons, when many of the smaller streams will have low water - water diversion works can be minimised and the original course restored immediately after the work has been completed;
- drivers are made aware of diversions and other works at bridge construction site to avoid accidents;
- drainage structures are properly designed to accommodate forecast discharges;
- side drain waters must be discharged at every available stream crossing to minimize volume and prevent erosion at discharge point;
- provide lined drainage structures;
- where an increased discharge of surface water endangers the stability of the water outlet, erosion protection measures such as bioengineering measures, ripraps, and check dams are incorporated;
- in areas with high water tables, seepage may occur and side drains and up-slope catch drains must always been lined to avoid percolation; and
- all debris and vegetation, clogging culverts are regularly cleared.

269. Ground water pollution is not envisaged in this subproject.

e. Air Quality

270. During construction air quality may be degraded for short periods due to (i) the exhaust emissions from the operation of construction machinery; (ii) fugitive emissions from brick, concrete, and asphalt plants; (iii) the dust generated from the haulage of materials, exposed soils and material stockpiles; (iv) cutting and filling of hill slope; (v) cleaning of the road; (vi) material loading; (vii) unloading; and (viii) blasting activities. The impact is expected to be localised, temporary and confined to construction areas.

271. Adverse air quality impacts during construction are likely to result from three main sources; (i) emissions from construction equipment, including delivery trucks; (ii) fugitive dust from earth-moving operations and demolition; and (iii) localised increased traffic congestion in construction areas.

272. The adverse impacts on air quality during construction stage were classified and presented in Table 77. There are two types of pollution i.e. dust pollution and pollution from harmful gases.

Table 77: Impact on Air Quality during Construction Stage

Sl. No.	Impact	Source
1.	Generation of Dust (SPM)	• Cutting of slopes towards hillsides • Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense; • Blasting operations; • Activation of landslides and rock falls etc.; • Transportation of raw materials from quarries and borrow sites; • Stone crushing, handling and storage of aggregates in asphalt plants; • Site levelling, clearing of trees, laying of asphalt, construction of bridges; • Concrete batching plants; • Asphalt mix plants – due to the mixing of aggregates with bitumen; and • Construction of structures and allied activities
2.	Generation of polluting gases including SO_2, NOx and HC	• Hot mix plants; • Large construction equipment, trucks and asphalt producing and paving equipment; • The movement of heavy machinery, oil tankers etc. on steep slopes will cause much higher emissions of gases; • Toxic gases released through the heating process during bitumen production; and • Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

273. On the Imphal-Kanchup-Tamenglong road section, it is expected that air quality will be affected to some minor extent by dust and particulate matters generated by construction, vehicular movements, site clearance, earth filling and material loading and unloading. The impacts are expected to be localised, temporary and confined to construction areas. Care should, however, be taken at sensitive urban locations so that harmful impacts can be minimised.

f. Air Quality Modelling and Prediction of Impacts

274. To assess the likely concentrations at the various locations along the project road corridor, the prediction of the pollutant concentrations has been carried out using CALINE-4, a dispersion model based on Gaussian Equation. Detailed analysis is presented in Annex 5. The input parameters for the prediction are detailed in subsequent paragraphs.

275. CALINE-4 is a dispersion model based on Gaussian equation. It is developed by the California Department of Transportation for the prediction of concentrations of critical atmospheric pollutants (CO, NOx and PM10) along the highways. This model employs a mixing zone concept to characterize pollutant dispersion over the highway and can be used to predict the pollutant concentrations for receptors upto 500 m of the corridor. The model uses the baseline data on existing concentration of pollutants and estimates the incremental emissions due to the project.

276. Various input parameters for the prediction of pollutant concentrations are discussed below:

- **Road Geometry:** In the CALINE-4 model the entire length of the selected road section is divided into various links. The terrain is hilly. The division of sections into links has been done in such way, so that the link can be fairly considered as straight stretch of road having homogenous geometry with uniform road width, height, route alignment and traffic volume. The coordinates of end points of links specify the location of the links in the model. The maximum numbers of link in each road section can be 20. The mixing zone width calculated for selected highway corridor is 12m (3 m + 3 m + 6 m) as per guideline provided in CALINE4 model.

- **Emission Factors:** Emission factor is one of the important input parameter in Caline-4 model. In the present study, the emission factors specified by the Automotive Research Association of India (ARAI, 2007) have been used for calculation of weighted emission factors. These emission factors have been expressed in terms of type of vehicles and type of fuel used (for petrol and diesel driven passenger cars). Since, there is only one input requirement for total no. of vehicles in the CALINE 4 model, whereas, there are different categories of vehicles (viz., Two wheelers, Cars, Bus and trucks) with different year of manufacture and fuel used, it is essential that a single value representing the equivalent or weighted emission factors for all the vehicles is input into the model. The emission factor used to estimate WEF are given below in table 5.8. The traffic data are not available for fuel types, therefore average emission factor are used in this study. Thus, WEF expressed in g/mile (converted from gm/km) has been calculated for the present study using methodology given by Sharma et al., 2013. The emission factor for CO used in the present study for different vehicles type are given in table 78. The calculated WEF for CO for peak traffic hours is given in table 79.

Table 78: Emission factors for different types of Vehicle (ARAI, 2007)

Vehicle type	CO Emission factor (gm/km)
Two wheeler	3.08
Three Wheeler	2.50
Cars/Jeep	1.53
LCV	2.02
BUS	8.40
HCV	12.65

Table 79: Weighted Emission Factor for proposed traffic

Year	Weighted Emission factor (g/mile)
2014	4.37
2017	5.32
2019	5.29
2024	5.19
2029	5.07
2034	5.01

- **Meteorological data:** The study was conducted to predict concentrations for worst meteorological conditions. The meteorological parameters such as wind speed, wind direction standard deviation, temperature, mixing height and stability condition are used in model. The wind direction standard deviation was calculated to know the flexibility of wind direction and used as input parameters in worst case run condition. The model has been run with worst case, in which models predicted maximum pollutant concentration.

- **Receptors:** A set of link receptors were taken at various receptor locations within each section at a distance of 5 m, 10 m, 20 m, 40 m, 70m, 100 m and 200 m both sides from edge of the carriageway to know the dispersion of pollutant from the road. The monitoring station are marked as receptor points to compare the monitoring and predicted CO concentrations.

g. Results

277. The model has been setup and run to predict hourly average CO, PM2.5 and PM10 concentrations[10] for year 2014, 2019, 2024, 2029 and 2034 using forecasted traffic data on proposed highway. The predicted hourly average concentration of CO, PM2.5 and PM10 during peak traffic is shown in Tables 80, 81 and 82 for proposed highway project, respectively at four selected receptor locations. The graphical representation of hourly average pollutant concentrations on both side of the road sections shown in Figure 38, 39 and 40 at different locations.

[10] As per NAAQS, 2009, SPM is not listed in the criteria for air pollutants. Instead of SPM, PM10 and PM2.5 are described in the NAAQS by considering its more health impacts. It is PM2.5 and PM10 which are emitting the vehicle exhaust. In ARAI, 2007 published report, we do not have any emission factors for SPM generated from vehicles. Therefore, impacts of the proposed road have been evaluated in form PM2.5 and PM10 instead on SPM.

Table 80: CO predicted concentrations (ppm) along the proposed road for peak traffic hour

Road Stretch	Year	CO concentrations (ppm)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	**-100**	**-70**	**-40**	**-20**	**-10**	**-5**		**5**	**10**	**20**	**40**	**70**	**100**	**200**
Section 1	2014	0	0	0	0	0.1	0.1	0.1		0.1	0.1	0.1	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2024	0	0.1	0.1	0.1	0.1	0.2	0.3		0.3	0.2	0.2	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.4	0.6		0.6	0.5	0.3	0.2	0.1	0.1	0
	2034	0.1	0.3	0.4	0.4	0.4	0.5	0.7		0.7	0.6	0.4	0.4	0.3	0.2	0.1
Section II	2014	0	0	0	0	0	0	0.1		0.1	0	0	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.3	0.3		0.3	0.3	0.3	0.2	0.1	0.1	0
	2034	0.1	0.2	0.3	0.3	0.3	0.4	0.4		0.4	0.4	0.3	0.3	0.2	0.1	0.1
Section III	2014	0	0	0	0	0.1	0.1	0.1		0.1	0.1	0.1	0	0	0	0
	2019	0	0	0	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.3		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0	0.1	0.1	0.1	0.3	0.3		0.3	0.2	0.1	0.1	0.1	0	0
	2034	0.1	0.1	0.2	0.2	0.3	0.4	0.4		0.4	0.3	0.2	0.2	0.1	0.1	0.1
Section IV	2014	0	0	0	0	0	0	0.1		0.1	0	0	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.3	0.3		0.3	0.3	0.3	0.2	0.1	0.1	0
	2034	0.1	0.1	0.3	0.3	0.3	0.4	0.4		0.4	0.4	0.4	0.3	0.3	0.1	0.1

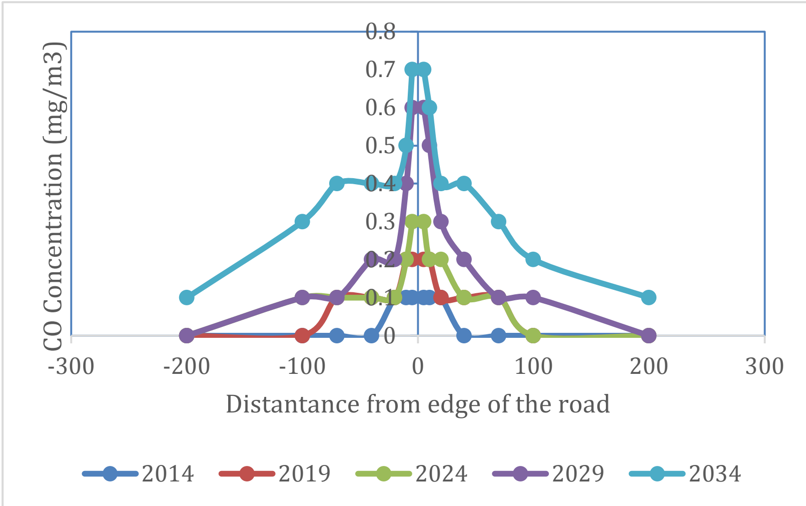
Table 81: PM2.5 predicted concentrations (µg/m3) along the proposed road for peak traffic hour

Road Stretch	Year	$PM_{2.5}$ concentrations (µg/m^3)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	**-100**	**-70**	**-40**	**-20**	**-10**	**-5**		**5**	**10**	**20**	**40**	**70**	**100**	**200**
Section 1	2014	6.57	13.14	18.77	23.46	26.07	29.96	34.84		36.63	31.50	30.56	27.50	22.03	11.01	4.41
	2019	6.93	13.86	19.80	24.75	27.50	31.61	36.76		38.55	33.15	32.16	28.94	23.18	11.59	4.64
	2024	7.50	15.01	21.44	26.80	29.78	34.23	39.8		41.59	35.77	34.69	31.22	25.01	12.51	5.00
	2029	8.38	16.76	23.95	29.93	33.26	38.23	44.45		46.24	39.77	38.57	34.72	27.81	13.90	5.56
	2034	9.99	19.99	28.56	35.70	39.66	45.59	53.01		54.8	47.13	45.71	41.14	32.96	16.48	6.59
Section II	2014	6.43	12.86	18.37	22.97	25.52	29.33	34.11		35.86	30.84	29.92	26.92	21.57	10.78	4.31
	2019	6.79	13.57	19.39	24.23	26.93	30.95	35.99		37.74	32.46	31.48	28.33	22.70	11.35	4.54
	2024	7.35	14.69	20.99	26.24	29.15	33.51	38.96		40.72	35.02	33.97	30.57	24.49	12.24	4.90
	2029	8.20	16.41	23.44	29.30	32.56	37.42	43.52		45.27	38.93	37.76	33.99	27.22	13.61	5.44
	2034	9.78	19.57	27.96	34.95	38.83	44.63	51.90		53.65	46.14	44.75	40.28	32.26	16.13	6.45
Section III	2014	6.30	12.59	17.99	22.49	24.98	28.72	33.39		35.11	30.19	29.29	26.36	21.11	10.56	4.22
	2019	6.64	13.29	18.98	23.72	26.36	30.30	35.23		36.95	31.78	30.82	27.74	22.22	11.11	4.44
	2024	7.19	14.38	20.55	25.69	28.54	32.81	38.15		39.86	34.28	33.25	29.93	23.97	11.99	4.79

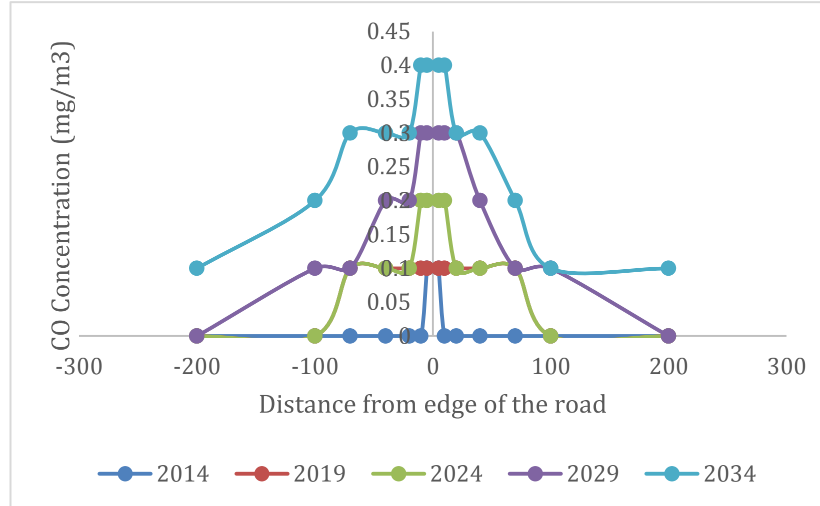
	2029	8.03	16.07	22.95	28.69	31.88	36.64	42.60		44.32	38.11	36.97	33.27	26.65	13.33	5.33
	2034	9.58	19.16	27.37	34.21	38.01	43.69	50.81		52.52	45.17	43.81	39.43	31.59	15.79	6.32
Section IV	2014	6.16	12.33	17.61	22.01	24.46	28.11	32.69		34.37	29.56	28.67	25.80	20.67	10.33	4.13
	2019	6.50	13.01	18.58	23.23	25.81	29.66	34.49		36.17	31.11	30.17	27.16	21.75	10.88	4.35
	2024	7.04	14.08	20.12	25.15	27.94	32.12	37.34		39.02	33.56	32.55	29.30	23.47	11.73	4.69
	2029	7.86	15.73	22.47	28.09	31.21	35.87	41.71		43.39	37.31	36.19	32.57	26.09	13.05	5.22
	2034	9.38	18.76	26.80	33.49	37.22	42.78	49.74		51.42	44.22	42.89	38.60	30.92	15.46	6.18

Table 82: PM10 predicted concentrations (μg/m3) along the proposed road for peak traffic hour

Road Stretch	Year	PM_{10} concentrations ($\mu g/m^3$)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	-100	-70	-40	-20	-10	-5		5	10	20	40	70	100	200
Section 1	2014	13.59	27.19	38.84	48.55	53.95	62.01	72.1		73.89	63.55	61.64	55.48	44.44	22.22	8.89
	2019	14.34	28.69	40.98	51.23	56.92	65.42	76.07		77.86	66.96	64.95	58.46	46.83	23.41	9.37
	2024	15.53	31.06	44.37	55.46	61.63	70.83	82.36		84.15	72.37	70.20	63.18	50.61	25.30	10.12
	2029	17.34	34.69	49.55	61.94	68.83	79.11	91.98		93.77	80.65	78.23	70.41	56.40	28.20	11.28
	2034	20.68	41.37	59.10	73.87	82.08	94.34	109.70		111.4	95.88	93.01	83.71	67.05	33.52	13.41
Section II	2014	13.31	26.62	38.02	47.53	52.81	60.70	70.59		72.34	62.21	60.34	54.31	43.50	21.75	8.70
	2019	14.04	28.08	40.12	50.15	55.72	64.05	74.48		76.23	65.56	63.59	57.23	45.84	22.92	9.17
	2024	15.20	30.41	43.44	54.30	60.33	69.35	80.63		82.39	70.85	68.73	61.85	49.55	24.77	9.91
	2029	16.98	33.96	48.51	60.64	67.38	77.45	90.06		91.81	78.96	76.59	68.93	55.21	27.61	11.04
	2034	20.25	40.50	57.86	72.32	80.36	92.36	107.40		109.1	93.87	91.05	81.95	65.64	32.82	13.13
Section III	2014	13.03	26.06	37.23	46.53	51.70	59.43	69.10		70.82	60.90	59.08	53.17	42.59	21.29	8.52
	2019	13.75	27.49	39.28	49.10	54.55	62.70	72.91		74.63	64.18	62.25	56.03	44.88	22.44	8.98
	2024	14.88	29.77	42.53	53.16	59.06	67.89	78.94		80.66	69.37	67.28	60.56	48.51	24.25	9.70
	2029	16.62	33.25	47.49	59.37	65.96	75.82	88.16		89.88	77.30	74.98	67.48	54.05	27.03	10.81
	2034	19.82	39.65	56.64	70.80	78.67	90.42	105.14		106.8	91.90	89.14	80.23	64.26	32.13	12.85
Section IV	2014	12.76	25.51	36.44	45.56	50.62	58.18	67.65		69.33	59.63	57.84	52.05	41.69	20.85	8.34
	2019	13.46	26.92	38.45	48.07	53.41	61.39	71.38		73.06	62.83	60.95	54.85	43.94	21.97	8.79
	2024	14.57	29.14	41.63	52.04	57.82	66.46	77.28		78.96	67.91	65.87	59.28	47.49	23.74	9.50
	2029	16.27	32.55	46.50	58.12	64.58	74.23	86.31		87.99	75.67	73.40	66.06	52.92	26.46	10.58
	2034	19.41	38.82	55.45	69.31	77.02	88.52	102.93		104.6	89.97	87.27	78.54	62.91	31.46	12.58



Homogenous Section I



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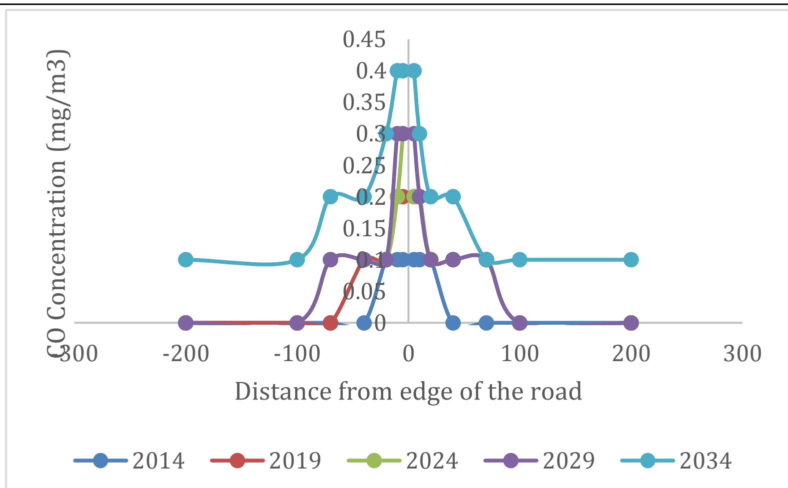

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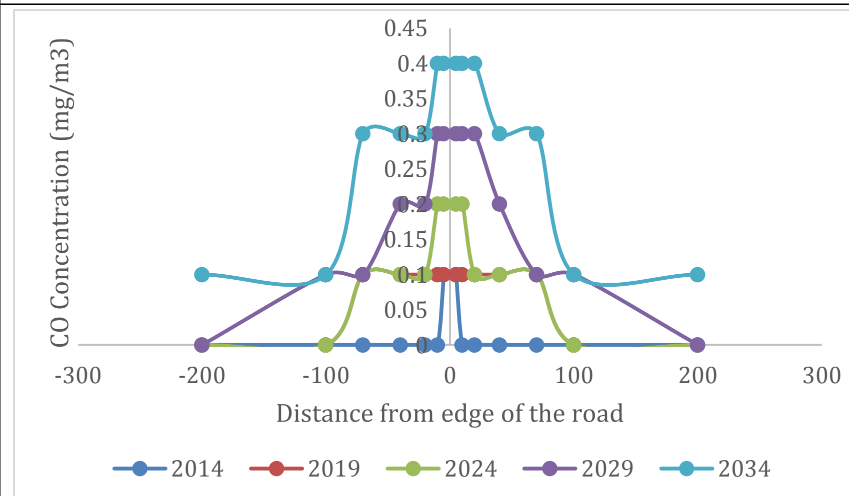
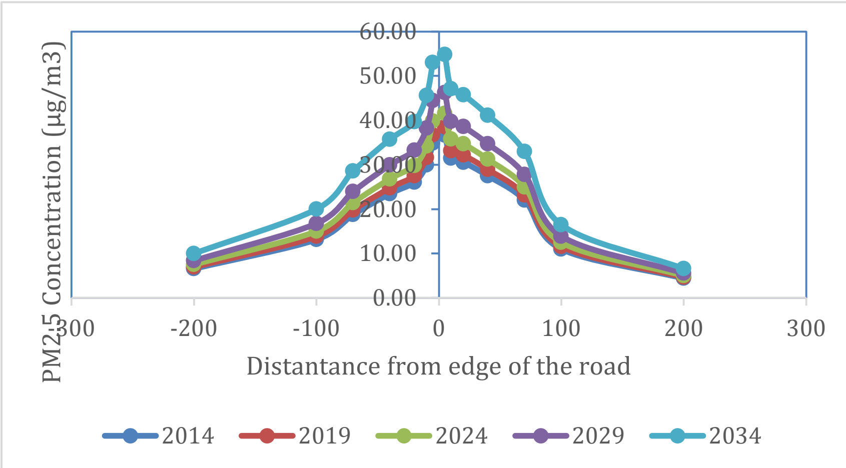


Homogenous Section IV

Figure 38: CO predicted concentrations (ppm) along the Project Road



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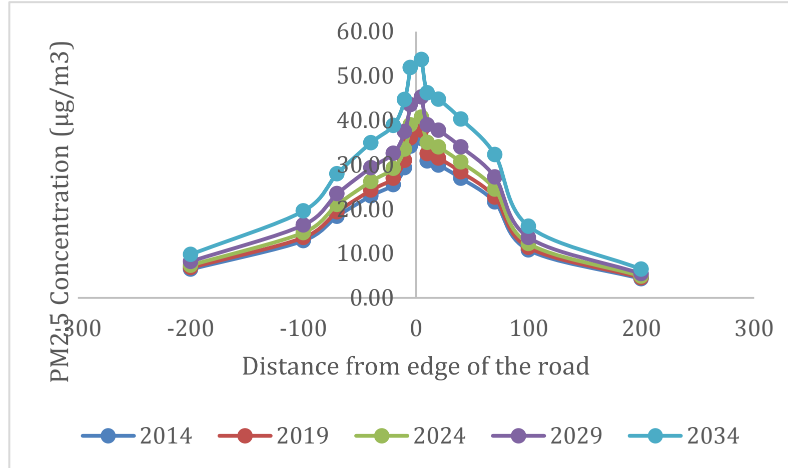

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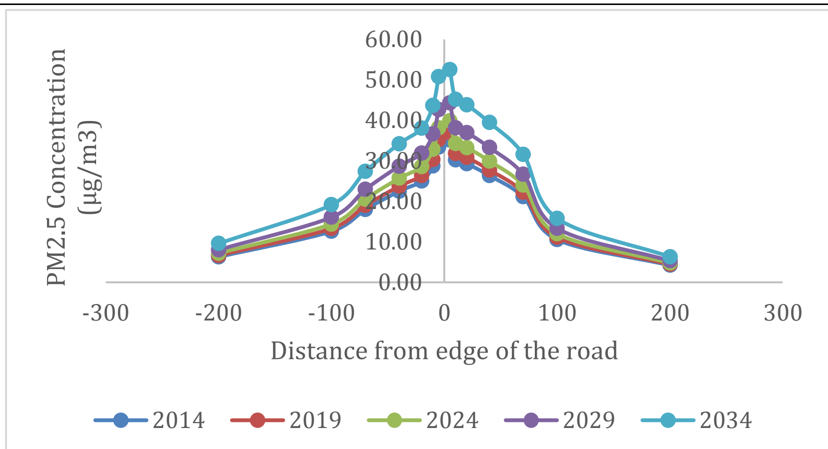
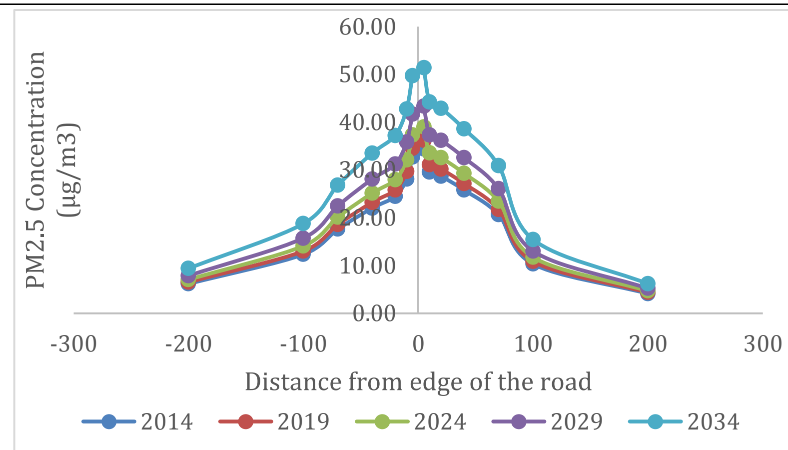


Homogenous Section III



Homogenous Section IV

Figure 39: PM2.5 predicted concentrations (µg/m3) along the Project Road

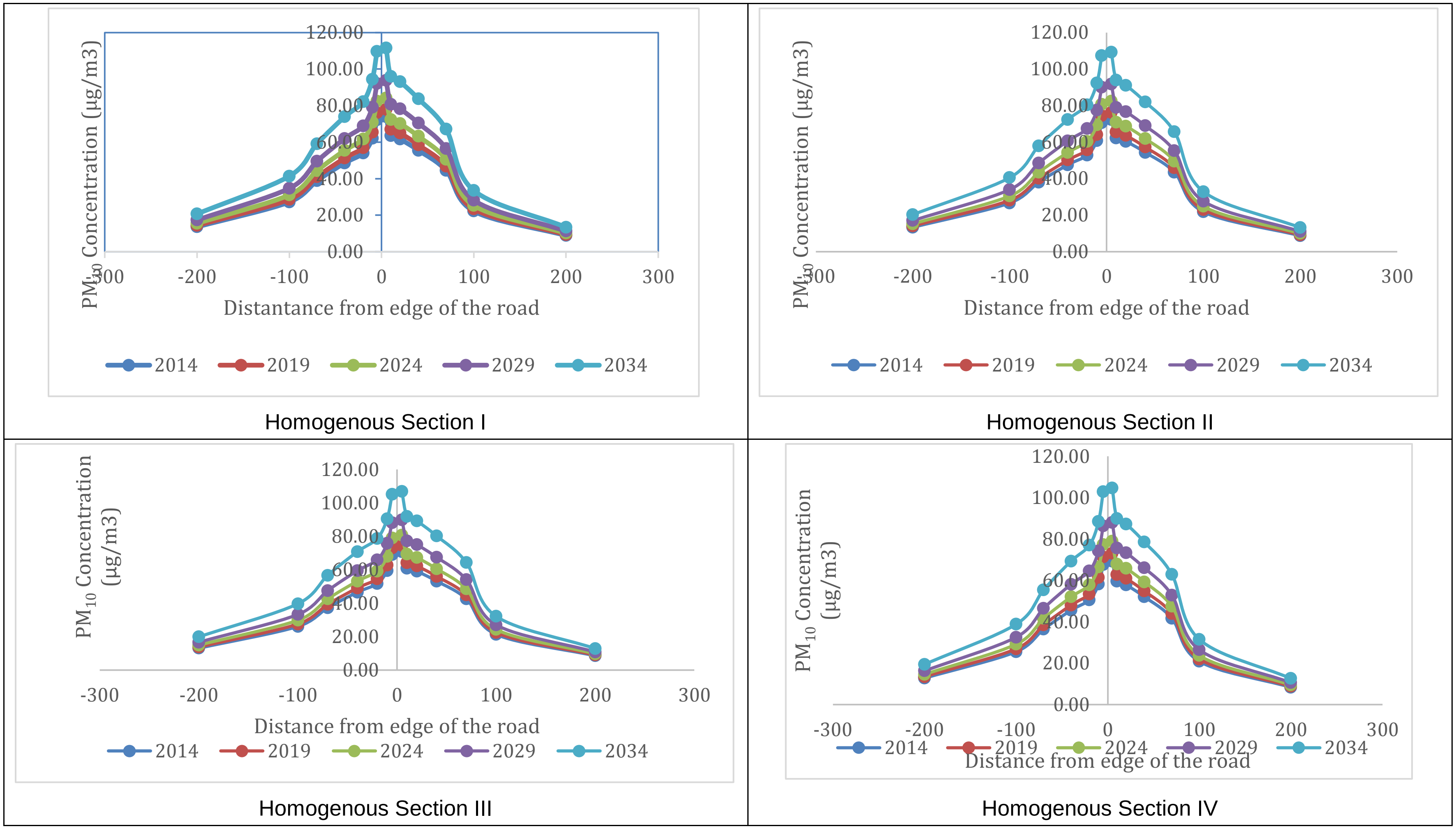
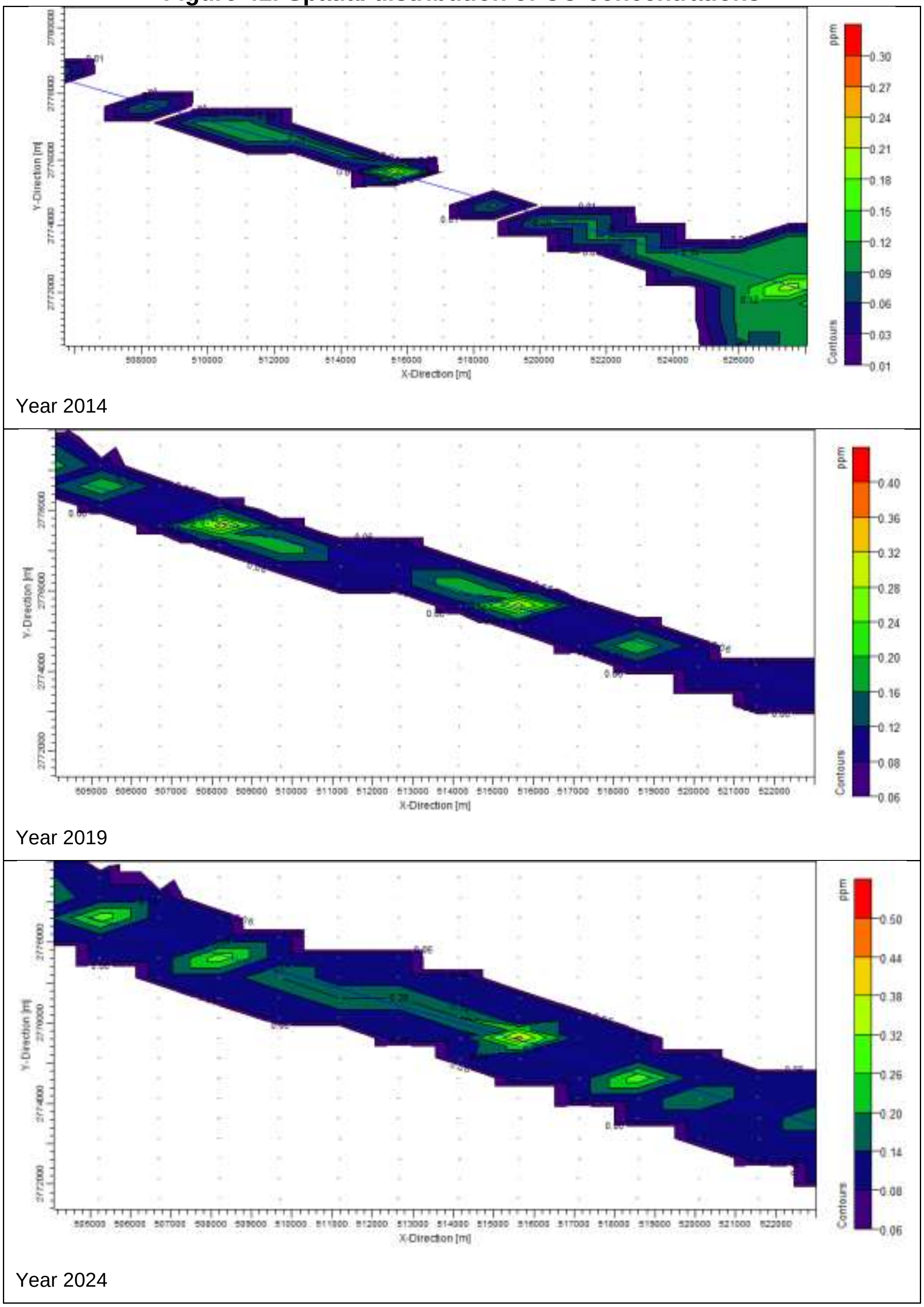
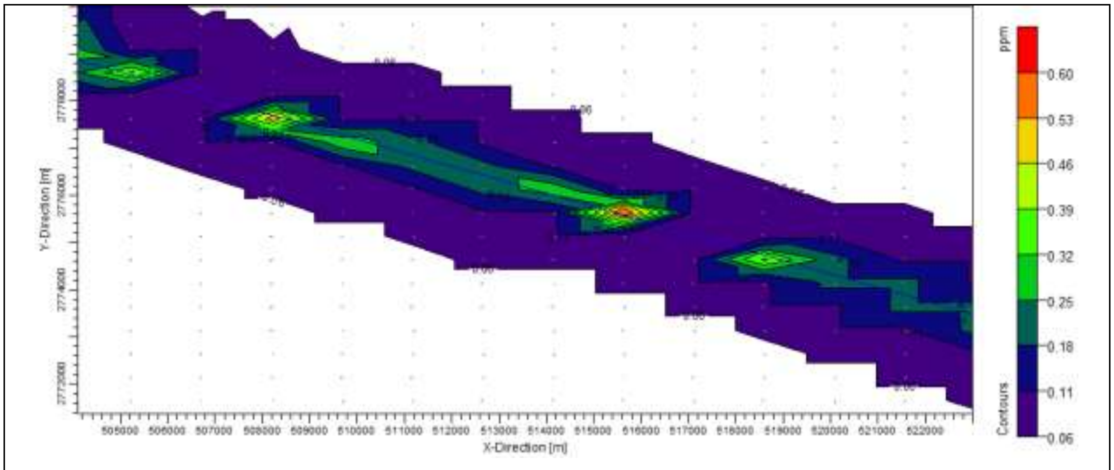


Figure 40: PM10 predicted concentrations (µg/m3) along the highway corridor

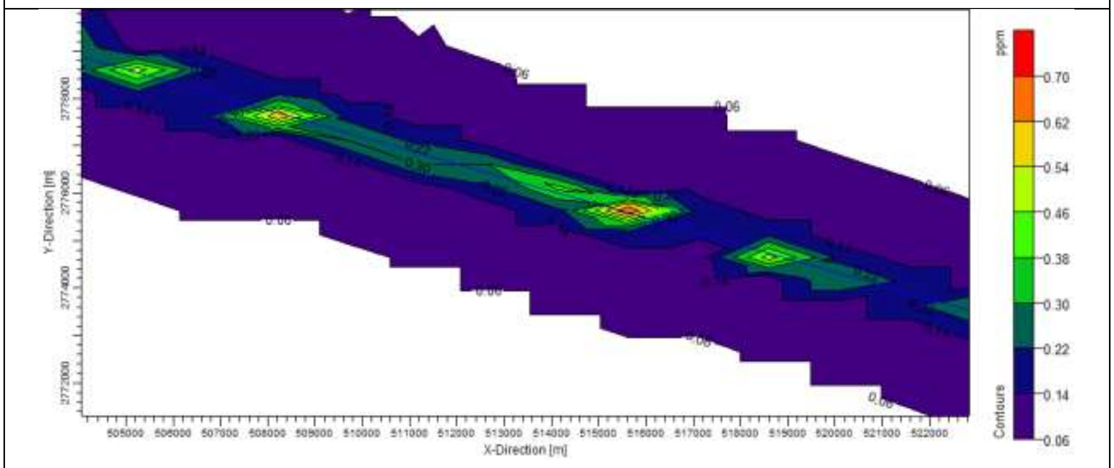
278. In addition, the spatial distribution of hourly average predicted CO, PM2.5 and PM10 concentrations have been plotted in Figures 41, 42 and 43, respectively for peak traffic hour which shows that pollutant concentrations is decreasing when goes away from the kerb side. A section of road corridor has been selected to show the spatial dispersion of pollutant concentrations.

Figure 41: Spatial distribution of CO concentrations



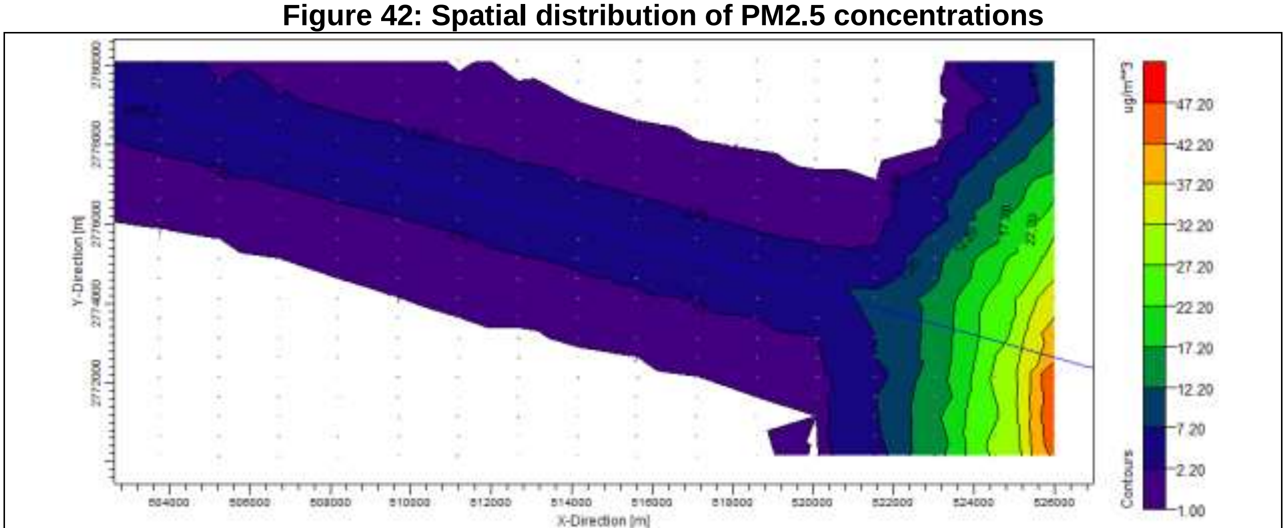


Year 2029

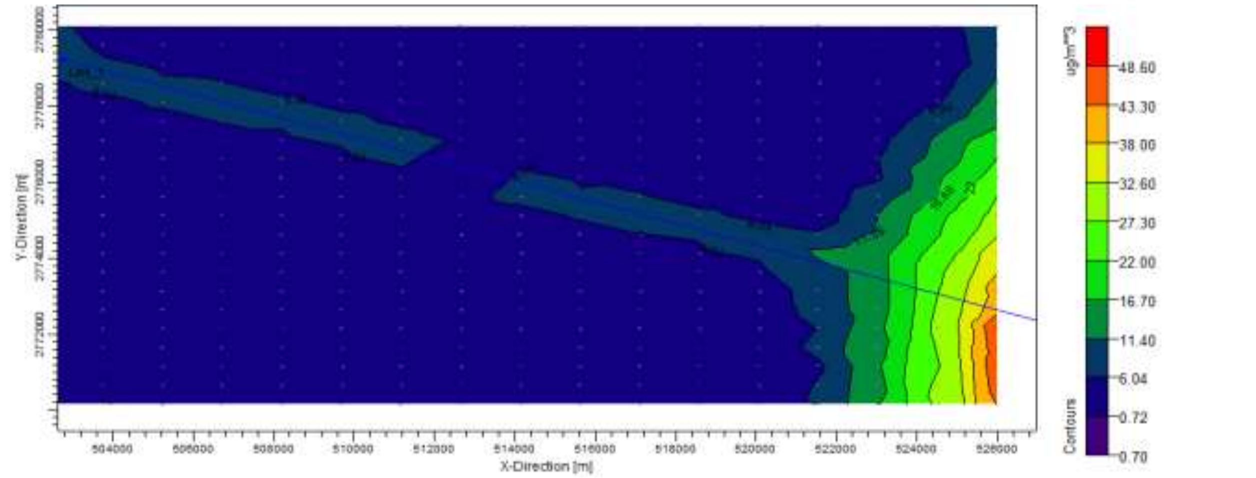


Year 2034

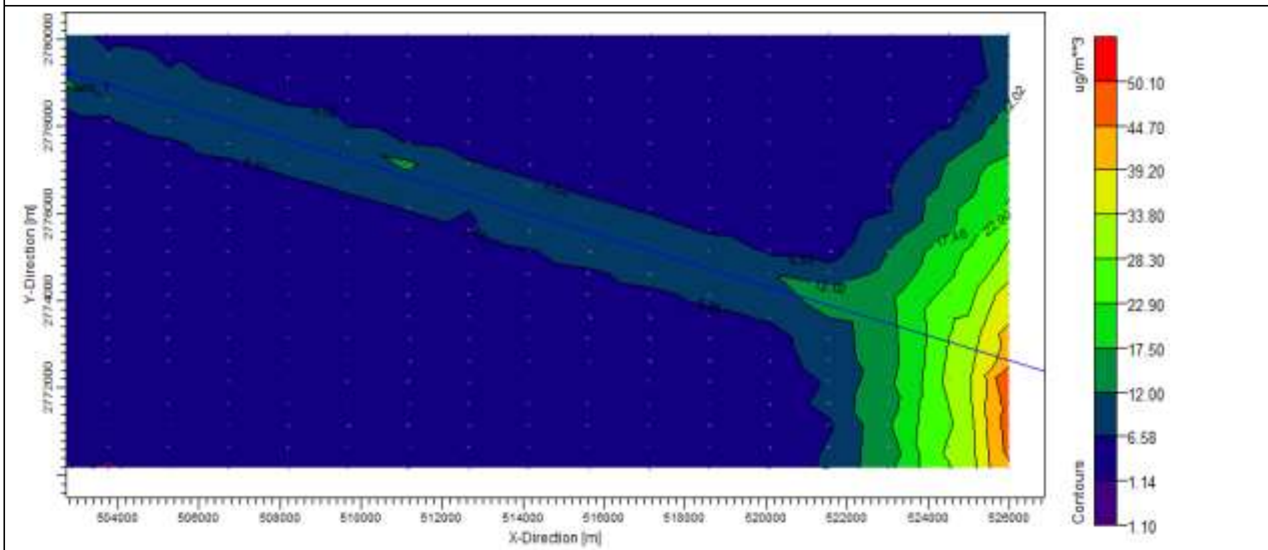
Figure 42: Spatial distribution of PM2.5 concentrations



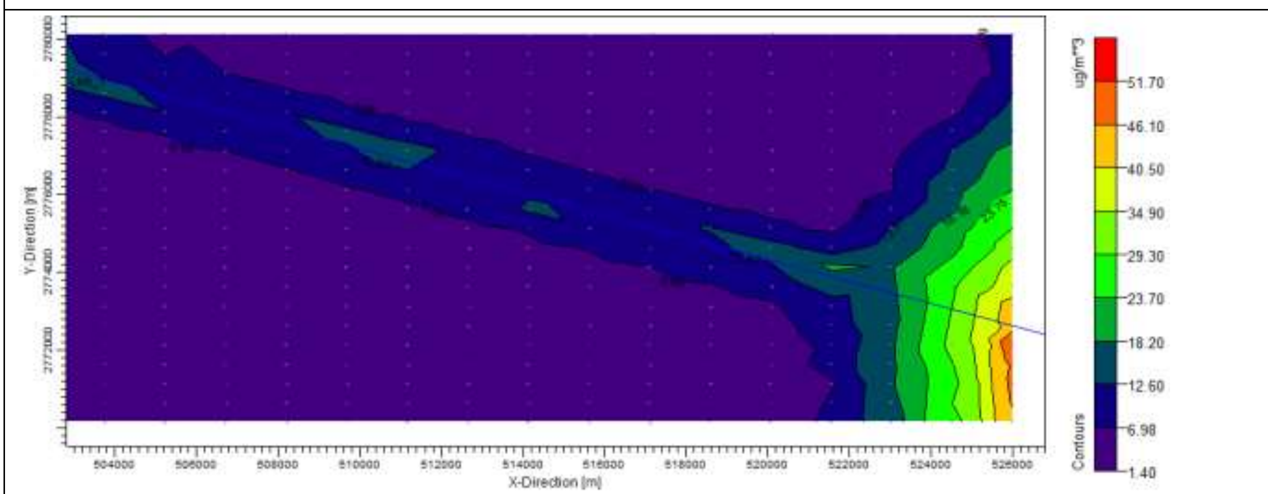
Year 2014



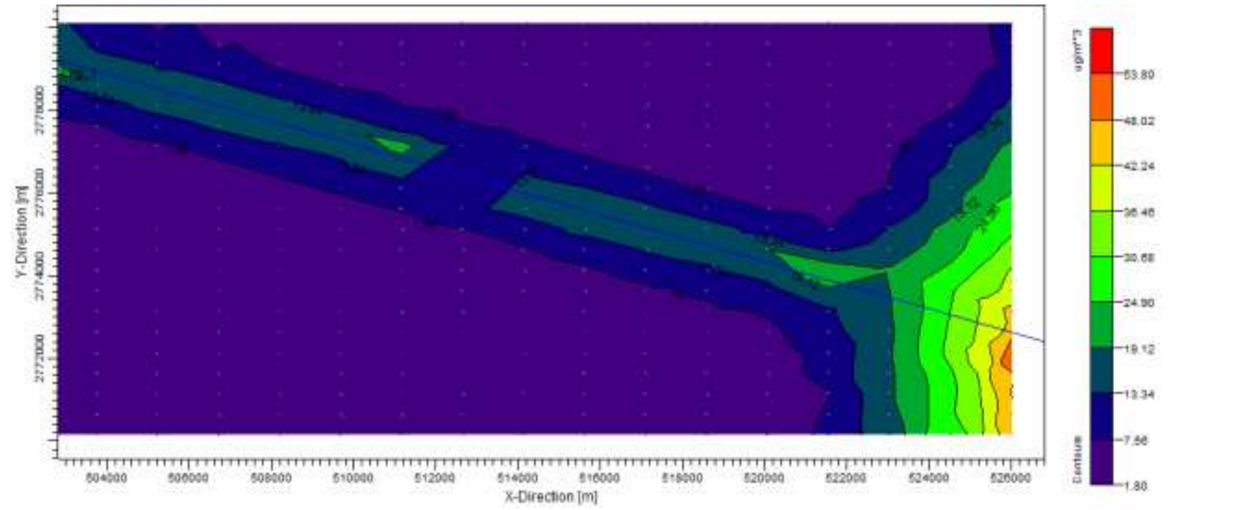
Year 2019



Year 2024

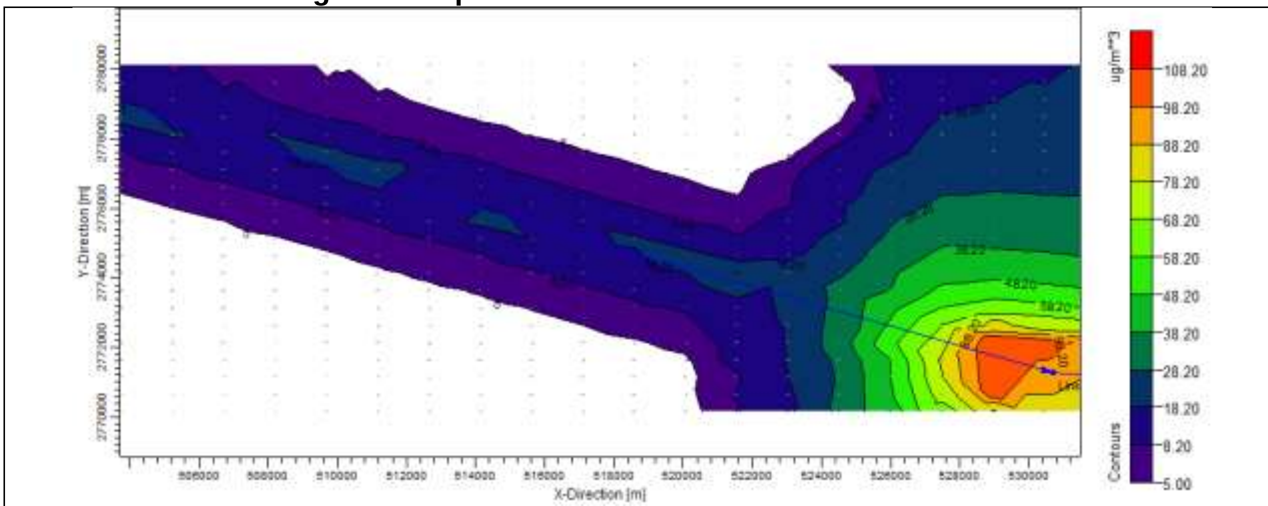


Year 2029

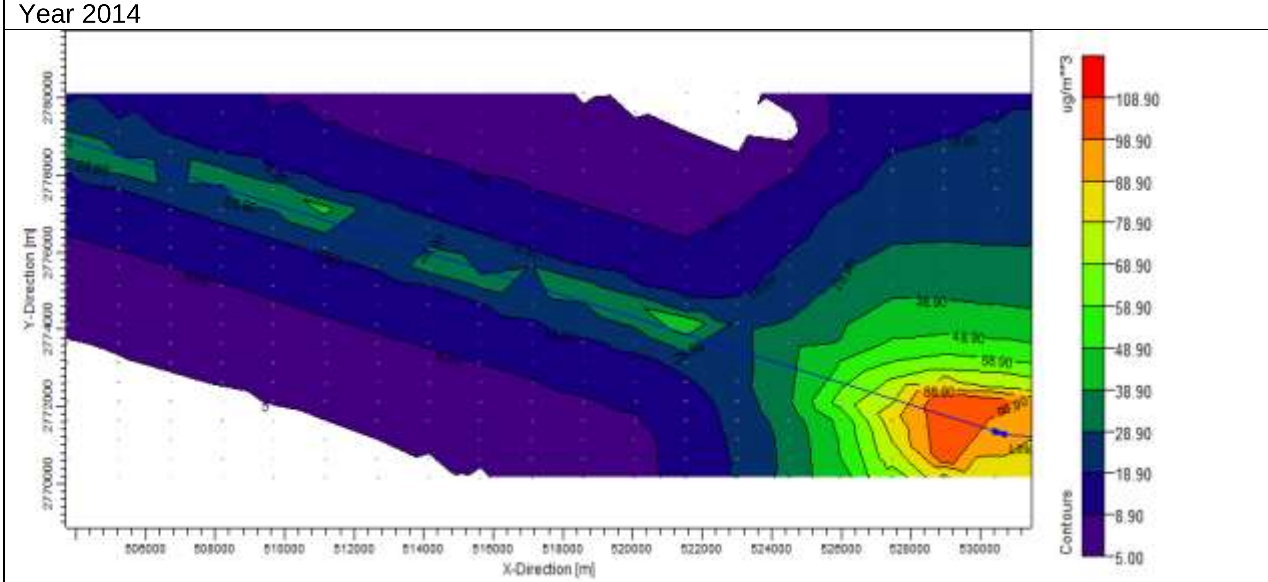


Year 2034

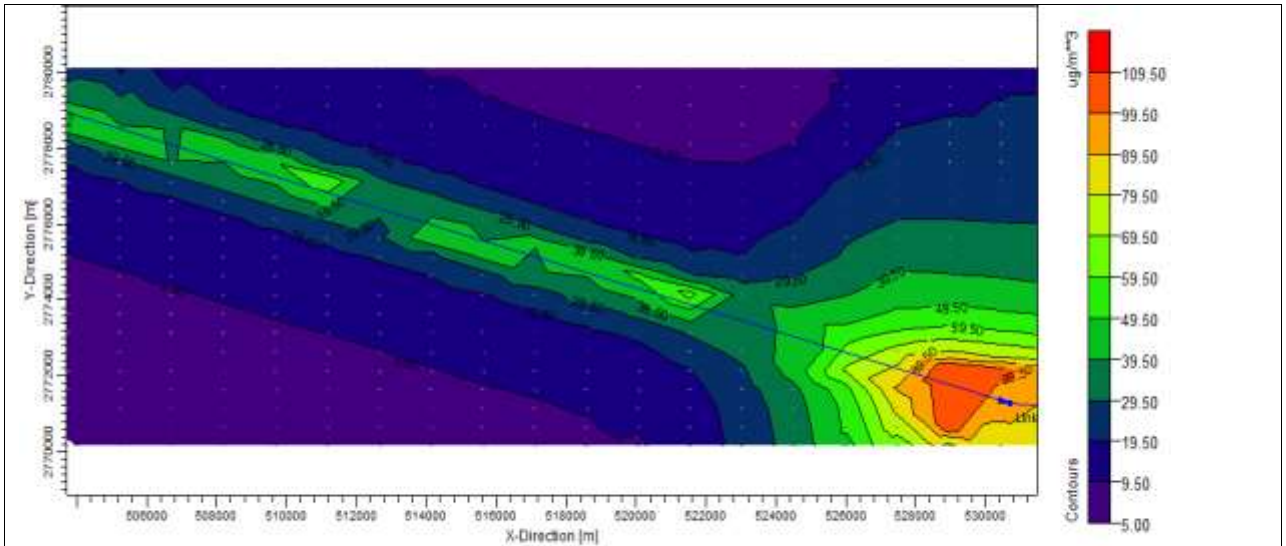
Figure 43: Spatial distribution of PM10 concentrations



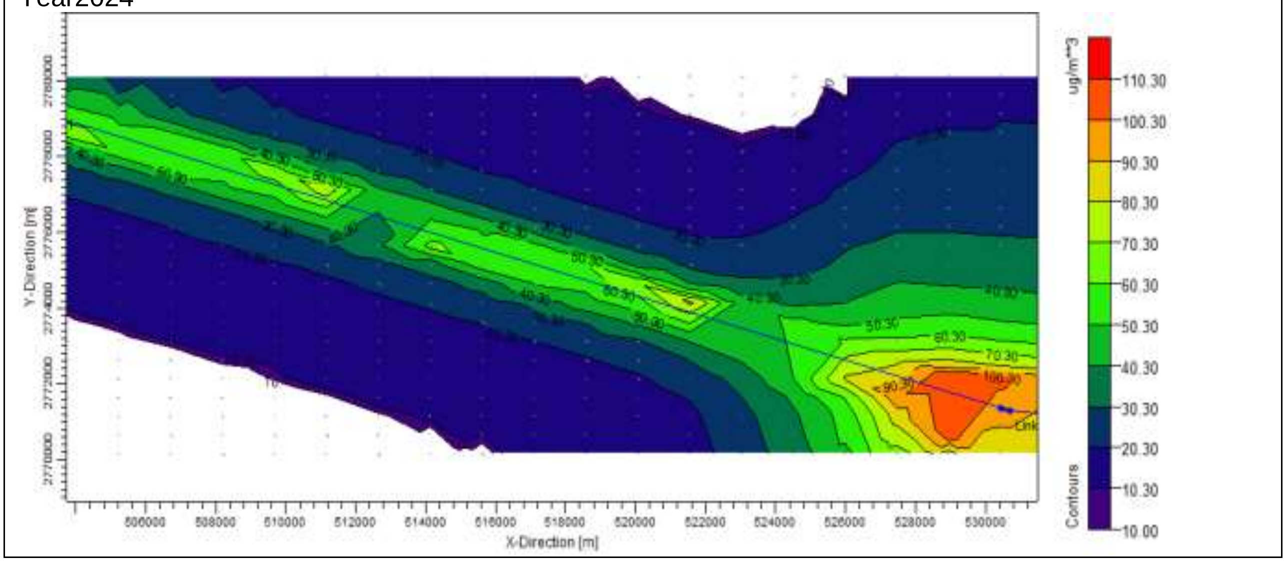
Year 2014



Year 2019



Year2024



279. It has been observed from the model output that when the traffic volume increases, the concentration of air pollutants also increases correspondingly. However, the maximum predicted pollutant concentrations of CO, PM2.5 and PM10 over the existing ambient air quality are found to be within the National Ambient Air Quality Standards (Annex 3) as well as IFC (World Bank EHS Guidelines).

h. Noise Levels

280. With the exception of the urban centres such as Imphal and Tamenglong, the ambient noise level along the road sections is within standards. During the construction period, noise will be generated from the operation of heavy machinery, blasting works, the haulage of construction materials to the construction yard and the general activities at the yard itself. Concrete mixing and material movements will be the primary noise generating activities and will be uniformly distributed over the entire construction period. These construction activities are expected to produce noise levels in the range of 80-95 dB(A) at a distance of about 5 m from the source.

281. Construction noise is not normally regulated, though still may cause concern among local villagers. The range of typical noise levels in relation to distance from a construction site is shown in Table 83.

Table 83: Construction Noise / Distance Relationship

Distance from construction site (m)	Range of Typical Noise Level dB(A)
8	82 – 102
15	75 – 95
30	69 – 89
61	63 – 83
91	59 – 79
122	57 – 77
152	55 – 75
305	49 - 69

Source: Department of Transportation, State of Wisconsin (USA)

282. Piling, if necessary, will also cause vibration. Noise and vibration from this source will be unavoidable but the impact will only be temporary and affect people living or working near piling locations. In construction sites within 500 metres of a settlement, noisy operations should cease between 22:00 and 06:00 hrs. Regular maintenance of construction vehicles and machinery must also be undertaken to reduce noise. The impact and sources of noise and vibration are summarised in Table 84.

Table 84: Likely Impact on Noise Quality in the Vicinity of Project Area

Impact	Source
Increased noise levels causing discomfort to local residents, workers and local fauna	• Mobilisation of heavy construction machinery; • Accelerations/ decelerations/ gear changes – though the extent of impact will depend on the level of congestion and smoothness of the road surface; • Use of blasting to cut into hill sides; • Excavation work for foundations and grading; • Construction of structures and other facilities; • Crushing plants, asphalt production plants; and loading, transportation and unloading of construction materials.

283. Typical noise levels associated with various construction activities and equipment are presented in Table 85.

Table 85: Typical noise levels of principal construction equipments
(Noise Level in db (A) at 50 Feet)

Clearing		**Structure Construction**	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88

Clearing		**Structure Construction**	
Grading and Compaction		**Landscaping and clean-up**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94
Source: U.S. Environmental Protection Agency, noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. 300.1.December 31, 1971			

284. The noise levels indicated for various construction activities/equipment, while far exceeding permissible standards of CPCB and WB EHS for residential areas, it will occur only intermittently. Still, these extremely high sound levels present real risk to the health of workers on- site. Timely scheduling of construction activities, proper maintenance of construction machineries, use of personnel protective equipments etc. will minimize these impacts.

285. Residences, schools, health clinics, and other noise sensitive areas within 100 m the roadways will be affected temporarily during construction. The number of persons potentially affected and the duration of these effects cannot be estimated based on available information.

286. During construction, varying degree of noise impacts are likely to be felt by the communities of main settlements i.e. Imphal, Kanchup, and Tamenglong and other small settlements along the project road. Although temporary in nature, the construction noise will affect the most communities living close to the construction zone.

287. Noise impacts are an unavoidable consequence of construction that should be mitigated by limiting the times of construction to daylight hours (8am-5pm) in the vicinity of sensitive receptors. Further to minimize noise impacts near sensitive receptors (particularly schools), operation of excavator and other heavy machineries will be carried out mostly during off-hours (7 am to 9 am) and 3.30 pm to 7 pm) and on holidays (Saturday and Sundays). Baseline noise will be established for all sensitive areas prior to construction and follow up noise monitoring will be carried out during the construction.

i. Noise Level Modeling and Predictions

288. Federal Highway Administration's Traffic Noise Model (FHWA TNM) helps for highway traffic noise prediction and analysis. Detailed analysis is presented in Annex 6. TNM computes incremental highway traffic noise at nearby receivers. As sources of noise, it includes noise emission levels for the following vehicle types:

- Automobiles: all vehicles with two axles and four tires -- primarily designed to carry nine or fewer people (passenger cars, vans) or cargo (vans, light trucks) -- generally with gross vehicle weight less than 4,500 kg (9,900 lb);
- Medium trucks: all cargo vehicles with two axles and six tires -- generally with gross vehicle weight between 4,500 kg (9,900 lb) and 12,000 kg (26,400 lb);
- Heavy trucks: all cargo vehicles with three or more axles -- generally with gross vehicle weight more than 12,000 kg (26,400 lb);
- Buses: all vehicles designed to carry more than nine passengers; and
- Motorcycles: all vehicles with two or three tires and an open-air driver / passenger compartment.

289. The procedure for prediction of noise levels involves the following steps:

- Identification of various receivers,
- Determination of land uses and activities which may be affected by the noise generated,
- Assemble input parameters, and
- Application of the model.

290. The description of the components to predict noise level are as follows:
- **Receivers:** TNM calculates the sound levels at the input receivers.
- **Land Uses:** Land use along the road is obtained from the topographic drawings. This information provides the range of shielding and absorption factors to be applied at the various receivers.
- **Input Parameters:** Traffic volume for the projected period is obtained from the traffic projections. The total number of vehicles passing per hour by type - light, medium and heavy along with their average speed is used for predictions.
- **Average Noise Level:** All vehicles produce noise, which is taken as the base, and the cumulative noise at the receiver distance due to the whole traffic is estimated. The average noise level varies depending on the type of vehicle.
- **Application of Model:** Equivalent noise levels due to traffic at the receivers are estimated using Federal Highway Noise model. Equivalent Sound Level (TEQ, denoted by the symbol, LAeqT): Ten times the base-10 logarithm of the square of the ratio of time-average, mean-square, instantaneous A-weighted sound pressure, during a stated time interval, T (where T=t2-t1), and the reference mean-square sound pressure of 20: Pa, the threshold of human hearing, e.g., 1HEQ, denoted by the symbol, LAeq1H, represents the hourly equivalent sound level. LAeqT is related to LAE by the following equation:

  $$L_{AeqT} = L_{AE} - 10*\log10(t_2-t_1)$$

  where L_{AE} = Sound exposure level in dB

291. **Sound Exposure Level (SEL, denoted by the symbol, LAE):** Over a stated time interval, T (where T=t2-t1), ten times the base-10 logarithm of the ratio of a given time integral of squared instantaneous A-weighted sound pressure, and the product of the reference sound pressure of 20:Pa, the threshold of human hearing, and the reference duration of 1 sec. The time interval, T, must be long enough to include a majority of the sound source's acoustic energy. As a minimum, this interval should encompass the 10 dB down points.

Table 86: Predicted Noise Levels along the Project Road

Receptor locations	Year	Predicted LAeq in peak hour dB(A)							
		Distance from the edge of the road, m. (Left side)				Distance from the edge of the road, m. (Right side)			
		60	40	20	10	10	20	40	60
Section 1	2014	56.5	59.5	62.8	66.2	65.5	62.4	60.7	57.2
	2019	58.1	61.7	65.4	69.1	68.3	64.9	63.1	59
	2024	56.7	59.9	63.6	67.6	66.8	63.1	61.2	57.5
	2029	61.2	64.2	67.5	70.9	70.2	67.1	65.4	61.9
	2034	62.8	66.3	70	73.8	73	69.6	67.8	63.7
Section II	2014	58.1	61.7	65.4	69.1	68.3	64.9	63.1	59
	2019	56.7	59.9	63.6	67.6	66.8	63.1	61.2	57.5
	2024	61.2	64.2	67.5	70.9	70.2	67.1	65.4	61.9
	2029	62.8	66.3	70	73.8	73	69.6	67.8	63.7
	2034	61.4	64.6	68.3	72.3	71.5	67.8	65.9	62.2
Section III	2014	56.7	59.9	63.6	67.6	66.8	63.1	61.2	57.5
	2019	61.2	64.2	67.5	70.9	70.2	67.1	65.4	61.9
	2024	62.8	66.3	70	73.8	73	69.6	67.8	63.7

	2029	61.4	64.6	68.3	72.3	71.5	67.8	65.9	62.2
	2034	62.8	65.8	69.1	72.6	71.9	68.8	67	63.6

j. Observations

292. Noise levels (Leq) near the receivers are found to be marginally higher than desired levels for the respective categories. The maximum predicted value 65.5 dB(A) is recorded at the receiver located close to section 1 monitoring site for base year 2014 (Table 86). The predicted levels show increase in noise levels for future years at all receivers considering increase in traffic volume.

k. Noise dispersion

293. A small road corridor has been selected to develop noise contour for base year as well as future years also. The contour lines are generated by plotting a contour zone within 30 m distance from edge of the project road on both side of the road. Due to model limitation, it is not possible to select the whole road corridor in the modelling domain. Therefore, spatial dispersions of noise have been show with a small stretch of road. Figure 44 to 48 shows noise level contour around a small road corridor for year 2014, 2019, 2024, 2029 and 2034 respectively. The selected road stretch is small part of Section I, i.e., Imphal- Kangchup road stretch. These predicted results are for peak traffic hours. During non-peak traffic hours, the noise level is very less compared to noise level for peak traffic hours.

Figure 44: Noise contour for year 2014

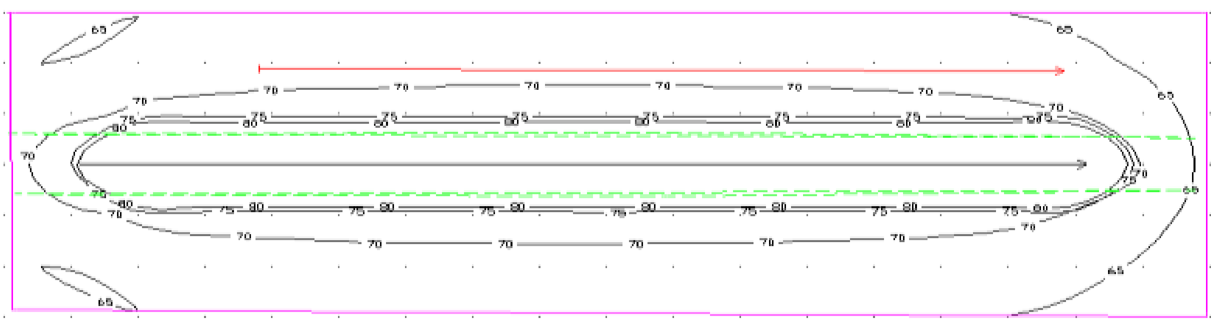


Figure 45: Noise contour for year 2019

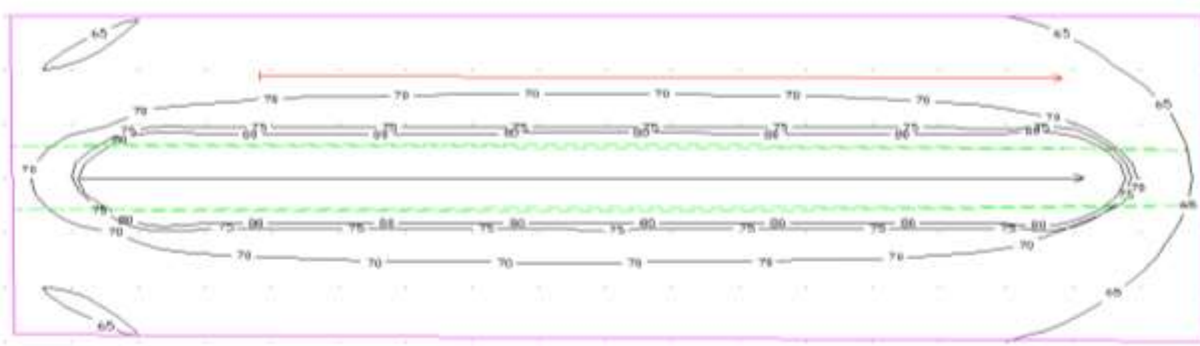


Figure 46: Noise contour for year 2024

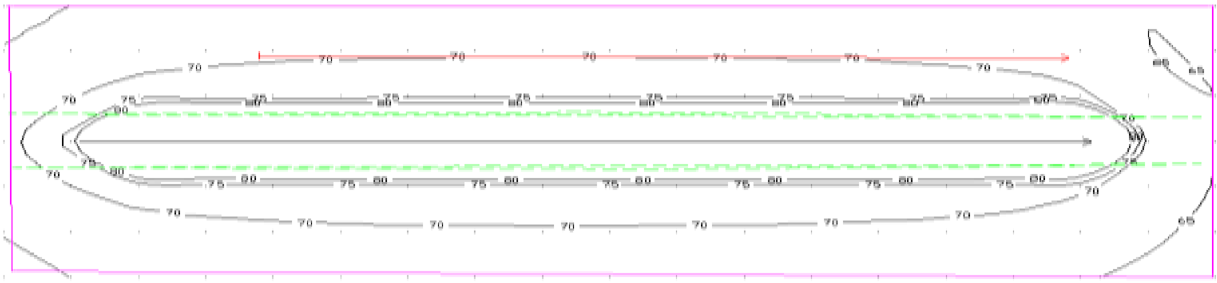


Figure 47: Noise contour for year 2029

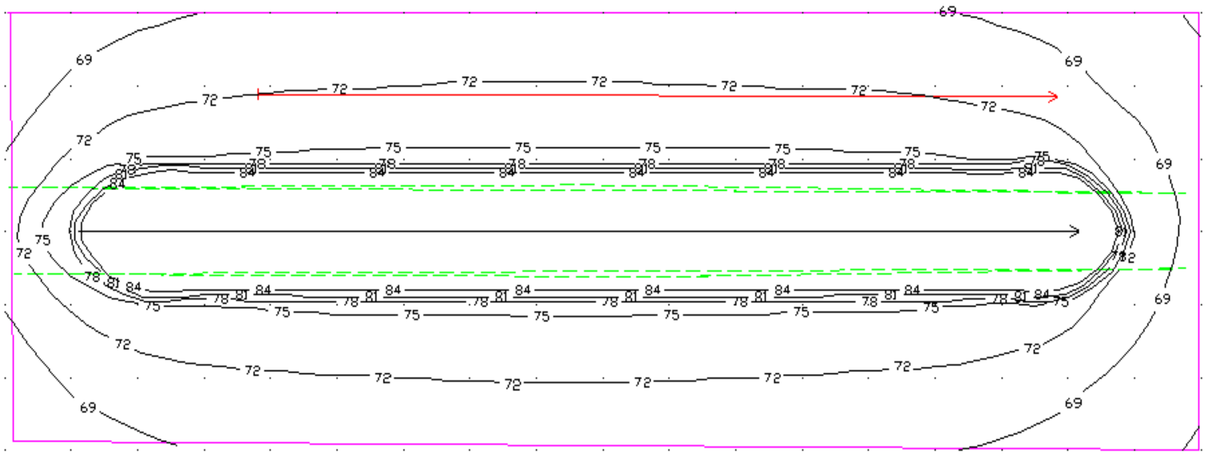
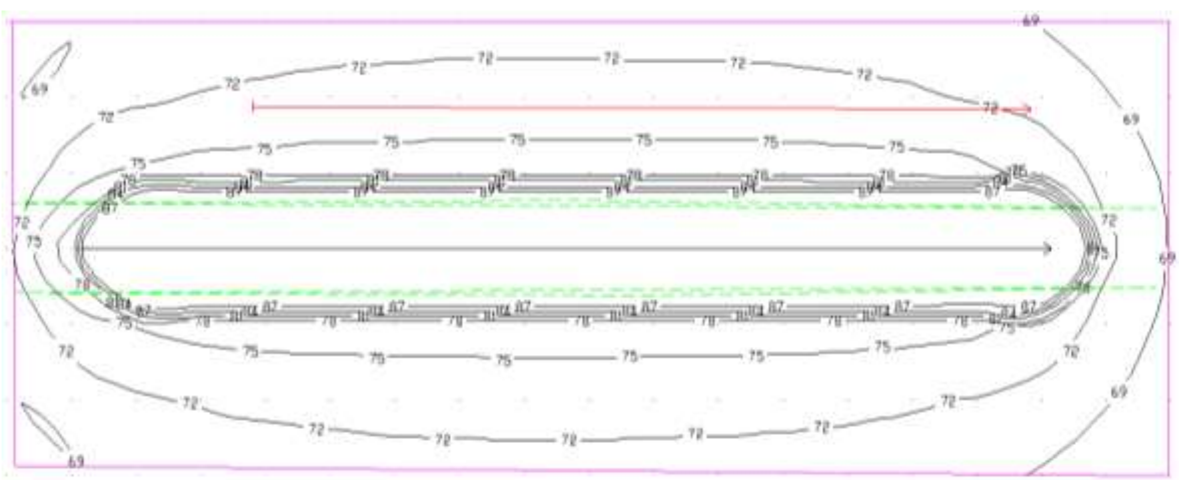


Figure 48: Noise contour for year 2034

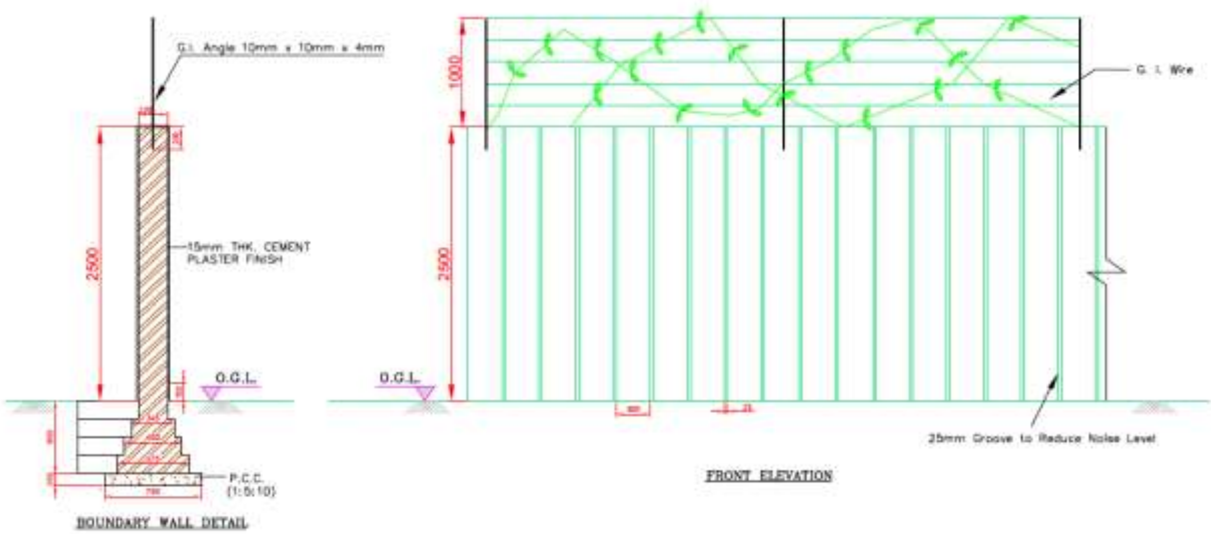


294. It can be seen from the Table 86 that noise levels (Leq) near the receivers are found to be higher than desired levels for the respective categories when compared with prescribed standards of CPCB (Government of India) as well as IFC (World Bank EHS Guidelines). The predicted levels show increase in noise levels for future years at all receivers considering increase in traffic volume. The current spot measurement level at few sensitive receptors shows much lower value compared to the traffic-based assessment indicating noise is being attenuated by various existing barriers like trees, buildings etc. Installations of physical noise barriers are proposed sensitive locations to keep

the projected noise levels at these locations within CPCB/WB EHS standards i.e. 55 dB(A). The current spot measurement level at few sensitive receptors shows much lower value compared to the traffic-based assessment indicating noise is being attenuated by various existing barriers like trees, buildings etc. Installations of physical noise barriers are proposed sensitive locations close to the edge of the road i.e. Temple at km 4.2, Public Girls High School at km 4.8, Praja High School at km 5.1, Heibongpokpi High School at km 8.1, Temple at km 8.4, Heibongpokpi Lairenkabi School at km 9.2, Don Bosco School at km 12.5, U Yaibi School at km 13.9, Gadailong Primary School at km 100.1, Dialong Church at km 101.9, UBC Church at km 102.0, Hindu Temple at km 102.3; to keep the projected noise levels at these locations within CPCB/WB EHS standards i.e. 55 dB(A).

295. 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. Conceptual drawing of the noise barried is provided in Figure 49 below. Environmental Specialist of supervision consultant will prepare site specific design of the noise barries and will provide it to the Contractor.

Figure 49: Conceptual Drawing of the Noise Barrier



296. Although estimated noise over the project duration shows higher noise levels at various receptor locations; implementation of suitable mitigation measures will reduce the construction noise to acceptable limits. Mitigation measures should include:

- Installations of noise barriers;
- construction machinery should be located away from settlements;
- careful planning of machinery operation and the scheduling of such operations;
- controlled blasting should only be carried out with prior approval from the Engineer in charge;

- contractors should be required to fit noise shields on construction machinery and to provide earplugs to the operators of heavy machines;
- blasting should be conducted only during day-light hours; and
- only controlled blasting should be conducted.

297. Trees will be planted along the road to act as natural barrier to noise. Further, physical noise barriers have been provided in the subproject design. These physical noise barriers can be constructed from earth, concrete, masonry, wood, metal, and other materials. To effectively reduce sound transmission through the barrier, the material chosen must be rigid and sufficiently dense (at least 20 kilograms/square meter). 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.

I. Topography and Appearance

298. Construction activities of the project road will bring permanent changes in the local-level topography and appearance of the project site. There will be loss in aesthetic beauty of the project area mainly due to the earthwork. Table 87 elaborates potential effects on the topography and appearance and appropriate mitigation measures.

Table 87: Potential Effects on Topography by the Proposed Road Section Upgrading

Sl. No.	Construction activity	Potential effect on topography and appearance	Mitigation
1.	Clearing of vegetation and cutting of hillside for widening of the road	Scarring of landscape from cutting and potential landslides (short term and long term) may be caused. There may be minor permanent changes in the landscape.	Cut material should be used to widen the road or disposed off at proper disposal sites. Cut slopes should be re-vegetated immediately after widening activities.
2.	Stone quarrying	Scarring of landscape and potential landslides (rock slides/falls). There may be permanent changes in the landscape.	Stone quarrying should only be undertaken in legally approved areas. Controlled and environmental friendly quarrying should be carried out to minimise landslides and erosion.
3.	Earthwork from borrow areas	Scarring of landscape due to unearthing activities. Minor but permanent changes in landscape.	Borrow areas should be in legally approved locations. As soon as construction activities are complete, they should be re-vegetated and brought back as far as possible to their previous appearance.
4	Waste disposal	Disposal of cut soils and debris at improper locations such as hillside below the road will make the area look untidy and unattractive.	Cut off material should be used to widen the road or disposed of at proper disposal sites.
5	Establishment of labour camps	Disposal of waste and litter at improper locations and deforestation for fire-wood will make the area look dirty	Provision and allocation of proper waste disposal bins and sites are required. A supply of cooking gas should be

Sl. No.	Construction activity	Potential effect on topography and appearance	Mitigation
		and unattractive.	provided by the contractor to eliminate the use of fire wood.

3. Ecological Resources

a. Wildlife

299. The proposed road alignment is not located inside or within a 10 kilometer distance from a legally protected or key biodiversity area which was identified as the corridor of impact.

300. The impacts of road building to wildlife includes direct and indirect mortality; destroying, degrading, and fragmenting habitat; serves as barriers to movement; and spurs domino effect brought by a change in land-use. Small animals that often disperse, large animals like ungulates and carnivores are at risk to road kills during project operation. The construction of the new road section, with a total length of 90.0 kilometers across forested areas may cause wildlife habitat fragmentation, and disruption of wildlife movement corridors.

301. ***Avifauna:*** It is found that altogether 11 species of birds were observed in forest areas along the project road alignment. Black-headed bulbul (*Pycnonotus atriceps),* Black-headed yellow bulbul (*Pycnonotus melanicterus*), Purple wood pigeon (*Columba punicea*) and Batek were most commonly observed avifauna in the all forest areas. The species of Blue-eared kingfisher (*Alcedo meninting*) and White-breasted kingfisher (*Halcyon smyrnensis*) were seen in forest areas adjoining to Ijei and Irang rivers. Besides these birds, Purple wood pigeon (*Columba punicea*), Forest eagle owl (*Bubo nipalensis*), Tawny eagle (*Aquila vindhiana*), Indian golden-backed three-toed woodpecker (*Dinopium javanense*) were also observed. Based on the secondary source the proposed alignment affected forest areas are possible habitat for one globally threatened species (Great Indian hornbill) and five nationally vulnerable (Mrs. Hume's bar backed pheasant, Burmese ring dove, Indian moorhen, the Bar tailed dove, Pheasant tailed Jacana) birds species. A globally near threatened species of bird (Great Indian hornbill) was recorded from the forest areas in the project areas.

302. The short term impacts on these specific of birds is expected due to cuttings of trees as well as due to construction activities. Appropriate mitigation measures including planting of additional tree specific used by these birds will be undertaken by the contractors in coordination with local forestry officials. Additional resrouces would be made available to the forest department to undertake conservation activities for birds in the forests.

303. ***Wild Animals*:** Altogether 7 mammalian species were recorded in and around the project road alignment through direct sighting and sign survey technique. The 7 species belonged to 5 families. Of these two species, Slow Loris (*Nycticebus coucang*) and Flying Squirrel *(Hylopetes alboniger)* were recorded by direct sighting in protected forest area of Kangchup Leimakhong Irang. Signs (droppings & footprints) of Barking Deer *(Munitacus muntjak)* were found in the protected forest area of Tairenpokpi Tamenglong and signs of hunting of Barking Deer were also observed near to transect line no. 5 at chainage km 26+800 to 27+000 (approx.). Clouded Leopard (*Neofelis nebulosa*), Jungle/Wild Cat (*Felis chaus) &* wild pig *(Sus scrofa)* were recorded on the basis of animal signs (droppings) located in transect line no 5 & 7 during field survey.

304. ***Wildlife Movement Tracks/Routes:*** There are no designated widlife movement routes across the project alignment. However during the surveys and consultations with local communities it is found that between chainage km 26+000 to 29+800 there was possible movement of wild

animals (barking deer, wild pig & sabeng) across proposed alignment as animals track from hill towards local stream (water source) was found with less slope area of the forest. In this region of Tairenpokpi Tamenglong protected forest area was with minimum human movement due to no track in this region.

305. Movement of barking deer and wild pig is also observed by local communities between chainage km 40+000 to 42+000. In Kangchup Leimakhong Irang protected forest area at km 62+000 to 65+000 there was possible barking deer movement track across the road section. This region has Irang River to serve as water source for wild animal on the hills. In Bhalok village boundary under unclassed forest area of Tamenglong possible route of wild animal movement from hills to fields across alignment at chainage km 79+000 to 80+000. As per local community from Bhalok settlement there was a movement track for wild animals (tiger, leopard, barking deer & wild pig) crossing proposed alignment at chainage km 90+700 to 91+000.

306. ***Threatened and Endangered Wild Animals****:* 16 species of wild animals listed in Schedule of Wildlife Protection (Act) 1972 of India has been reported in the project area. Of these the Hoolock (*Hylobates hoolock)* is endangered, Hog badger (*Arctonyx collaris*) and Otter (*Lutra lutra*) are threatened. Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Serow (*Capricornis sumatraensis*), Sambar (*Cervus unicolor*) are considered vulnerable. Least concerns animals list includes Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*). Of these species of wild animals Clouded leopard (*Neofelis nebulosa)*, Slow loris (*Nycticebus coucang*), Barking deer (*Muntiacus muntjak*) and Wild pig (*Sus scrofa*) are also recorded during site survey in the forest areas. Barking deer, leaopard, junle cat, Sabeng, wildpig and sajaan are animals frequently sighted in the forest. Community informed that the frequency of sighting of animals (Hoolock Gibbon, Clouded Leopard, Leopard Cat, Golden Cat, Bear, Great Indian hornbill) is decreasing in the region.

307. In the project area there are 1 Engandered, 3 Thretened, 4 Vulnerables, and 2 Least concerened species of wild animals listed in the IUCN red list. It also has 1 globally near threatened species (Great Indian hornbill), and 5 nationally vulnerable birds species reported in the project area. Among plant species 4 species protected by Government of India, 1 species by IUCN, and 5 species by CITES are reported in the project area. Because of these facts the project area has been considered as critical habitat. The critical habitat assessment has been perfomred in order to determine if project area itself is critical for survial of these threatened species. This assessment is based on the latest IUCN data and maps for the key species of concern, as well as recent research reports and surveys for specific animals. It has also been supported by habitat and wildlife surveys in the proposed project footprint areas; working plans of forest divisions in the project areas; opinions of wildlife and species experts (including officials from wildlife division of Manipur forest department and field staff of respective forest divisions in the project area; discussion with WWF India in the early phase of the EIA and again as this critical habitat assessment was developed), as well as review of wildlife staff and local community scientific and anecdotal information on wildlife in the project area. The objective of this critical habitat assessment is to: (i) determine if critical habitat is present in the project area; and, (ii) determine if there will be any measurable adverse impacts, following the definitions and requirements within ADB's Safeguard Policy Statement (SPS, 2009). In order to identify if the project area is critical for the survival of threatened species, quantitative thresholds for critical habitat determination described in the International Finance Corporation (IFC) Performance Standard 6, Guidance Note 2012 have also been used as guidance (see below). Specifically, the IFC describes critical habitat in two tiers.

308. The conclusion of the forest and wildlife office review and species expert opinions in this critical habitat assessment is that the project will not present any concerns with regard to habitat

functionality and species persistence. The forests and the species experts have indicated that the project area does not fall in the critical habitat of the species assessed, and that it is not expected that there will be any measurable adverse impacts on the species populations and habitat values.

309. Regarding the six definitions of critical habitat (ADB SPS) and the IFC Tier 1 and 2 definitions, none of these definitions has been found to apply to the project area. Since there are no legally defined critical habitats (the ADB SPS notes that critical habitats include legally protected areas such as the national parks, wildlife sanctuaries, biological corridors), the project area does not impinge on any specific areas that is critically important to the populations of threatened species in India. Regardless of this conclusion, the project is still taking a precautionary approach and will be implementing a biodiversity conservation plan that includes monitoring and development of a wildlife database, as well as field conservation measures to protect wildlife. Furthermore, at night time, all construction activities will be disallowed, to avoid disrupting wildlife movements particularly in sections of project road with forest areas. Complete critical habitat assessment is provided in Annex 16.

310. The road construction through reserve forest in 2.1 km (Kanchup Researve Forest) and hilly terrain with protected/unclassed forest areas between Kanchup (km 13.0) and Tamenglong (km 103.02) will require new hill cutting and steep slopes. The road constrcution work in this area will affect the habitats of the area. The critical wildlife habitat tests using the biodiversity decision framework tool of IFC, World Bank as shown in Table 88; indicates that there will no major or severe impacts on the critical habitat and its endangered/ threatened species as listed above. The main predicted impact is the damage and disruption of wildlife movement routes (although no specific route exist); and loss of food sources and the nesting sites for birds.

Table 88: Critical Wildlife Habitat Tests using biodiversity Decision Framework Tool as required by SPS

Sl. No.	Question	Answer
1.	Is the site legally protected or proposed for protection?	No. About 2.1 km length of the project road passing through and bordering Kanchup Reserve Forest. Section between Kanchup and Tamenglong is unclassed community forest area which do no have any legal status and these forests are managed by communities.
2.	Are the project activities consistent with the protected area management plan?	Yes. The project is an improvement of existing road, which is allowed as per forest management plan of the forest department of Manipur.
3.	Have the protected area sponsors and managers, local communities and other key stakeholders been consulted and their views taken into account?	Yes. The officials from Forest Department including Chief Wildlife Warden, Chief Conservator of Forests (Wildlife), Field Staff of Forests, NGOs (IBCN/WWF), representative of local communities and villagers, were consultant in the process of environmental impact assessment and their views were incorporated in the design of the Project.
4.	Have appropriate additional programs been implemented to promote and enhance the conservation aims of the protected area?	Yes. The project will support conservation programs as prioritized by forest authorities in the management plan of divisions such as community based education and wildlife conservation programs.

Sl. No.	Question	Answer
5.	Will the project reduce populations of any recognized critically endangered or endangered species?	No. Since the critical habitat in the project area is small part of the overall habitat available for Hoolock gibbon, Slow lorries, Malayan Sun Bear, Serrow, Pangolin, Leopard, Golden cat, Hornbills.
6.	Will there be measurable adverse impacts, or likelihood of such, on the habitat's ability to support its high value species and functions?	No; since project will avoid the damage of critical habitat area of forest; will restrict felling of tall, matured and fruiting trees; provide temporary migratory passage during construction; and restore or build permanent crossing points for wildlife. Further, safety feature such as wildlife movement signage and speed limit will be erected to minimize the wildlife-vehicle collisions.
7.	Will there be a loss in habitat which will compromise the persistence of a viable and representative host ecosystem?	No. Since the road formation cutting will be restricted to minimum required width and wherever feasible existing tracks are used and important wildlife sites are avoided altogether.
		Any remaining impacts will be mitigated by implementing suitable mitigation measures recommended by the EIA report and under the EMP.

311. Steep road cuts will form a barrier to wildlife movements and disrupt the wildlife migration. It is generally known that wildlife generally migrates seasonally. Environmental Specilaist of supervision consultant in consultation with the wildlife conservators of forest divisions will determine the exact migratory routes and the timing of their migration for planning and execution of road construction. The survey shall be carried out in advance prior to the start of civil works in the critical habitat areas. Road construction works will be allowed only during dry season following winter timing from 8.00am till 4.00pm to minimize the disturbance to wildlife. Total controlled blasting will be implemented if rock blasting is unavoidable. Blasting will be carried out during daytime (from 8.00am till 4.00pm) only. Gentle side slope will be maintained wherever there are known wildlife crossings (as per the recommendations of Environmental Specialist of CSC). The gentle slopes will be maintained in all known movement/migratory paths. Spoil will be disposed to the pre-identified dump-sites. Wildlife crossing and speed limit signages will be posted on both sides of road in Reserve Forest area to caution travelers of possible dangers of collision with wildlife. Exact location of signage posting will be determined by Environmental Specilaist in consultation with the Wildlife conservator. Further as long-term mitigation measures, the habitat enrichment activities such as planting of native bamboos, fruiting and fodders trees will be carried out. Environment Specialist in collaboration with Wildlife Conservator will determine the suitable plant species for wildlife habitat enrichment. There will be strict compliance monitoring by Environmental Specilaist while constructing road through Reserve Forest area.

312. Construction workers may hunt, fish or carry out other activities that will negatively impact wildlife. No construction or labour camps, batching plants, stone crushing plants, and quarrying activities will be allowed within or 1 km radius Reserve Forest area and potential biological Corridor. The contractor will clearly brief the construction workers on strict forestry rules on illegal harvesting of forest products, poaching of wildlife and illegal fishing. Contractor will ensure supply of all necessary food items, cooking fuel and proper housing is provided to prevent illegal hunting and tree felling.

313. The operation of various construction equipment is likely to generate significant noise. Noise disturbance may cause migration of the animals to other areas which may increase the probability of human-animal conflicts. Setting of construction camp near forests or protected area may generally disturb surrounding fauna.

314. Limited indirect ecological degradation may also occur from wildlife poaching, by construction workers and outsiders due to greater accessibility and as a result of increased local demand for food. In order to avoid such impacts the contract document should include the following:

- Improvement proposals are restricted to minimum width in the length passing through Reserve Forest Area. Aligment has been selected to avoid areas with dense forests.
- Adequate measure are included in the design to minimize impacts on widlife.
- Signage for no-noise zones, wildlife conservation boards should be installed at the required project sites.
- Noise generating equipment like DG set, compressors will have acoustic enclosures. These will not be installed at least in one km area of 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 wild animal come within the vicinity of 100m from the construction site, construction works must immediately stop and resume only after the wild animlas have moved away
- Provisions of signage as a precautionary measure to provide awareness about animal movement will be made to avoid accidents
- project staff and work crews should not be allowed to have fire-arms and animal traps etc. in the work zone within Reserved Forest;
- construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest stretches.
- employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities.
- Strict anti-poaching surveillance measures need to be implemented, especially during project construction phase in the reserved forests.

315. The forests along the project road also faces many problems and issues including hunting, poaching, etc.; and additionally the illegal trade on wildlife parts and articles at the International Cross Border (with Myanmar). Environment Specialist of CSC will coordinate with forest authorities to support its programmes on regular checking and monitoring of illegal contraband wildlife, their parts and other wildlife articles.

b. Vegetation

316. Part of the subproject road passes though the forest area. The density of vegetation in forest is 0.4 to 0.5. Removal of the existing vegetative cover and the uprooting of 2732 trees is an unfortunate activity, which will reduce the ecological balance in the areas. This will also enhance soil erosion. About 2700,000 sq m (30 m strip for entire length 90 km) of scrub forests and vegetation will probably be removed for improvement of road section between Kanchup and Tamenglong. The loss of vegetative cover will mostly be permanent and only some might be revived through mitigation efforts. Another impact from road construction activities and deriving from the cutting of hillsides, quarrying, preparation and transfer of stone chips and other earthwork; is the accumulation of dust on the surrounding vegetation. This leads to deterioration of the vegetative health, which in turn will affect the ecology as well as the aesthetic beauty of the area. Induced impacts may result from the following:

- increased forest harvesting for fire-wood, construction timber, forage, medicinal plants and other products;
- increased earth and rock extraction;
- construction crew demands for wood as a fuel and for building materials;
- construction crew demands for food and recreational hunting and fishing;

317. To minimise negative impacts on the vegetative cover the contract documents should specify that:

- all wood building material for workers' housing should be brought from outside the project area;
- workers should be supplied with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract;
- all contract equipment and plants should be cleaned to the satisfaction of the project engineer in charge prior to their relocation to project sites;
- during site clearance, care should be taken to ensure that the minimum area of vegetation area is affected; and
- water sprinkling of trucks used as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation are minimised.
- preservation of archid and other threatened plant species during construction by transplanation of archids found within proposed alignment and if transplantation is not possible, compensatory afforestation will be done in coordination with forest and horticulture departments of Manipur.

4. Human Use Values

318. Field reconnaissance surveys of the project road were conducted to assess the environmental and social conditions. It was noted that the relocation of structures will be required at congested locations along the subproject road mainly Imphal, Kanchup and Tamenglong. The widening options have been devised to minimise impacts of structures.

319. The survey also found that there are 345 temporary structure and three shrines likely to be affected due to widening of road section. A resettlement plan is prepared to address this issue. The affected people will be compensated and rehabilitated as per the provisions of the Resettlement Plan.

320. There will be negligible land acquisition as the proposed widening will be accommodated within existing ROW i.e. 54 ft either side of the road.

321. At certain locations on the road, particularly at bridge /culver sites, traffic will be temporarily diverted from the existing carriageway while construction is in progress and temporary traffic diversions will be managed within the ROW. In other instances, traffic may have to be diverted across adjacent private land, in which case compensation will be paid for any loss of crops or the replacement of damaged structures. In other situations, most frequently not at bridge sites, for example when bitumen surfacing is in progress, it may be required to close the road temporarily. In these circumstances, adequate radio and press releases should be made beforehand and a date/time given for the re-opening.

322. Most construction will be undertaken during the dry season when few crops are planted. Losses should be minimised during construction.

5. Sensitive Location Such as School, Temples, Hospital along the Project Road

323. The sensitive location such as school, college and hospital along subproject road within 100 meter from the edge of the existing road has been identified as given Table 89.

Table 89: Sensitive Locations along the Project Road

Location / Chainage (Km)	Features
4.2	Temple
4.8	The Public Girls High School
5.1	Praja High School
8.1	Heibongpokpi High School
8.4	Temple
9.2	Heibongpokpi Lairenkabi School
12.5	Don Bosco School Phayeng
13.9	U Yaibi School
51.5	Bakuwa village through middle
100.1	Gadailong Primary School
101.9	Dialong Church
102.0	UBC Church
102.3	Hindu Temple

324. These structures are kept unaffected by the proposed improvement proposal. Short term impacts during the construction stage are expected. Measures such as timely scheduling of construction activities in these areas, provision of sign boards, appropriate noise barriers such as planting trees and / or raised boundary walls are adopted to minimize impacts.

6. Health, Safety and Hygiene for Construction Workers

325. Construction of the road will result in the generation of waste. In isolated places, the amount of waste generated may be greater than normal because of substandard subsoil materials, which will need to the replaced.

326. The Contractor will be required to control the construction site, keep it clean and provide facilities such as dust bins and collectors for the temporary storage of all waste. This waste should be adequately stored to avoid pollution of water supplies and water sources and to avoid dust formation. The Contractor will be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals.

327. All necessary safeguards should be taken to ensure the safety, welfare and good health of all persons entitled to be on the sites and to ensure that works are carried out in a safe and efficient manner. All personnel working at vulnerable site locations will wear safety helmets and strong footwear. It should be ensured that all workmen and staff employed on site use proper safety equipment – for example, eye protectors, ear plugs, safety helmets, the designated safety equipment when working over water - and that proper rescue equipment is available. Fire extinguishers and first-aid equipment will be kept at all sites.

328. The construction camps are anticipated to house up to 200 people for about two years. With this concentration of people, the potential for the transmission of diseases and illnesses will increase. The main health and safety risks during construction will arise from:

- inadequate sanitation facilities in worker camps;
- introduction of sexually transmitted, and other diseases, by immigrant workers; and
- outbreaks of malaria, typhoid, cholera etc. amongst the labour force.

329. The following actions will be undertaken at construction camps and stipulated in construction contracts:

- submit and obtain approval for a health and safety plan prior to the commencement of work;
- provision of adequate health care facilities; and
- workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

330. The project will support a public health education programme for workers and villagers covering road safety, malaria, hygiene, and sexually transmitted diseases. The district health departments will also be invited to participate in monitoring and educating communities and workers affected by the project.

7. Nuisance to Nearby Properties

331. Nuisance to nearby properties is likely to result from:

- noise and vibration from mechanical devices and construction plant;
- dust during quarrying, construction and the trafficking of new surfaces prior to sealing;
- gaseous emissions from heavy equipment; and
- fumes from asphalt boiling sites.

332. Much of the project road length in Kunchup-Tamenglong section passes through hilly terrain and presently air/dust pollution is not a major issue. Nonetheless, there will be regular watering of the road surfaces or the application of emulsion coats near villages, where dust is a nuisance. Noise generating equipment such as power generators and concrete mixers will be kept away from populated/commercial areas. Provisions will be incorporated into the contractor's contract to require the use of dust suppression measures.

8. Interference with Utilities and Traffic

333. On the project road, utilities interfere with the ROW at few locations that will have to be shifted / removed prior to construction. This should not be a major problem.

334. Traffic may experience minor delays when diverted around active construction areas, but will be more severely hampered at the locations where temporary road closures are necessary. Such hazard points will have proper signs indicating the nature of the problem envisaged.

335. Contractor will ensure that information on the timing of construction works and notifications of road closure (if any) is provided via the local media (radio, TV, newspaper etc.) or through the local community heads.

9. Community Impacts

336. Community impacts are mostly due to the resettlement of people due to widening of the project road to 4/2 lanes.

337. Construction camps may put stress on local resources and the infrastructure in nearby communities resulting to people raising grievances. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as health care clinics, places of worship, and occasional entertainment. The use of local labourers during the construction will be promoted to minimise these problems.

10. Quality of Life

338. The impact of the improvements of project road on the socio-economic environment will be significantly beneficial. Improved access and reduced travel time and cost will be major stimuli to economic growth, particularly in rural areas. Better access of agricultural goods to market will be important and a major contributor to poverty reduction.

339. Increased labour mobility will occur. This has both positive and negative impacts. Increased access is a two-way phenomenon, and the corollary to increased access to the project areas is increased access for the residents of these areas to more urban life-styles. Out-migration may result. There is also the likelihood of the relocation of homes and businesses to new road-side locations.

340. During construction, benefits to local people can be maximised if the contractor recruits construction workers locally regardless of gender. Where possible, he/she should also not discriminate in the employment of women.

11. Construction Materials

341. The use of proper sources for stone and aggregates has become a major issue in most of the north-eastern states. Historically, stone has been collected from the roadside or from shallow surface workings. Small quarries on steep slopes are often enlarged by blasting or excavation at the base. This is dangerous and can cause slope failures. Roadside stone collection continues in some districts despite its proven negative impacts on road safety and stability. Sand and gravel are often obtained from river deposits. Jurisdiction over stone and aggregates is shared between the Geological Survey of India and the State Forest Department. The Geological Survey of India issues licences for major mineral developments while the Forest Department issues permits for stone quarrying and for sand and gravel extraction. This is largely because these are mostly found on forest lands. Roadside quarrying is officially discouraged, but unofficially continues, invariably by petty contractors.

342. Adequate earth material is available from barren land in the vicinity. Estimated quantity is 1,45,500 cum Aggregates (320000 MT) will be mostly sourced from licensed quarries available locally. Sand 80,000 cum will be taken from river beds after prior permission from competent authority.

343. Construction water requirement (avg. 300KLD and peak 400 KLD) will be met through local rivers and other local streams. Domestic water requirement (50 KLD) for workers will also be met mainly through local streams. If needed, groundwater may also be abstracted.

344. Road maintenance, repair and new construction will continue to cause large demands for construction materials. There is a clear need for a better materials supply policy in each district to minimise environmental impacts of small-scale, poorly managed operations and improve the quality and reliability of supply. In some districts, it may be appropriate to develop centralised quarries, if an operator can be attracted. In any case, pre-designation of sources would give contractors a level playing field for bidding and minimise incentives for environmentally damaging cost cutting.

345. The engineering team as part of material survey has identified and recommended sources of the construction materials. Details are these sources are provided in Volume 1 (Material survey chapter) of Detailed Project Report. As a prior requirement of project, every new quarry and borrow area should also be subjected to a site specific environmental investigation work according to an

approved plan; and should be left in a safe condition or restored to a productive land use. Subject to these conditions, obtaining construction materials for projects will not cause unacceptable impacts.

346. Quarry and borrow pits may be filled with rejected construction waste and afterwards should be given a vegetative cover. If this is not possible, then the excavated slopes will be filled in such a way that they resemble an original ground surface.

347. Mitigation for Quarries

- aggregates will be first sourced from licensed quarry sites (which are in operation) that comply with environmental and other applicable regulations;
- occupational safety procedures/practices for the work force will be adhered to in all quarries;
- quarry and crushing units will be provided with adequate dust suppression measures; and
- regular monitoring of the quarries by concerned authorities to ensure compliance with environmental management and monitoring measures.

348. Mitigation of Borrow Areas

- prior approval will be obtained from concerned authorities and all local environmental regulations be complied with;
- within all identified borrow areas, the actual extent of area to be excavated will be demarcated with signs and access to the operational area controlled;
- borrow pit plant and machinery will conform to CPCB and World Bank EHS noise emission regulations;
- protective gear will be provided to the workforce exposed to noise levels beyond threshold limits and there should be proper rotation of such personnel; and
- all operation areas will be water sprinkled to control dust levels to national ambient air quality standards (Annex 3).

349. The project will require large amounts of bitumen or bitumen emulsion usually stored in drums. These empty bitumen drums are generally recycled as steel sheeting, or used in road construction as parapets or for river bank stabilisation. When supplied and used in this manner, bitumen is not regarded as a significant environmental hazard.

350. The project will require the import, transport and use of fuel and oils. Minor diesel spills are common in region, especially around fuel stations. To mitigate these impacts following measures will be applied.

- Secondary containment around fuel tanks and at fuelling stations will be built;
- Oil and fuel spills, and other runoff from contaminated areas will be controlled; and
- Equipment and fuel depots will be placed in safe zones away from drinking water sources and along river banks.

351. The project provides an opportunity to assist the PIU and contractors in improving fuel handling practices so as to minimise future fuel spillage.

F. Environmental Impacts - Operation Phase

1. Noise Vibration, Air Pollution, Runoff, Spoils of Hazardous Materials

352. The current low traffic flows along the project road is expected to increase because of improved economic activities associated with better access. The larger numbers of vehicles will be an additional source of noise and gaseous emissions.

353. The predication of future noise levels due to increase in traffic has been carried out using FWHA noise model. The detail results are provided discussed in Section 5.4.2.6 (Table 5.14). It is found that an incremental increase of about 3 to 5 dB(A) noise level is expected due to increased traffic over the designed life of the project i.e. 20 years. Most of these increase in noise level will be attenuated by natural means i.e. distance form source, obstacles from nearby and surrounding building and structures, difference in levels of vehicle and receptor as well as installation of recommended mitigation measures such as installation of noise barriers at sensitive location, planning of trees etc.

354. Repairs to culverts and new drainage work will eliminate/reduce the soil erosion problems presently caused by poor cross drainage. Also, the situation will remain good because this road pass through area that are largely forested and trees and plants have the capacity to absorb gaseous as well as noise pollutants. Bioengineering techniques may also help to absorb pollution.

355. As the subproject work will include blasting of rocks in hilly, there are possibilities of Acid Rock Drainage (ARD) due to leaching of sulphur containing materials from rocks that become exposed to atmospheric oxygen by blasting work. This may lead to degradation of water quality in the area. To avoid ARD issue, it is recommended that during the details design the CSC geologist should confirm that the local geology does not provide for any ARD issues. In case, there are indications of ARD issue, subproject EMP shall be updated by including appropriate mitigation measures to control ARD.

2. Land Use and Settlements

356. The likely impacts on land use and settlement patterns are limited. Improved access will lead to increased migration, but this will occur gradually and over a prolonged period. There will be time for new residential areas to be established. There will be a need to control ribbon development.

3. Social Impacts

357. Specific benefits to local people will include:

- easier communication;
- easier access to markets (both internally and regionally) with savings in travel times and costs;
- enhanced market efficiency through better distribution and accelerated deliveries etc.;
- improved access to health, education and other social services;
- employment generation;
- improved technical skills; and
- enhanced economic activity.

358. Likely adverse social impacts will include:

- increased chances of exposure to communicable diseases, particularly during construction;
- influxes of new settlers leading to increased pressure on natural resources causing hardship to local communities relying on local/forest resources; and

- rural-to-urban migration causing labour shortages in the depleted rural areas and other negative impacts in the urban areas.

G. Cumulative and Induced Environmental Impacts

359. According to the ADB Environment Safeguards Sourcebook [11] Cumulative Impacts is described as: “The combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project.” The sourcebook also describes Induced Impacts as: “Adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur at later or at a different location.

1. Cumulative Impacts

360. The projects with may cause environmental implications in the project areas are operations of tea gardens in Tamenglong, operation of proposed refinery and the development of mineral reserve that are avaialble in the Tamenglong district. Project road may act as one of the access routes to mineral resources in future.

361. Induced Traffic: Based on the experience of the Consultants for similar NH projects, induced traffic has been considered based on the potential for existing land uses to release extra demand which might have been suppressed prior to the improvement of the project road. It is logical to assume that such induced traffic would be released from the zones in the influence area of the project road and not from the zones very far from Imphal-Tamenglong road. The induced traffic has been taken as 5% of the traffic on the project road.

362. Generated Traffic: After improvement of the project road some generated traffic would also be added to the normal traffic due to land use developments, which will be triggered by the increased accessibility along the project road. The generated traffic on the project road may be on account of the existing tea gardens in Tamenglong, or due to the proposed petroleum refinery and the mineral reserve that is available along the project road. Presently these resources are not being used fully. Once the project road is improved and the accessibility is improved the generated traffic will be released on the project road. Thus the share of generated traffic has been taken as 15% for the project road. Besides vehicular emission, other impacts associated with operation of new industries are soil erosion, noise and dust.

363. Regional Trade: Since the project road will be connected to ASEAN highway netwrok at Imphal, the project will also contribute to the regional trade.

364. The establishment of civilian government in Myanmar and the intensification of engagement with other countries and relaxation of trade sanctions are opening up trade opportunities with Myanmar. India is engaged in Myanmar with several projects and is actively taking steps to upgrade border trade infrastructure and other trade facilitation measures. All these are expected to significantly increase the border trade. The India-ASEAN FTA in goods has seen increasing India’s trade with ASEAN has seen large increase reaching USD 80 billion last year. The FTA is expected to abolish tariff restrictions on 3200 items by end of 2013 and will facilitate large growth in trade. Myanmar with its strategic location is the only land bridge to the ASEAN nations. With the opening up of Myanmar and the large potential in India-ASEAN trade growth, there is vast scope for generating traffic from adjacent country Myanmar for the various tradable goods. The trade potential at the Indo-Myanmar border through Moreh was estimated based on available

[11] Environment Safeguards, A Good Practice Sourcebook, Draft Working Document, December 2012

assessments from various sources12,13 and volume of trade estimated through Moreh Integrated Check post within 5 years of its operationalization. It is expected that a large portion of North East India's need will come through these border points in future. Based on the details collected from the Manipur PWD, the estimated goods vehicle traffic are given below for each type of tradable item:

- **Pulses, beans and lentils:** 150 truckloads daily @ 10 tons capacity (Background of the forecast: Estimated at two-third of the North East India pulses Consumption @ 58.1gm/capita/daily currently brought from rest of India).
- **Timber and timber products (teak, hardwood & C class)** - for use in 'Timber Park' at Moreh and for domestic demands: 50-60 truck loads daily (Background of the forecast: Estimated volume 200,000 cubic meters, (100,000 cum from Myanmar and 100,000 cum import from ASEAN Countries)).
- **Minerals** (coal, limestone, granite, iron ore, gypsum, silica sand, dolomite, rock phosphate etc.)= 75 to 200 truck loads daily. (Background of the forecast: Estimated at the installed manufacturing capacity of the factories in North East and local market).
- India is importing about 5 million tons of rock phosphate for manufacture of fertilizer; of this about 2 million tons are imported from Kunming China. In return China imports 1.5 to 2 million tons of iron ore from India. Kunming to Kolkata via Moreh-Manipur route is less than 2000 Kms. There are huge coal mines in Myanmar, coal is cheaper and better. Other minerals command the same advantage from commercial points of view.
- **Items of general trade & commerce:** 40 to 60 truck loads daily. Items: Industrial goods & FMCG products, steel bars, cement, hardwares, petroleum products, tyres, automobile parts, machinery, equipments, fabric, yarn, essential commodity products, tea, marine fish, crafts & handlooms products, minor forest products etc.

365. Assuming about one-third of the export-import through land routes and Moreh being the main gateway from Myanmar, the potential of trade through Moreh is of the order of UD$ 600 million and this in terms of truck traffic based on broad assumptions is equivalent to about 750 trucks per day. With an annual growth of 14% in trade between India and Myanmar3 and the potential for trade with other ASEAN countries also through this corridor, it is safe to assume the potential will realize in the next 10 years and the potential for truck traffic is of the order of 1000 trucks per day along this corridor including empty trucks by 2022. This is also in line with the above estimate of about 400 trucks for import alone from Myanmar (almost 600 trucks including empty trucks).

366. The road upgrading will also improve the travel speed and travel condition along the Imphal-Tamenglong corridor (through Moreh via Imphal) and is expected to generate a road user cost saving of over 10% and this will result in additional traffic generation along the corridor which is taken at 3% of the traffic

367. Currently there is no other information on future development projects along the project road. Hence, it is difficult to assess cumulative impacts from other projects which may get implemented in the project area. Given the above information on existing projects in the project area and the lack of information on future projects it can be concluded that based on existing information cumulative impacts from the project as a whole will be minimal. Appropriate mitigation

[12] Kimura, F., T. Kudo and S. Umezaki (2011), 'ASEAN-India Connectivity: A Regional Framework and Key Infrastructure Projects' in Kimura, F. and S. Umezaki (eds.), ASEAN-India Connectivity: The Comprehensive Asia Development Plan, Phase II, ERIA Research Project Report 2010-7, Jakarta: ERIA, pp.1-56.

[13] Augmenting Bilateral Trade Between India &Myanmar, Country Report, Indian Chamber of Commerce, 2012

measures have been included in the EMP for possible short-term and long-term impacts which may arise particularly in Tamenglong region where refinery is planned and also mineral resouces exists.

1.1 Comulative Impacts of Extension of Project Road to Haflong

368. An assessment is made of likely cumulative impacts due to extension of project road further to Haflong where is meet East West Corridor on GOI which is a Mass Rapid Transport Corridor of the country. Although the project is included in the current 5-year plan of the Government, it is unclear whether and when this section will be impemented. Nevertheless this assessment is based on the review of the secondary data and maps on location, topography, terrain, land use and assciated construction activities.

369. This section of road starts at Tamenglong town (in Tamenglong district of Manipur and ends at NH-54 at Haflong (in Assam state) covering a total length of about 52 kms. The terrain is hilly (with steep slopes) for most part of the road and land use to forested. Elevation ranges from 1150 m above msl (at Tamenglong) to 710 m (at Haflong). It crossed two rivers. Figure 50 show the location map of the Tamenglong-Haflong Extension Road. The road work will include construction of new road to 2 lane carriageway standards.

Figure 50: Location map of the Tamenglong-Haflong Extension Road

370. Owing to the lack of exact information on improvement proposals, location, extent and timeframe of development of this extension road, it is not currently possible to assess cumulative impacts that may occur. Should these development projects take place in proximity of and concurrent to works on the proposed Imphal-Tamenglong road section, possible cumulative impacts may include:

- Land Acquisition: impacts due to acquisition of fresh land for construction of new road.
- Loss of Flora and Fauna: Due to diversion of forest land and also construction of road through protected area. Areas of protected flora and fauna sensitive to disturbance.
- Landslides: due to steep slope and soil erosion.
- Natural resources: road development projects are likely to require large amounts of aggregates during construction. There may be significant cumulative impacts from transportation of aggregates from the borrow pits and quarries to the construction sites, and from the operation of concrete batching plants.
- Water resources: There is the potential for pollution of sensitive water resources during construction in the same way as for the proposed Imphal-Tamenglong Project. The cumulative impact is considered to be potentially negative; however, large volumes of fuel, oil or chemicals are unlikely to be used during construction.
- Ecology: Cumulative impacts from the road extension project may include permanent removal of habitat. This is considered of lower significance, as these projects are mostly upgrades and will be in general an extension to the existing footprints rather than completely new ones in areas of undisturbed habitat.
- Air quality: At locations where construction of the proposed extension road passes in close proximity to dwellings, construction dust may cause a temporary nuisance to local residents. There could be some additional dust in the atmosphere or the duration of increased dust concentrations could be longer.
- Noise and vibration: At locations where construction of the proposed road extension work is carried our, noise may cause a temporary disturbance to local residents as well as vibration may cause damage to the most vulnerable properties.
- Community health and safety: during road construction impacts in community health and safety due to exposed to noise, dust and vibration disturbance and the risk of road traffic accidents.
- Traffic: The proposed Project will involve a large number of vehicle movements on public roads that are also used by other developments and construction projects, as well as the public. This could have a cumulative impact in terms of temporary congestion or an increased risk of accidents, and is considered to be a potentially negative. There may be significant cumulative impacts from general construction traffic movements, including transportation of aggregates from the borrow pits and quarries to concrete batch plants and construction sites.
- Unplanned events: New developments will not be permitted within a defined distance from the proposed project facilities in accordance with Indian law, and any development planned within 500m will be subject to risk assessment. Keeping third-party developments at safe distance from the project facilities means that third-party incidents are extremely unlikely to escalate to include the project or vice versa.

371. Since the topography, terrain, land use and improvement proposals of the Tamenglong-Haflong extension road is expected to be similar to those of Imphal-Tamenglong Road, the mitigation measures proposed in the EMP for project road would minimize above impacts associated with extension of project road to Haflong. Therefore it is recommended to follow the proposed EMP for extension road section as well.

2. Induced Impacts

372. An assessment is made of likely induced impacts due to improved project activities.

373. Development of new industries and the trade level between border countries is on rise since a very long period. Lack of good connectivity and 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 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. Few of the probable positive and negative induced impact are indicated below:

a. Positive Induced Impact

- Increased Trade Opportunities among ASEAN countries
- Increase in Per Capita Income in Manipur and country as a whole
- Easy access to cross country education and employment opportunities
- Increased competition requiring better products at least costs, forcing entrepreneur adoption of technologically advanced systems and process resulting in efficient resource utilisation,
- Link infrastructural development.

b. Negative Induced Impacts

- May stress the available limited resources
- May lead to conversion of more and more agricultural areas to non-agricultural uses
- May have cultural changes due to movement of people from different caste and culture
- May lead to faster growth of urban population putting larger pressure on municipal infrastructure.
- May result in deterioration of air, water and soil quality due to inappropriate disposal of municipal waste and increase of vehicle population in satellite town areas.
- There are mineral resources within Tamenglong district. Though they are not located within the project area, the project road may act as one of the access routes to mineral resources in future.

374. For addressing the impacts of air pollution, noise and safety, measures on regular maintenance of the road including the road furniture, monitoring of vehicle emissions and enforcement of Euro 3 standards, construction of noise barriers and others have been included in the EMP during operation stage.

H. Potential Environmental Enhancement/ Protection Measures

375. Annex 7 to Annex 11 of this EIA Report presents good environmental management practices and guide documents in the following aspects of road construction:

- Plant Management – Annex 7
- Camp Site Management – Annex 8
- Debris Disposal Management – Annex 9
- Borrow Area Management – Annex 10

- Quarry Area Management – Annex 11

VI. CLIMATE CHANGE IMPACTS AND RISKS

A. Climate Change Mitigation

376. The Transport Emissions Evaluation Model for Projects (TEEMP)[14] developed by Clean Air Asia[15] was utilized to assess the CO2 gross emissions 'with' and 'without' the subproject improvements which is mainly surface roughness and directly impacts of vehicle speed and fuel consumptions. It also allows the assessment of future congestion, if they will occur in the future given the projected increase in traffic and road capacity 'with' and 'without' the subproject improvements like lane configuration and road roughness.

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

- Tranche 1 subproject road between Imphal-Tamenglong will improve 103.02 km road section (rural highway) located in two districts i.e. Imphal West and Tamenglong; of Manipur state in northeastern part of India;
- Road section between Imphal-Kanchup (13.0 km) will be widened and improved to 4-lane carriagway configuration (with 26 m carriageway width) whereas section between Kanchup-Tamenglong (90 km) will be contrcuted as greenfiled road to 2-lane configuration (with 7 m carriageway width);
- road surface roughness will decrease from the general condition of 7.0 m/km to 3.0 m/km;
- Other improvements include the repair or reconstruct damaged culverts, introduction of paved drains for all road section and built up drains where necessary, removal of any irregularities that are on the existing vertical profile, and road safety appurtenances.

378. Traffic forecasts were taken from the economic analysis / engineering report (Chapter 4 of Main Volume of Detailed Project Report) for two homogeneous road sections disaggregated into vehicle types and share to the annual average daily traffic as presented in Table 90.

Table 90: Vehicle Composition on subproject road

Vehicle Type	Traffic Composition (%)	
	Section 1 (HS-2)	Section 2 (HS-2)
Car	28	18
Commercial (Cars, Taxi, Vans)	4	3
Mini Bus	0	0
Bus	0	0
LGV - 4 Wh	1	4
3 Axle Truck	0	0
2 Axle Truck	3	1
4 to 6 Axle	0	0
LGV 3 Wheeler	1	1
3-Wheeler	19	26
2-Wheeler	35	38

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

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

Vehicle Type	Traffic Composition (%)	
	Section 1 (HS-2)	Section 2 (HS-2)
Tractor	0	0
Tractor With Trailer	0	0
Cycle	8	6
Cycle Rickshaw	0	1
Hand Cart	0	0
Animal Drawn	0	0

379. Road capacity of 7,200 PCU/lane/day for rural roads was adopted for the project. Emission factors were mostly taken from the CBCP/MOEF (2007) Draft Report on Emission Factor Development for Indian Vehicles, the Automotive Research Association of India, and C. Reynolds et.al (2011) Climate and Health Relevant Emissions from in-Use Indian for three-wheelers rickshaw as presented in Table 91.

Table 91: CO2 Emission Factors used in the TEEMP Model

Vehicle Type	Petrol	Diesel	LPG/CNG
2-Wheel	1.37 kg/l		
3-Wheel	2.12 kg/l	2.58kg/l	3 kg/l
Cars/bus/bus	2.24 kg/l	2.58 kg/l	

380. Finally, emission from 1 kilomerte rural road construction were taken from the ADB reference (ADB - Carbon footprint 4, http://www.adb.org/documents/reports/estimating-carbon-footprints-road-projects/default.asp). In present case 109600 kg CO2/km of road constrcution were taken as referecne value. This value if based on estimation of unit bill of materials required to upgrade /construct 1 kilometer of rural highway which include cement, steel, gasoline, diesel, and bitumen etc.

381. **Estimated carbon emissions**. For each kilometer of rural highway upgrading, CO2 emission from construction is estimated at 6.2 tons. The design life of the project road range from 15 to 20 years. Total annual emission without the project at the middle of the design life at year 10 is estimated at 20810 tons and with project including induced traffic is estimated at 60,806 tons. A summary of the expected annual CO2 emissions is provided in Table 92.

Table 92: Estimated Annual Gross CO2 Emissions Intensity for subproject road

Road Section	Business-As-Usual	Project (without Induced Traffic)	Project (with Induced Traffic)
Imphal-Kumchup-Tamenglong	20810	(37128)	60806

382. While there is an increase in the CO2 emissions due to increase in traffic the levels are still far below the 100,000 tons per year threshold set in the ADB SPS 2009 and therefore not required to implement options to reduce or offset CO2 emissions.

B. Climate Risks and Adaptation Needs

383. Climate risks were identified following both top down and bottom up approaches. Under the top down approach changes of key climate parameters, mainly temperature and precipitation were projected for 2050 using an ensemble of Global Climate Models (GCMs). Given the projected variations of temperature and precipitation the subproject road were screened for 9 types of climate risks:

- Landslide triggered by increased precipitation
- Fire
- Flood
- Drought
- Tsunami
- Cyclone wind
- Cyclone surge
- Sea level rise
- Coastal erosion

384. Climate risk maps based on information from the GCMs were created for the subproject area using Geographic Information System (GIS) maps. After overlaying the road locations on the climate risk maps low to medium risks identified for the subproject road were flooding, landslides triggered by precipitation, and drought.

385. Landslides triggered by precipitation. Heavy rains can cause disruption of the road network, decreased accessibility, erosion of roads and embankments, surface water drainage problems, slope failures, landslides, among others. Increased river flow resulting from precipitation and storminess may result in damages to bridges. Bridge/culvert capacities are reduced or exceeded, causing upstream flooding to occur. Seasonal variation is rainfall also causes drought in subproject areas. Section between Imphal-Kunchup is particularly vulnerable to flood and submergence risks since this is low-lying area. Flooding occurs during the rainy seasons (May to October).

386. Landslide Triggered by Precipitation. Road section between Kunchup and Tamenglong, which is basically hilly terrain with weak geology, is potentially susceptible to medium to high levels of landslide risk.

387. Droughts are also experienced in recent years in subproject areas mostly Imphal, Thoubal and also in Chandel districts of Manipur. The drought risk is low.

388. Under the bottom up approach environmental checklists were compiled on all environmental features including risks for landslides, flooding, drought for the subproject road. A combination of review of published data, field visits and public consultations were carried out to complete the environmental checklists. State/District level consultations with key stakeholders were carried out to find out information on history of flooding and drought in the project area. Through these methods information on the existing hydrology as well as meteorological data, and potential hydro-meteorological impacts that may arise from the project activities were compiled. Based on information from the subproject road specific environmental checklists, public consultations and hydro-meteorological analysis the main risks identified were flooding, landslides and drought.

389. The climate risks and subproject road section with risks identified using the top down and bottom up approach though not exactly the same were largely consistent. After combining the findings from the two approaches, the final list of road sections and types of risks they faced were listed. A final review of the road sections was carried out by the engineers. It was found that the risk of drought was very low. Hence, only flooding and landslide that was considered for addressing the road design.

390. Key engineering measures taken to address these risks in the design are: i) increase in embankment height in Imphal-Kunchup section, ii) construction of new side and lead away drains, iii) construction of new culverts or widening of existing ones, iv) construction of new bridges, v)

construction of retaining walls, and iv) use of slope protection techniques. As shown in Table 93, costs for taking these measures add up to a total of US$ 42.6 million. This is approximately 29.4% of the total civil works costs. It must be pointed out that these measures would have been considered anyway in the conventional design as the issue of flooding and landslide is a threat to the sustainability of the road. However, these measures also contribute to adaptation of the road for future increases in precipitation. This risk screening and risk identification exercise has helped to ensure that subproject road has adequate climate risk mitigation or adaptation measures. The sectionwise details of climate risks, specific engineering measures taken and the costs of those measures are provided in Table 93.

Table 93: Cost of Climate Adaptation Measures (in million US$)

Section	Increase Embankment Height	New side and lead away drains and Retaining walls	New/ Widening Culverts	Major Bridges	Total
Imphal-Kumchup-Tamenglong	1.7	16.5	9.1	15.3	**42.6**

391. Provisions have also been made in the bidding documents for the contractor to prepare contract package specific EMP's based on the final detailed design to address a range of issues including climate related risks and vulnerabilities such as flooding, coastal erosion, landslide and accordingly incorporate required costs in the BOQ.

Table 94: Climate Adaptation Measures and associated costs for Imphal-Kuncgup-Tamenglong Road Subproject

Road Section	Climate risk	Cause of risk	Adaptation measures taken in design	Costs for adaptation measures (US$)
Imphal-Kumchup-Tamenglong	Damage of road due to flooding	Located in low lying areas	• Raising embankment height by 1.0 m to 3m in Imphal-Kunchup section (low lying area)	1.7 million
		Croosing of subproject roads	• Constrcution of culverts (new culvers, widening, and rehabilitation) along Imphal-Kunchup-Tamenglong Section	9.1 million
		Croosing of subproject roads	• Constrcution of Major bridges along Imphal-Kunchup-Tamenglong Section	15.3 million
		Croosing of subproject roads	• Constrcution of draingage and protection work (turfing of embankment slopes, planting trees and shrubs, side drains (lines and unlined) etc.) along Imphal-Kunchup-Tamenglong Section	13.5 million
	Damage of road due to landslides	Hilly sections along the project road	• Construction of retaining walls on hill side to protect slopes along Kunchup-Tamenglong Road Section	3.0 million

VII. ANALYSIS OF ALTERNATIVES

A. Introduction

392. This chapter presents the symmetrically compared feasible alternatives to the proposed project with respect to site, design, technology etc. Since the Imphal-Kunchup section involves improvement of the existing road, only one alternative alignment was considered for this section. For Kunchup-Tamenglong sections, various alternate alignment options were studied including option of a Tunnel, use of alignment of existing tracks, improvement of existing roads i.e. NH-37 and NH-102. Besides this an evaluation has been carried out for the 'with' and 'without' project situation-in terms of the potential environmental impacts for the justification of the project. This chapter discusses how environmental parameters were assigned due importance and were carefully considered in the analysis of alternatives.

B. 'With Project' and 'Without Project' Scenario

1. 'With Project' Scenario

393. The 'with Project' scenario includes improvement of Imphal-Kanchup-Tamenglong road section to four/two lane carriageway configuration in Imphal West and Tamenglong districts of Manipur. The 'with project' scenario has been assessed to be economically viable and will alleviate the existing conditions. It would thereby, contribute to the development goals envisaged by the Government of Manipur as well as Government of India, and enhance the growth potential of the state as well as SASEC Region as well as region.

394. To avoid the large-scale acquisition of land and properties, the project envisages the widening of road to two lane and mostly along the existing tracks to minimize the loss of properties and livelihood of the PAPs.

2. 'Without Project' Scenario

395. In the case of 'without project' scenario the existing road and tracks without carriageway will be considered as it is. Considering the present traffic volume and potential for growth in near future, the capacity of the present road is insufficient for handling expected traffic volume and calls in for immediate improvements.

396. The project road provides shortest connectivity for the State of "East West Corridor" of the National Highway Authority of India. This shall also reduce the distance to Guwahati, the commercial hub of the North East, from Imphal by at least 90 (ninety) Kms as compared to the existing route via Dimapur. The alignment passes through Imphal, Kangchup, Haochong, Bhalok and Tamenglong. Tracks at certain sections between Kangchup to Haochong earlier known as KT road during British era are still being used by settlers to transport wooden logs during dry season and are accessible on foot or Shaktiman trucks only. Existing road surface has exposed rocks as it has not been maintained due to heavy rains in the region. The alignment has many settlements and rivers along its length. Alignment traverses through steep mountains towards Haochong settlement, via Waphong settlement. Existing alignment at certain section has very steep grades. Alignment passing through Waphong settlement crosses Ijei River very close to the settlement.

397. The poor road conditions, population growth, increase in traffic volumes and the economic development along the project corridor would continue to occur and will exacerbate

the already critical situation. The existing unsafe conditions and the adverse environmental consequences, in terms of the environmental quality along the roads, would continue to worsen in the absence of the proposed improvements.

398. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development. Keeping in view the site conditions and the scope of development of the area, the 'With' and 'Without' project scenarios have been compared as shown in Table 95. By looking at the table it can be concluded that "With" project scenario with positive/beneficial impacts will vastly improve the environment and enhance social and economic development of the region compared to the "Without" project scenario, which will further deteriorate the present environmental setup and quality of life. Hence the "With" project scenario with minor reversible impacts is an acceptable option than the "Without" project scenario. The implementation of the project therefore will be definitely advantageous to achieve the all – round development of the economy and progress of the State.

Table 95: Comparison of Positive and Negative Impacts of 'With' and 'Without' Project Scenario

With Project Impacts		Without Project Impacts	
+ve	**-ve**	**+ve**	**-ve**
• With the improvement of road surface and slope protection measures, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced. • Tourism will flourish. • Better access to other part of the region as the project road is a lifeline of the region. • Providing better level of service in terms of improved riding quality and smooth traffic flow. • Will reduce accident rate.	• Minor change in topography is expected due to construction of embankments. • Minor changes in land use pattern. • Loss to properties and livelihood.	Nil	• Increase in travel time. • Increase case of landslide and soil erosion. • Increase in fuel consumptions. • Increase in dust pollution and vehicular emission. • Increase in accident rate. • Overall economy of the State will be affected.
• Better access and reduced length to Guwahati bu 90 kms by direct connecting instead by current route via Dimapur.	• Change in land use.	NIl	• Increase in travel time. • Increase case of landslide and soil erosion. • Increase in fuel consumptions. • Increase in dust pollution and vehicular emission. • Increase in accident rate. • Overall economy of the State will be affected.
• All weather access reliability.	• Removal of vegetative cover along the road at selected locations and loss of trees. • Impacts of flora and fauna. • Diversion of small area of forest land.	Nil	• Increase in accidents.
• Reduced transportation costs.	• Increase in air pollution due to vehicular traffic. • Short term increase in dust due to earth work during construction at micro-level.	Nil	• Project road will further deteriorate.

With Project Impacts		Without Project Impacts	
+ve	**-ve**	**+ve**	**-ve**
• Increased access to markets.	• Increase in noise pollution due to vehicular traffic during construction work.	Nil	• Increased vehicle operation cost.
• Access to new employment centers.	Nil	Nil	• Reduced employment/ economic opportunities.
• Employment to local workers during the execution of the project.	Nil	Nil	• Arrest of possible significant enhancement and economic development of the region.
• Better access to health care centres and other social services. • Improved quality of life.	Nil	Nil	• Land degradation, dust pollution and damage to pastureland, contamination in water bodies due to vehicles travelling along multiple tracks on the open ground. • Deep impact to human health in case of emergency.
• Strengthening of local economies.	Nil	Nil	• In absence of the project, it is extremely difficult to generate funds for such a massive improvement of the road infrastructure from its own resources.
• Reduction in travel time and development of the important places of in the districts of Tamenglong and Imphal West.	Increase in speed may lead to accidents in congested areas.	Nil	• Affect the development of the area.
• Reduction in erosion and landslides from multi tracking and stone pitching of elevated embankments.	Nil	Nil	• Increase in dust pollution and creation of sedimentation problems in water bodies.
• The widened and paved road will reduce impacts due to multiple tracking on soil and vegetation along the road.	Nil	Nil	• Increased adverse impacts on soil and vegetation.

C. Use of Existing Alignments (Roads)

399. Figure 51 show the existing connectivity to Tamenglong from Imphal. There are two options i.e. via NH-37 and via NH-02 (Imphal-Kangpokpi-Tamei-Tamenglong Road).

Figure 51: Alternate Routes Considered

400. The existing connectivity to Tamenglong via NH-37 is of 146 kms length. The geometrics of the existing road do not meet the stipulated requirement. There are numbers of acute horizontal curves which are difficult to negotiate even for normal Trucks especially in the portion from Km. 10 to Km. 60 Kms. The maximum permissible laden weight on the road is presently restricted to 18 tons and therefore the road does not have the characteristics of a proper Highway. The last 41 kms (Khongsang to Tamenglong) is of Single Lane standard (3.75m). The road shall require substantial re-alignment to avoid these curves and ensure speed of 30 Kms per hour.

401. The construction of the Tipaimukh Dam shall result in submersion of the road at km 100 which again shall necessitate re-alignment which shall increase the length of the road.

402. The length of the existing alignment along NH-02 (Imphal Kangpokpi Tamei Tamenglong Road) is 167 kms. The carriageway is Intermediate Lane (5.50m) which shall require widening to SDL (7.00m) to function as an Inter State Highway.

403. The length of the proposed project Road Imphal Kangchup Tamenglong is 103.20 km. The Project Road is therefore shorter by 43 kms from the existing alignment along NH-37 (New) and 62 kms from the alignment along NH-02 (old 39).

D. Location and Alignment Alternatives

404. **Use of existing tracks:** The consultants have studied various alternatives for the alignment including the improvement of the existing tracks. However the alignment along existing tracks is too steep and its not possible to improve it to the project standards. Hence the consultants have worked out a new greenfield alignments. To reduce the length an option of a 1.45 km long tunnel from km 57.850 to km 59.300 has been studied.

405. The alignment of the Imphal Tamenglong road is along an existing road for the first 15 km on Imphal side and about 4km on Tamenglong side and balance ingreenfield alignment in hilly terrain. The alignment has been studied taking into account the following obligatory points:

- Imphal
- Kangchup
- Haochong
- Bhalok
- Tamenglong

406. During Feasibility study, **two alignment options** have been studied for Imphal-Kangchup-Tamenglong Road.

- **Option 1**: Following the existing road upto Kangchup and further green field alignment upto Tamenglong connecting the obligatory points.
- **Option 2**: The alignment as given in option 1 except provision of Tunnel (1.44 Km) near Sangphei.

407. The proposed Imphal Kangchup Tamenglong highway is to provide shorter alternative alignment as compared to the existing NH 53 along with better grades and improved geometry between Imphal and Haflong and further will reduce travelling distance to Guwahati which is major hub for commercial exchange of commodities. It will also serve as a link to the East West corridor. The alignment mostly passes through Hilly terrain between Kangchup to Tamenglong. To reduce the travel time by 9.11km, the tunnel has been proposed near sangpoi village.

408. The alignment of the tunnel has been optimized keeping in view the topography and disposition of the hill range across the finalized recommended highway alignment in this stretch. A single tube D-shaped straight tunnel having provision of bidirectional traffic flow has been proposed to be excavated to about 12 m width and 8.5 m height.

409. Lay byes are also required to be provided at interval of 750 m inside the tunnel. At the locations of the lay byes, the underground excavation of each tube will be of about 15 m width and 10 m height. The proposed Tunnel is planned in latitude of 24°-54'N and in longitude of 93°-37'. The maximum overburden cover along the tunnel alignment is of about 393 ml. Based on the geological set up and the geological features of the tunnel site, geometrics and traffic requirements, the typical functional cross-section of the mined tunnel and cut and cover sections have been designed in accordance with IRC: SP: 91 – 2010 "Guidelines for Road Tunnels" and "Guidelines for Expressway Volume-II Design". The location map of the proposed tunnel is given in Figure 52.

410. The tunnel is located at chainage From Km 68+170 to Km 69+610 (1.4 km). The alignment in section between km 55 to km 78 again passing through steep hills. From km 55+500 to km 61+500 the alignment passes by the settlements of Songphhei, Khaochangpung and Lukhambi. In this section the alignment winds to the top of a ridge and then climbs down

towards Irang river. In order to reduce the length of the road the consultants have explored the option of the provision of a tunnel through the ridge as shown in the referred figure. The length of the alternative is 6km including a 1.5km long tunnel as compared to an alignment length of 15.2 km without tunnel. Hence there is a reduction in the length of the road by 9.2km with the provision of the tunnel. Though the cost of the tunnel shall be high but it will be adequately offset by the reduction in the length and the road and the savings in the vehicle operating costs over the design life. Hence technically provision of the tunnel is justified .However on the flip side the communities falling along the road will get bypassed by the provision of tunnel causing social discontent. Hence a final decision on this issue will be taken in consultation with the client. The alignment crosses Irang river at about km 75+200 where a bridge is under construction which will be retained. The alignment further moves westwards parallel to the Irang river on the north bank.

Figure 52: Project Alignment Options

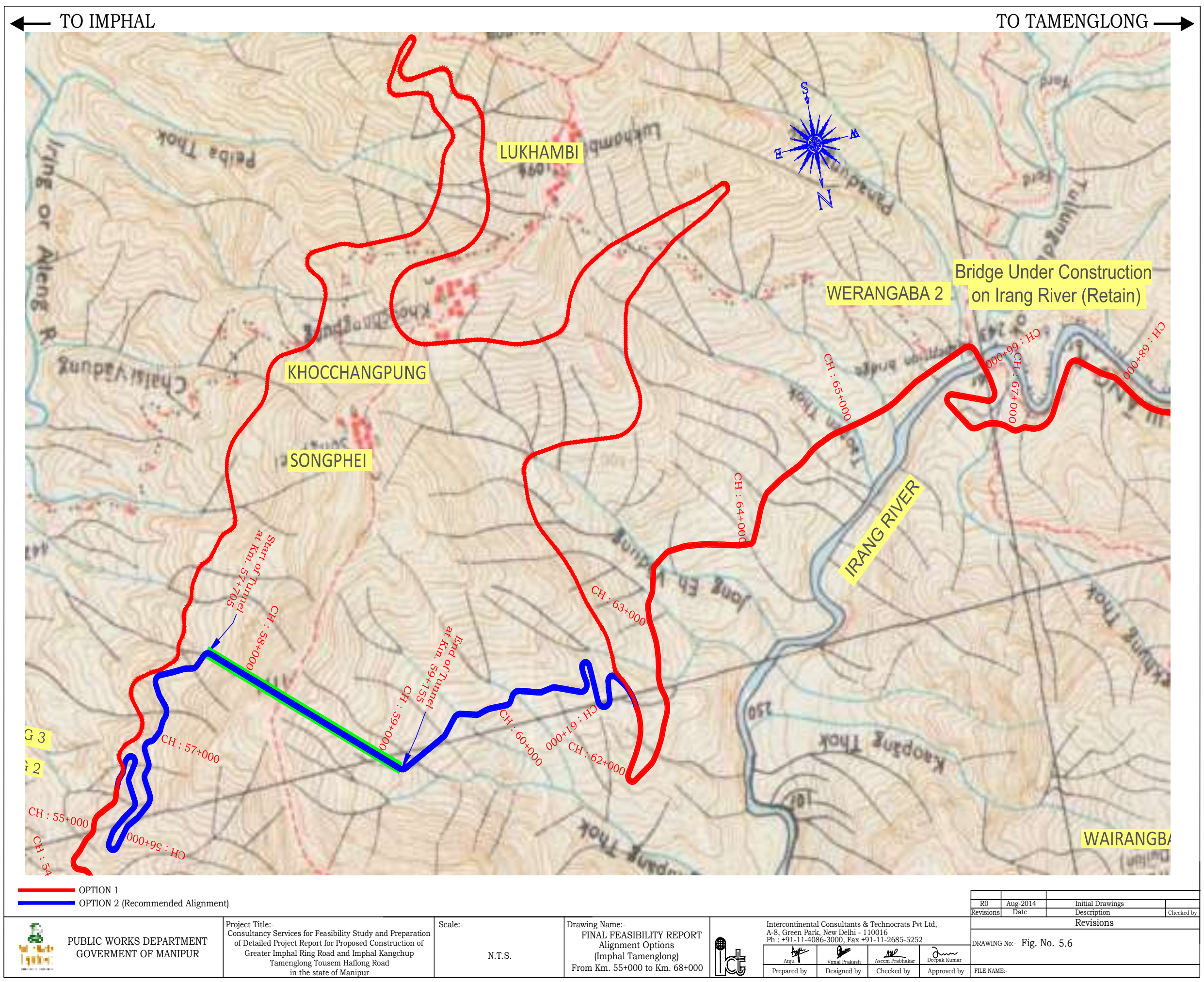
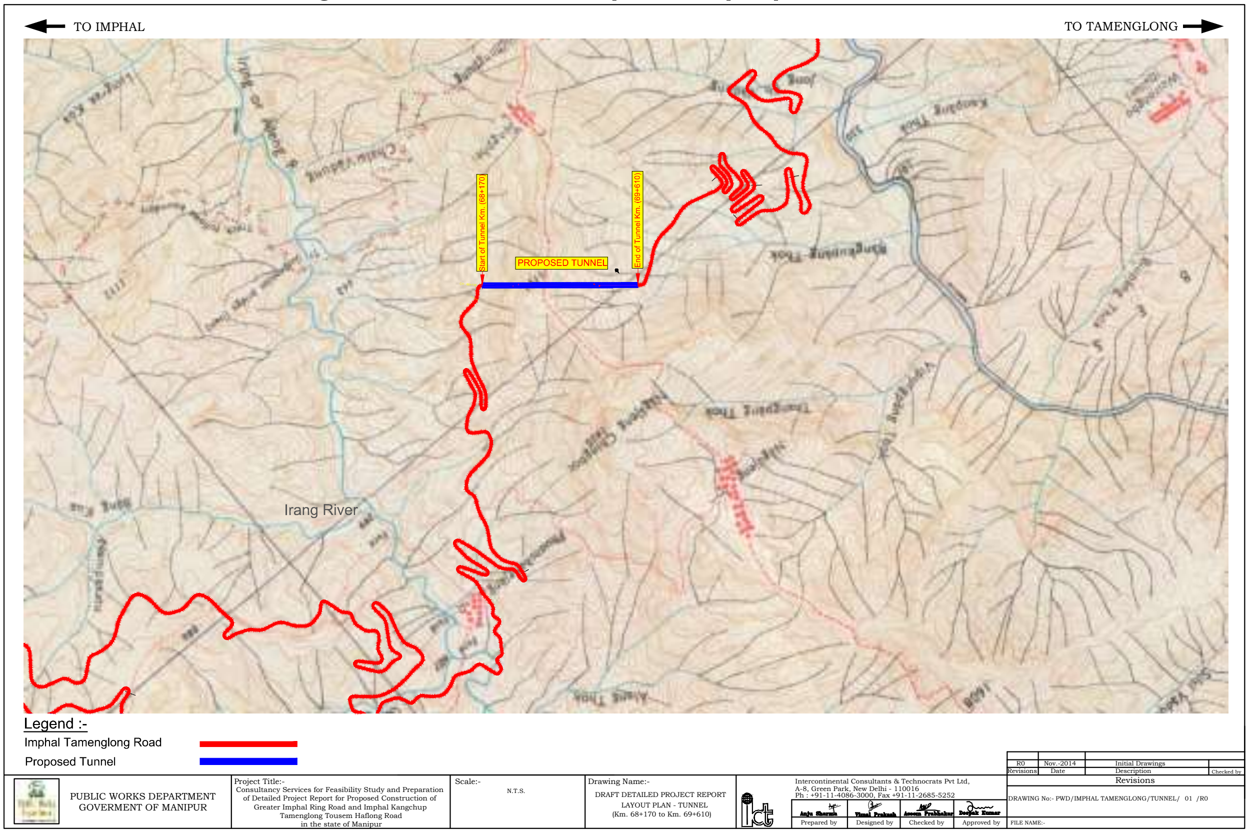


Figure 53: Location map of the proposed Tunnel



411. After careful consideration, the Option 1 alignment without Tunnel has been approved for improvement. The comparative analysis was carried out based on various environmental factors and the cost of construction as shown in Table 96.

Table 96: Comparison of Alternative Alignments for Imphal-Tamenglong Road Section

Sl. No.	Environmental Parameter	Option 1: Without Tunnel	Option 2: With Tunnel
1.	Total Length (km)	120.255	111.055
2.	Use of existing road (km)	0	0
3.	Existing carriageway width (m)	New alignment	New Alignment
4.	Terrain	Hilly with settlements	Hilly
5.	Land requirements	Required in most of the sections	Minimum land take
6.	Major bridges	0	0
7.	Forest land take up	Not required	0
8.	Sensitive Habitat and Biological corridor	None	None
10.	Slope stability	Pass partly through stable areas and partly through weak unstable areas	Pass through weak geology and unstable areas
11.	No. of villages directly benefitted	02	0
12.	Construction cost (as per	820.16	840.43

Sl. No.	Environmental Parameter	Option 1: Without Tunnel	Option 2: With Tunnel
	feasibility report) – in Rs. crores		

E. Alignment Modifications due to Environmental Considerations

412. The selection of the alignment / widening options along various sections has been worked out based on continuous interaction between the engineering design team and environmental study teams. Various alignment improvement alternatives (left/right) for the project road have been analyzed along entire project road considering rural sections, urban sections, alignment in forest areas and junction improvements. The factors considered for evaluation of alternatives are:

- Flora and fauna likely to be impacted;
- Productive agricultural land likely to be impacted;
- Impact on water resources and surface water bodies;
- Environmental quality.
- Land availability;
- Land uses along the alignment;
- Residential / Commercial structures Impacted;
- Utilities likely to be impacted;
- Common property resources likely to be impacted; and
- Religious structures affected.

F. Engineering / Technological Alternatives

413. The formulation and analysis of engineering alternatives have been undertaken in terms of alternative cross-sections of road, highway-design principles (such as embankments for soil erosion and slope protections, hill cuttings, minimum width of road ride drainage, adequacy of roadway width at cross drainage structures, minimum gradient, etc.), comparison between flexible and rigid pavements (cement-concrete built rigid pavement as being environmentally superior then traditional flexible pavement), and selection of environmental friendly road construction methods.

414. The final alignment considered after detailed survey and design is about 103.02km in length, which is 7km shorter than original alignment.

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

415. In accordance with ADB's Safeguard Policy Statement (SPS) 2009 and Environment Impact Assessment Notification of GoI (2006), public consultations were held, as part of environment assessment study. The consultation undertaken with project beneficiaries, local/ government officials, community leaders, non-government organizations (NGO's), stakeholders in the corridor of impact and people likely to be effected due to the project on various issues affecting them and incorporation of various measures pertaining to environmental issues based on the responses from the people.

A. Objectives of Consultations

416. The process of public participation/ consultations was taken up as an integral part of the project in accordance with environmental assessment requirements. The objectives of these consultations are:

- To inform and educate the general public, specially potentially impacted communities/ individuals and stakeholders about the proposed project activities;
- To familiarize the people with technical, environmental, social and economic issues of the project for better understanding;
- To solicit the opinion of the affected communities/ individuals on environmental issues and assess the significance of impacts due to the proposed development;
- To foster co-operation among officers of PWD, the communities and the stakeholders to achieve a cordial working relationship for smooth implementation of the project;
- To identify the environmental issues relating to the road improvement work;
- Assess the views of the beneficiary communities and their willingness to participate in the project in a bottom up planning and decision making process;
- To secure people's inputs in respect of project planning, selection of mitigation measures and monitoring strategies;
- To ensure lessening of public resistance to change by providing them a platform in the decision making process;
- To inculcate the sense of belongingness among the public about the project.

B. Methodology used for Consultations

417. Both formal and informal modes of consultation were used in the public consultation process for the project. Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires as well as unstructured questionnaires. In addition, focused ground discussions (FGDs) and personal discussions with officials, on-site discussion with project affected stakeholders, and reconnaissance visits have also been made to the project area. 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, women, residents near the existing road, local commuters, and other concerned were also consulted.

C. Identification of Stakeholders

418. Stakeholders were identified to ensure as wide coverage as possible of the project area as follows:

- Households in the project area including potential Project Affected Persons,
- Women groups,
- Local, regional and international voluntary organisations / non-government organizations (NGOs),
- Government agencies, and
- Community leaders.

419. Questionnaire survey/ discussions were designed to obtain background information and details of general environmental issues that concern people in the project area. In addition, environmental issues were discussed with relevant organizations, government officials, beneficiaries, community leaders, women groups and experts.

420. In compliance with ADB's SPS requirements consultations will be continued throughout the project planning, design and implementation phase. The consultation process initiated during preparation of the EIA study. The official consultation with the key stakeholders was undertaken in the months of April 2014 to December 2014 at respective district offices and head quarter in Imphal. Various officials consulted include PWD Officials, Officials from Department of Environment (Manipur), Forest Officers, Wildlife Officials, Environmental Officers from pollution control board, statistical officer, officials from NGOs active in the project areas etc. Various issues discussed are:

- Statistics of forests cover in the State and its legal status i.e. Reserved, Protected, Unclassed;
- Protected area network of Manipur,
- Applicability of various laws and regulations to the present road development project;
- Requirements of Forest Department to carryout project activities within forest /protected areas;
- Flora and Fauna and endangered species in the State and project area in particular;
- Scope of the proposed road development, EIA and likely impacts on flora & fauna;
- Major threats to flora & fauna in the state;
- Applicability of EIA notification to the proposed project;
- Procedure to get clearance from forest department and NOC from pollution control board;
- Environmental quality parameters i.e. air, water, noise quality in the State and major sources of pollution;
- Institutional capacity of state authorities in pollution control and environmental management;
- Socio-economic conditions and likely impacts on due to proposed road improvement;

421. The list of officials/ people contacted along with the venue, issues raised, date of consultation is presented on Table 97.

Table 97: List of Officials Consulted & Issues Discussed During Field Visit

Sl. No.	Name of Official Consulted	Department	Issue discussed
1.	Mr. Neeraj Verma	Joint Secretary, Ministry of Road Transport and Highway, Government of India, New Delhi	Scope of the work, implementation arrangement, policy and regulatory requirements from environmental point of view.
2.	Mr. Kh. Temba Singh	Addl. Chief Engineer-II PWD, Manipur, Imphal	Overall scope of the Project, existing conditions of road section in Manipur, implementation arrangement, existing capacity of PWD, Major problems of NH, treatment to landslides
3.	Mr. Y. Joykumar Singh	Project Director, NESRIP, PWD Manipur, Imphal	Existing conditions of state road, Major problems of state roads, clearances /permits requirements, Treatment to landslides
4.	Th. Ibobi Singh, IFS	Additional PCCF (Wild Life) and Chief Wildlife Warden, Forest Department, Govt. of Manipur, Imphal	Scope of EIA, Impacts on wildlife and forest, Wildlife status in state, flora & fauna species, environmental aspects of hilly roads, regulatory requirements of Manipur and GOI for the implementation of the Project.
5.	Mr. A.K. Rana	PCCF, Forest Department, Govt. of Manipur, Imphal	Scope of EIA, Impacts on wildlife and forest, Wildlife status in state, flora & fauna species, environmental aspects of hilly roads, regulatory requirements of Manipur and GOI for the implementation of the Project.
6.	Mr. L. Joukumar Singh, IFS	Dy. Conservator of Forests (Wildlife), National Parks and Sanctuaries Division, Forest Department, Government of Manipur, Imphal	Scope of EIA, Impacts on Wildlife and forest, Wildlife status in state, flora & fauna species, Environmental aspects of hilly roads
7.	Mr. Dhananjay, IFS	Chief Conservator of Forests, Forest Department, Manipur, Imphal	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project
8.	Mr. Mahendra Pratap, IFS	Conservator of Forests, Forest Department, Manipur, Imphal	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project
9.	Mr. K. Jagadishwar Singh, IFS	Member Secretary, Manipur Pollution Control Board (MPCB), Lamphalpat, Imphal	Applicability of MPCB requirements for the currently road development project. Ambient air quality monitoring network in Manipur and existing environmental quality in Manipur.

Sl. No.	Name of Official Consulted	Department	Issue discussed
10.	Mr. W. Roshan Singh	Assistant Environmental Engineer, MPCB, Lamphalpat, Imphal	Ambient air quality monitoring network in Manipur and existing environmental quality in Manipur.
11.	Mr. Khumanthem Tomba Singh	Scientist C, MPCB, Lamphalpat, Imphal	Environmental quality monitoring for along project road section. Existing environmental quality in Manipur.
12.	Dr. T. Brijakumar Singh	Research Officer, Directorate of Environment, Government of Manipur, Imphal	Environmental issues in the project areas. Biodiversity studies in the project areas. Flora and fauna species.
13.	Dr. N. Sana Macha	Investigator, Directorate of Environment, Government of Manipur, Imphal	Environmental issues in the project areas. Biodiversity studies in the project areas. Flora and fauna species.
14.	Dr. H. Nandiram Sharma	Rtd. HOD, PG Dean College, President Science Teacher forum, Manipur	Environmental issues in the project areas. Research projects on biodiversity.
15.	Dr. Vinay Kumar	Associate Professor, Deptt. Of Life Sciences, Manipur University, Imphal	Environmental quality and issues in the project areas. Research projects on biodiversity.
16.	Dr. Sharma	Professor, Deptt. Of Life Sciences, Manipur University, Imphal	Environmental quality and issues in the project areas. Research projects on biodiversity.
17.	Mr. RajKumar Birjit Singh	State coordinator, Indian Bird Conservation Network (IBCN), Ningthoukhong, Bishnupur, Manipur	IBCN activities in Manipur, biodiversity issued in Manipur, bird conservations programs in Yangoupokpoi Lokchao Wildlife Sanctuary, presence of threaten/endangered/vulnerable species of birds and wilier in Yangoupokpoi Lokchao Wildlife Sanctuary.
18.	Mr.Wahengbam Rajesj Singh	Nodal Person, Indian Bird Area (IBA) Program for Yangoupokpoi Lokchao Wildlife Sanctuary, IBCN, Imphal, Manipur	Bird conservations programs in Yangoupokpoi Lokchao Wildlife Sanctuary, presence of threaten/endangered/vulnerable species of birds and wilier in Yangoupokpoi Lokchao Wildlife Sanctuary.
19.	Ms. Archita B. Bhattacharyya	Program Officer, WWF India (Assam & Arunachal Pradesh State Office), Uzan Bazar, Guwahati	WWF activities in Manipur and north-eastern region, biodiversity issued in Manipur, conservations programs in Yangoupokpoi Lokchao Wildlife Sanctuary, presence of threaten/endangered/vulnerable species of

Sl. No.	Name of Official Consulted	Department	Issue discussed
			flora and fauna in Manipur and in Yangoupokpoi Lokchao Wildlife Sanctuary.
20.	Mr. Jaydish Bose	Officer In charge, WWW Program in North-eastern States, WWF India, New Delhi	WWF activities in Manipur and northeaster region, biodiversity issued in Manipur, conservations programs in Manipur and in Yangoupokpoi Lokchao Wildlife Sanctuary, Elephant conservation programs in Manipur (if any).

422. In order to document likely impacts on affected persons, an interview survey has been carried out. A sample of PAPs was selected and interviewed through a designed questionnaire. Precaution has been exercised during the survey to ensure that the sample interviewed is truly representative of the affected groups and the questions are worded so as not to generate a bias response. Image 9 below shows one such interview survey. The consultation is focussed on:

- General awareness in local communities about environmental quality in terms of quality of water in rivers, ponds, lakes, ground water, ambient air and noise quality and its sources.
- Presence of archaeological / historical sites, monuments in the project region and likely impacts
- Presence of endangered /rare species of flora and fauna and its locations in the project region
- Frequency of natural calamities / disasters in the region
- Cultural places along the project roads and likely impacts of proposed road development, etc.

Image 9: View of Community Consultation

423. Besides interview surveys, focused group discussions (FGDs) were organized at key locations along the project roads. In total ten (10) FGDs meetings involving 193 participates from affected people, landowners, and village authorities, were organized. Specific emphasis was given to women participants to ensure that gender concerns are addressed in the project. Out of total participants, 73 participants were from women group.

424. Summary of public consultations through focused ground discussions (FGDs) meeting organized is presented in Table 98. Details of these consultations are presented in Annex 12.

Table 98: Summary of Public Consultations

Date	Venue / Place	Participants	Remarks
17 September 2014	Village: Bhalok District: Tamenglong	19 Participants (12 man and 7 women) from village community including village heads, teachers, housewife, business owners, labours, farmers and students	All participants supported the project.

Date	Venue / Place	Participants	Remarks
15 September 2014	Village: Dailong District: Tamebglong	13 Participants (8 man and 5 women) from village community including village housewife, business owners, labours, and farmers.	All participants supported the project.
16 September 2014	Village: Gadailung District: Tamebglong	09 Participants (6 man and 3 women) from village community including villages heads, councillors, housewife, business owners, labours, farmers and students	All participants supported the project.
16 September 2014	Village: Puching District: Tamebglong	11 Participants (8 man and 3 women) from village community including villages heads, ward members, housewife, business owners, labours, farmers and students	All participants supported the project.
01 October 2014	Village: Wairangba District: Tamebglong	21 Participants (16 man and 5 women) from village community including villages heads, housewife, business owners, labours, farmers and students	All participants supported the project.
06 October 2014	Village: Waphong District: Tamebglong	16 Participants (9 man and 7 women) from village community including village heads, housewife, business owners, labours, farmers and students	All participants supported the project.
06 October 2014	Village: Yairong District: Tamebglong	14 Participants (06 man and 08 women) from village community including government servants, housewife, business owners, labours, farmers and students	All participants supported the project.
07 October 2014	Village: Bakuwa District: Tamebglong	08 Participants (05 man and 03 women) from village community including government servants, housewife, business owners, labours, farmers and students	All participants supported the project.
08 October 2014	Village: Kunchup Bagla District: West Imphal	09 Participants (07 man and 02 women) from village community including government servants, housewife, business owners, labours, farmers and students	All participants supported the project.
08 October 2014	Village: Kunchup Chiru District: West Imphal	13 Participants (09 man and 04 women) from village community including government servants, housewife, business owners, labours, farmers and students	All participants supported the project.

D. Results of Consultations

425. Most of the people interviewed strongly support the project. The people living in the entire project area expect the different project elements to facilitate transport, employment, boost economic development and thereby provide direct, or indirect, benefits to themselves.

426. Construction camps may, however, put stress on local resources and the infrastructure in nearby communities. In addition, local people raised construction-process related grievances with the workers. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as proper housing, health care clinics, proper drinking water and timely payment. The use of local labourers during the construction will, of course, increase benefits to local peoples and minimise these problems. Wherever possible, such people should be employed.

427. In order to access the existing environment and likely impacts on PAPs, an interview survey has been carried out. A sample of PAPs has been interviewed through a designed questionnaire. Precaution has been exercised during the survey to ensure that the sample interviewed is truly representative of the affected groups and the questions are worded so as not to generate a bias response.

428. It is envisaged from the interview survey that there is increased environmental awareness among the people. It can also be seen from the table that more than 76% of the persons believes the existing environmental conditions of the area is good. Over 80% of the people agreed that the quality of air, water and noise in the area is good; whereas, about 10% respondent feel that the environmental quality is being deteriorated. Poor road condition and vehicular emissions are the major sources they feel responsible for this. In case of presence of archaeological / historical the responses are very few. In case of cultural and historial sites, the response of the people is mizxed. The area experiences natural disasters i.e. floods, earthquake etc. as it also envisaged that 73% of respondent reported history of natural disaster. Only 10% people indicated that there are rare and endangered species of fauna in the forests of the region. Overall, the general environmental conditions in the region are good and people have increased environmental awareness. Table 99 shows the result of public opinion survey carried out in the region.

Table 99: Peoples' Perception about Environment Degradation

Sl. No.	Question asked about	No. of people interviewed	Positive response (%)	Negative response (%)	No response (%)
1.	Water quality of rivers, ponds, wells, and canals	34	88	7	5
2.	Noise quality of the area	34	76	14	10
3.	Air quality of the area	34	91	3	6
4.	Archaeological sites	34	63	26	11
5.	Natural disaster	34	63	37	0
6.	Rare species of animals and birds	34	10	90	0
7.	Cultural sites i.e. market, melas	34	62	38	6

Note: Positive response shows that the overall environmental scenario in the area is good and wise versa.

429. During FGDs, local people extended their support to the project as they expect better connectivity and improved livelihood opportunities from the development of proposed road sections. Details of issues discussed during FGDs and mitigation measures incorporated in the project design are presented in Annex 12.

E. Interaction with Local/National and International NGOs

430. In order to get independent views on the likely impacts of the projects, non-government organizations at local as well as international level were consulted during the EIA process. This includes Indian Bird Conservation Network (IBCN); World Wide Fund (WWF) for Nature Assam and Arunachal Office; and local self-help groups. The IBCN is active in protected areas if Manipur whereas the WWF do not have direct activities along the project road. Local NGOs consulted included i) Social Education and Economic Development Society (SEEDS)-Wangjing; ii) Social and Health Development Organization, Moreh; and iii) Socio-Economic Development Association (SEDA), Thoubal.

431. Aspects such as conservation activities, presence of flora and fauna, likely project impacts and possible mitigation measures were discussed and views and suggestions from these NGO's were incorporated in the EMP. Consultation will continue with these NGO's during finalization of EIA, and project implementation and operation.

F. Public Disclosure

432. The project EA will be responsible for the disclosure of this EIA in compliance to ADB's Communication Policy 2011 and ADB SPS 2009. The draft Environmental Impact Assessment Report was disclosed in the English language in the office of PWD. The report was also made available to interested parties on request from the office of the PWD. Since this is Category A subproject, the draft EIA report was disclosed to the public through the ADB website, 120 days before the approval of the respective tranche for ADB financing. The draft EIA report will also be made available to all stakeholders as part of the consultation process required under the SPS 2009. The final report will also be disclosed on ADB website.

IX. ENVIRONMENTAL MANAGEMENT PLAN AND GRIEVANCE REDRESS MECHANISM

A. Introduction

433. The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time-frame with specific responsibility assigned and follow-up actions defined. It contains all the information for the proponent, the contractor and the regulatory agencies to implement the project within a specified time-frame

434. This EMP consists of a set of mitigation, monitoring and institutional measures to be taken for the project to avoid, minimize and mitigate adverse environmental impacts and enhance positive impacts. The plan also includes the actions needed for the implementation of these measures. The major components of the Environmental Management Plan are:

- Mitigation of potentially adverse impacts;
- monitoring of EMP implementation during project implementation and operation; and
- Institutional arrangements to implement the EMP.

B. Objectives of Environmental Management Plan

435. The main objectives of this EMP are:

- To ensure compliance with Asian Development Bank's applicable safeguard policies, and regulatory requirements of Manipur and the Government of India;
- To formulate avoidance, mitigation and compensation measures for anticipated adverse environmental impacts during construction and operation, and ensure that environmentally sound, sustainable and good practices are adopted;
- To stipulate monitoring and institutional requirements for ensuring safeguard compliance; and
- The project road should be environmentally sustainable.

C. Impacts and Mitigation Measures

436. The identified environmental issues and suggested mitigation measures with institutional arrangements for implementation, supervision and monitoring have been provided in a matrix format in Table 9.3. However, anticipated potential impacts and suggested mitigation measures specific to this project are summarised in following paragraphs. These mitigation measures will be implemented as part of this project.

1. Impacts

437. Following are anticipated potential adverse environmental impacts:

- Impacts due to acquisition of about 270 hectare of land for new alignment,
- Impacts on surrounding area due to tree cutting (2732) for the proposed improvement work;
- Impacts do to diversion of about 6.3 hectare of forest land for non-forest purpose;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);

- Impact on biophysical environment due to quarry operation;
- Impacts on roadside flora and fauna particularly on sections of road passing through Reserved Forest Area;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road ;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all onsite and offsite construction works.

2. Mitigation Measures

a. Compensatory Tree Plantation

438. The compensatory plan is being developed in consultation with local forest department. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting) as detailed in Table 100.

Table 100: Details of Trees to be Cut and Planted

Sub-project	Road Section (From / To)	Length (km)	Tree to be cut in the project road	Proposed tree to be planted in the project area in consultation with Forest Dept. (1:3 of tree cutting)
Tranche 1 subrpoject	Imphal-Kanchup-Tamenglong	103.02	2732	8196

b. Slope Protection and Bio-engineering Measures

439. To minimize the likely impacts on the wilidlife and other animals in forest areas along the project road, following measures were incorporated in the project design as well as proposed for implementation during construction and operation phase of the Project.

- Improvement proposals are restricted to minimum width in the length passing through forest areas. Forest areas are avoided to the possible extent.
- Adequate measure are included in the design to minimize impacts on wildlife.
- Signage for no-noise zones, wildlife conservation boards should be installed at the required project sites.
- Noise generating equipment like DG set, compressors will have acoustic enclosures. These will not be installed at least in one km area of 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 wildlife come within the vicinity of 100m from the construction site construction works must immediately stop and resume only after the wild animal have moved away
- Provisions of signage as a precautionary measure to provide awareness about animal movement will be made to avoid accidents
- project staff and work crews should not be allowed to have fire-arms and animal traps etc.;
- construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest stretches.

- employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities.
- Strict anti-poaching surveillance measures need to be implemented, especially during project construction phase in the areas of reserved forests.

c. Slope Protection and Bio-engineering Measures

440. The bio-engineering measures are suitable for slope protection in hill roads. The following items have been suggested as bio-engineering measures for slope protection in hill roads.

- Turning of slopes through rough grassing; and
- Tree plantation along the hill section (slopes) of the project road to control the soil erosion.

441. The above items as bio-engineering measures have been incorporated in EMP budget.

d. Excavated Road Side Debris and its Disposal

442. The provision has been made in cost estimate to use the roadway excavated materials as necessary for the construction of road, which are as follows:

- For all types of soil, such as ordinary rock, hard rock and
- Excavation from drain and foundation of other structures.

443. As per above description, the Contractor will use the excavated road side material for construction of road. The rest unsuitable material will be disposed suitably. The lead and lift has been considered in cost estimates. The Contractor will not dispose the excavated unsuitable material generated from hill section to other side (valley side) of the project road. Proper disposal plan will be prepared by the Contractor to dispose the unsuitable material generated from hill cutting/ road excavation.

e. Protection of Water Bodies

444. The surface water bodies in the project road require protection during construction phase of the project road particulary at locations of river/stream crossing (i.e. Ijai river at chainage km 34.9, Iring river at km 51.9 and again at km 72.4, Digha river at km 81.0 and again at km 82.5, other local stream/rivers). The Contractor shall not disturb/ pollute these surface water due to construction activities of the project road. The Contractor will be responsible to protect these surface water and extra payment for the same will not be given.

f. Re-development of Borrow Area

445. The items for redevelopment of borrow area such as preservation of top soil and re-application of stored top soil has been considered in proposed EMP cost. The Contractor will re-develop the borrow areas before closing of same. The estimated quantities for preservation and re-application of the top soil has been considered for redevelopment of borrow area.

g. Protection of Sensitive Receptors

446. Sensitive receptors along the project road will be protected by implementing suitable measures such as timely scheduling of construction activities in these areas, provision of sign

boards, appropriate noise barriers such as planting trees and / or raised boundary walls are adopted to minimize impacts. Table 101 shows the locations identified for implementation of these mitigation measures.

Table 101: Sensitive Locations along the Project Road

Location / Chainage (Km)	Features
4.2	Temple
4.8	The Public Girls High School
5.1	Praja High School
8.1	Heibongpokpi High School
8.4	Temple
9.2	Heibongpokpi Lairenkabi School
12.5	Don Bosco School Phayeng
13.9	U Yaibi School
51.5	Bakuwa village through middle
100.1	Gadailong Primary School
101.9	Dialong Church
102.0	UBC Church
102.3	Hindu Temple

D. Environmental Monitoring and Reporting Program

447. Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions. To ensure the effective implementation of mitigation measures and environmental management plan during construction and operation phase of the up gradation of subproject road, it is essential that an effective Environmental Monitoring Plan be designed and followed.

448. Environmental monitoring program has the underlying objective to ensure that the intended environmental mitigations are realized and these results in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such program targets proper implementation of the EMP. The broad objectives are:

- To evaluate the performance of mitigation measures proposed in the EMP.
- To evaluate the adequacy of environmental assessment.
- To suggest ongoing improvements in management plan based on the monitoring and to devise fresh monitoring on the basis of the improved EMP.
- To enhance environmental quality through proper implementation of suggested mitigation measures.
- To meet the requirements of the existing environmental regulatory framework and community obligations.

1. Performance Indicators

449. The significant physical, biological and social components affecting the environment at critical locations serve as wider/overall Performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period of time and are, therefore, selected as specific Performance Indicators (PIs) for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise.

- Air Quality with respect to $PM_{2.5}$, PM_{10}, CO, NO_x and SO_2 at selected location.

- Water Quality with reference to DO, BOD, Oil and grease, COD, Suspended Solids and Turbidity, Alkalinity at crossing points on rivers/streams at selected points.
- Noise levels at sensitive receptors (schools, hospitals, community/religious places).
- Survival rates of trees planted as compensatory plantation to compensate for lost forestlands and compensatory plantation raised for removal of roadside trees.

2. Ambient Air Quality (AAQ) Monitoring

450. Ambient air quality parameters recommended for monitoring road development projects are PM2.5, PM10, Carbon Monoxide (CO), Oxides of Nitrogen (NOx) and Sulphur Dioxide (SO2). These are to be monitored, right from the commencement of construction activity at selected locations of plants and machinery, crushers on sites, excavation works etc. Data should be generated once in a season excluding monsoon at the monitoring locations in accordance with the revised National Ambient Air Quality Standards formulated by MoEF in 2009 (Annex 3).

3. Water Quality Monitoring

451. The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, Chloride, Lead, Zinc and Cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are given in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at locations identified along the project road during construction and operation phase. The Indian Standard Specifications – IS10500: 1991 is given in Annex 2.

4. Noise Level Monitoring

452. The measurements for monitoring noise levels would be carried out at sensitive receptors and construction sites along the project road. The Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989 or the standards by State Pollution Control Board of Manipur if such standards are stringent than those of the CPCB are to be complied. The CPCB standards are given in Annex 4. Sound pressure levels would be monitored on twenty-four hour basis. Noise should be recorded at “A” weighted frequency using a “slow time response mode” of the measuring instrument.

5. Success of Re-vegetation

453. The project involves widening and up-gradation including construction of cross drainage structures, hence these will require felling of trees. Such lost vegetation will be required to be replaced by compensatory plantation. As per policy of the State Government 03 trees have to be planted for each tree removed. These compensatory plantations will have to be monitored by the implementing agency with the help of the Forest Department. Such monitoring will be conducted through random samples. Such sampling should cover at least 5% of the area planted up.

E. Environmental Reporting System

454. The monitoring plan covering various performance indicators, frequency and institutional arrangements of the project in the construction and operation stages, along with the estimated cost, is summarized in Table 103.

455. The reporting system will operate linearly with the contractor who is at the lowest rank of the implementation system reporting to the CSC, who in turn shall report to the PIU. All reporting by the contractor and CSC shall be on a quarterly basis. The PIU shall be responsible for preparing targets for each of the identified EMP activities.

456. The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the PIU quarterly during the implementation period. The operation stage monitoring reports may be annual or biannual provided the Project Environmental Completion Report shows that the implementation was satisfactory. Otherwise, the operation stage monitoring reports will have to be prepared as specified in the said Project Environmental Completion Report.

457. Responsibilities for overseeing will rest with the CSC's staff reporting to the PIU. Capacity to quantitatively monitor relevant ecological parameters would be an advantage but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures as per the EMP.

458. During the implementation period, a compliance report may include description of the items of EMP, which were not complied with by any of the responsible agencies. It would also report to the management about actions taken to enforce compliance. It may however, be noted that certain items of the EMP might not be possibly complied with for a variety of reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible (such as jurisdictional issues). This would help in reinforcing the implementation of the EMP.

459. Photographic records will also be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages of construction and related activities have been proposed to ensure timely and effective implementation of the EMP.

460. The reporting system has been prepared for each of the stage of road construction namely:

- Pre construction stage
- Construction Stage
- Operation Stage

461. This reporting shall be done through:

- Reporting by the Contractor to the CSC
- Reporting by CSC to PIU.

462. The stage-wise reporting system is detailed out in the following Table 102.

Table 102: Stage-wise Reporting System of PIU

Format* No.	Item	Contractor	Construction Supervision Consultant (CSC)		Project Implementation Unit (PIU)	
		Implementation and Reporting to CSC	Supervision	Reporting to PIU	Oversee / Field Compliance Monitoring	Reporting to Environment Officer of PIU
C1	Monitoring of construction site and construction camp	Before start of work	-	Quarterly	-	Quarterly
C2	Target sheet for Pollution Monitoring	-	As required	After Monitoring	-	After Monitoring
C3	Target sheet for roadside plantation	-	Monthly	Quarterly	Quarterly	Bi-annual
C4	Target sheet for monitoring of cleaning water bodies	-	Monthly	Quarterly	Quarterly	Bi-annual
O1	Target sheet for Pollution Monitoring	-	-	-	As per monitoring plan	After Monitoring
O2	Target sheet for survival reporting of roadside plantation	-	-	-	Quarterly	After Monitoring
O3	Target sheet for monitoring of cleaning water bodies	-	-	-	Quarterly	After Monitoring

- Formats will be developed and provided by supervision consultant to the contractor.

Table 103: Environmental Management Plan

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
PRE-CONSTRUCTION PHASE							
1.	Tree cutting	Cutting of about 2732 nos. trees during site clearance	• Restricting tree cutting within construction limit. • Avoiding tree cutting at ancillary sites. • Providing and maintaining compensatory tree plantation of 8196 numbers i.e. three times of cutting.	No. of trees to be cut	Observations	Forest Dept. / PIU	PIU
2.	Removal of utilities	Work site clearance	• Necessary planning and coordination with concerned authority and local body. • Prior notice to and consultation with concerned authority, local body and public to be affected so as to ensure that work does not get affected and impact on public is minimum.	Utility shifting plan	Observations	Concerned utility agencies / PIU	CSC/ PIU
3.	Religious places	Work site	• Suitable mitigation measures have been incorporated in Social report.	Resettlement Plan	Observations	PIU	CSC/PIU
CONSTRUCTION PHASE							
1.	Air Pollution	Construction plants, equipment and vehicles	Refer Annex7 and Annex 8	PM10, vehicle maintenance record	PM10 Measurement	Contractor	CSC/PIU
		Temporary diversion	• Maintaining diversion and detour for road traffic in good shape and traffic regulated. • Regular sprinkling of water, as necessary.	Complaints from local residents	Observations	Contractor	CSC/PIU
		Dust during earth works or from spoil dumps	• Maintaining adequate moisture at surface of any earthwork layer completed or non-completed unless and until base course is applied, to avoid dust emission. • Stockpiling spoil at designated areas and at least 5 m away from traffic lane. Refer Annex 9	Dust pollution, Complaints from local residents	Observations, public discussions	Contractor	CSC/PIU
		Borrow pits and haul road	Refer Annex 10	PM10, Dust pollution, Complaints from local residents	Measurement Observations, public discussions	Contractor	CSC/PIU
		Storage of construction	Sprinkling of water as necessary.	Dust pollution,	Observations, public	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
		materials		Complaints from local residents	discussions		
2.	Water Pollution	Construction of Bridges or Culverts – Earthwork and marginal spillage of construction materials causing temporary turbidity and suspended solids	• Constructing and maintaining diversion channel, sedimentation basin, dykes, etc. as may be required to temporarily channelize water flow of streams / river. • Storage of construction material and excavated soil above high flood level.	Placement and no. of slabs, hume pipe/ bridge height, Total solids and turbidity level	Review of design document, turbidity level check	Contractor	CSC/PIU
		Construction vehicles	• Strictly avoiding cleaning / washing of construction vehicle in any water body.	Equipment/ vehicle maintenance record	Review records, site visit and observations	Contractor	CSC/PIU
		Soil erosion from construction site	• Proper planning of site clearing and grubbing so as not to keep the cleared site before working for long duration. • Providing temporary side drains, catch water bank or drains, sedimentation basin, as necessary to avoid or minimize erosion and prevent sedimentation to receiving water bodies.	Soil erosion planning and cases	Review of design document, turbidity level check	Contractor	CSC/PIU
		Seepage from Construction Debris	Refer Annex 9	Planning for seepage and spoil disposal, number of cases	Review of planning and practices for seepage and spoil disposal, control, site visits	Contractor	CSC/PIU
		Construction camp and workers' camp	Refer Annex 8	Planning for waste management	Review of planning and practices for waste management, site visit, observations	Contractor	CSC/PIU
3.	Ground water	Wastewater logging	• All wastewater will be diverted to a ditch that	Planning for	Review of	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
	Pollution		will be managed for the period of construction and after construction such ditches will be filled and restored to original condition.	water diversion	plans, field observations		
		Borrow pit excavation	• Excavation of borrow pit should not touch the aquifer.	Planning for borrow pit excavation	Review of plans, field observations	Contractor	CSC/PIU
		Human wastes and wastewater at construction camp	• Providing septic tanks for treating sewage from toilets before discharging through soak pits. • Locating soak pits at least 50m from any ground water sources. • Decanting and or controlled disposal of oil and grease as collected at collection tanks of maintenance yard and chemical storage areas. Refer Annex 8	Planning for waste management	Review of planning and practices for waste management, site visit, observations	Contractor	CSC/PIU
4.	Noise Pollution and Vibration	Vehicles and Construction machinery	• Site Controls: Stationary equipment will be placed along un-inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts. • Scheduling of Project Activities: Operations will be scheduled to coincide with period when people would least likely to be affected. Construction activities will be avoided between 9 P.M. and 6 A.M. near residential areas. • Protection devices (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. • Construction equipment and machinery should be fitted with silencers and maintained properly. • Source-control through proper maintenance of all equipment. • Use of properly designed engine enclosures and intake silencers. • Noise measurements should be carried out	Noise level, complaints from local residents, vehicle maintenance record, awareness programs implemented	Noise level measurement , field observations, discuss with local residents	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
			along the road to ensure the effectiveness of mitigation measures. • Vehicles and equipment used should confirm to the prescribed noise pollution norms. • Constructing noise barriers as proposed for schools and hospitals prior to taking up road construction activities at those sections. • Movements of heavy construction vehicles and equipment near public properties will be restricted. • Comply with siting criteria for stone crushers, Hot Mix Plant/s (HMP) and concrete batching plant/s (CBP), and installations and maintenance of pollution control devices as mentioned in Annex 7. • Refer Annex 11 for identification, and operation of quarry areas and adopting controlled blasting.				
5.	Land Pollution	Spillage from plant and equipment at construction camp	• Providing impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform. • Collection oil and lubes drips in container during repairing construction equipment vehicles. • Providing impervious platform and collection tank for spillage of liquid fuel and lubes at storage area. • Providing bulk bituminous storage tank instead of drums for storage of bitumen and bitumen emulsion. • Providing impervious base at bitumen and emulsion storage area and regular clearing of any bitumen spillage for controlled disposal. • Reusing bitumen spillage. • Disposing non-usable bitumen spills in a deep trench providing clay lining at the bottom and filled with soil at the top (for at least 0.5 m).	Vehicle maintenance record, review plans for waste management and oil handling practices	Check equipment maintenance records, field visits, observations	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
			Refer Annex 9 and Annex 10				
		Domestic solid waste and wastewater generated at camp	• Collecting kitchen waste at separate bins and disposing of in a pit at designated area/s. • Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil. • Collecting cottons, clothes etc. at separate bins and burning in a pit (with sand bed).	Planning for waste management	Review of planning and practices for waste management, site visit, observations	Contractor	CSC/PIU
		Borrow pits	• Controlled operation and redevelopment of borrow pits to avoid water logging and land contamination.	Plan for borrow pit management	Review plans, observations	Contractor	CSC/PIU
6.	Loss of topsoil	All construction sites	• The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil. • The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile be restricted to 2m. To retain soil and to allow percolation of water, the edges of the pile shall be protected by silt fencing. • Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin. • It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. • Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the CSC in a layer of thickness of 75mm – 150mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes and incidental	Planning for top soil conservation	Review plan, field visits and observations	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
			spaces.				
7.	Compaction of soil	All construction sites	• Construction vehicle, machinery and equipment shall move or be stationed in the designated area (RoW or CoI, as applicable) only. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, topsoil from agricultural land will be preserved as mentioned above.	Planning for top soil management, traffic diversion plan	Review plans, field visits and observations	Contractor	CSC/PIU
8.	Ecology	Site clearance	• Restricting tree cutting within corridor of impact.	No. of tree to be cut	Review clearance papers, field observations	Contractor	CSC/PIU
		Ancillary sites	• Minimizing tree cutting and vegetation clearance during site selection. • Preservation of trees within ancillary sites and avoiding impact on forest resources by providing buffer area from boundary of forest areas of 1km for locating construction plants, construction camp, and quarry and 500 m for borrow areas. • Preservation of trees of ecological, socio-cultural importance • Providing cooking at camp for discouraging and prohibiting use of fire-wood i.e. cutting of trees by the workers.	No. of tree to be cut	Review clearance papers, field observations	Contractor	CSC/PIU
9.	Occupational health and safety of workers	Construction camp	• Water supply, sanitation, drainage and medical health facilities at campsite. • Providing and using PPEs. • Using working reverse horn for all construction equipment and vehicles. • Providing earth link circuit breaker (ELCB) for all electrical connections. • Maintaining first aid at construction sites. • Maintaining emergency response system. Refer Annex 9	Planning for health and safety, practices being implemented	Review records, field check, observations,	Contractor	CSC/PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
10.	Accidents and safety	Construction sites	• Providing and maintaining traffic management comprising diversion; warning, guiding and regulatory signage; channelisers and delineators; lighting, flagmen; dust control system etc. as specified in the contract. • Providing adequate light at construction zone if working during night time is permitted by the Engineer. • Conducting induction and periodic training for all workers and supervisors.	Planning for Traffic management, training plans	Check records, field observations	Contractor	CSC/PIU
		Construction camp	• Conducting periodic mock drilling on critical accident prone activities. • Conducting periodic training for all personnel working at plant site.	Planning for health and safety	Check record, observations, discussion with workers	Contractor	CSC/PIU
OPERATION							
1.	Air Pollution	Vehicular gaseous emission	• Periodicals monitoring of air pollutants and if values exceed the standard limits (Annex 3), suitable mitigation measures to be taken.	PM10 level, gaseous emissions	PM10 monitoring, vehicle maintenance record check	PIU	SPCB and Traffic Police
2.	Noise Pollution	Vehicular	• Periodical monitoring of noise level will be carried out. If values exceed the standard (Annex 4) limits, suitable measures will be taken. • Providing and maintaining signage on noise regulation at silence zones.	Noise level	Noise level measurement s, field observations	PIU	SPCB
3.	Road Safety	Traffic and Vehicles Slow moving traffic	• Maintenance as per Standard Highway Safety Signage and Traffic Management.	Traffic movement	No. of accidents	PIU	PIU and Traffic Police
		Lighting	• Maintenance of road / flyover lighting.	Traffic movement	No. of accidents	PIU	PIU/Traffic police
4.	Tree plantation	-	• Roadside tree plantation three times of cutting.	Survival rate of trees	Field observations	Forest Dept. / PIU	PIU
5.	Contamination of Soil and Water Resources from Spills due to traffic & accidents	Vehicular Traffic	• Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. • Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged.	Incidences of spills, accidents	Review of records, field consultations	PIU	PIU

Sl.	Environmental Issue	Location/ Sources	Mitigation Measures	Monitoring Indicators	Monitoring Methods	Implementing Agency	Supervising & Monitoring Agency
6.	Soil Erosion and Sedimentation	-	• Maintaining the slope protection measures provided at stretches of high embankment and protection measures for bed scouring at cross drainage locations as per maintenance manual to be prepared before operation.	Cases of landslides	Maintenance Records	PIU	PIU
7.	Maintenance of drainage system	-	• The drains will be periodically cleared to maintain storm water flow. • Road drains will be cleared of debris before onset of every monsoon.	Maintenance plans	Maintenance Records	PIU	PIU

Note: PIU – Project Implementation Unit of MoRTH, CSC-Construction Supervision Consultant

Table 104: Environmental Monitoring Plan

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action Plan in case criteria exceeds the standards	Responsible party	
						Implementation	Supervision
Air Quality and Noise Levels							
Construction Stage	• $PM_{2.5}$, PM_{10}, SO_2, NOx, CO, HC (Standards given in Annex 3) • Leq - Noise levels on dB (A) scale (Standards given in Annex 4)	• Wherever the contractor decides to locate the Hot mix plant • Along the project road at different zone as suggested by CSC for regular monitoring • At hot mix plant and equipments yards	Once in a season excluding monsoon for 2 years	Continuous 24 hours/ or for 1 full working day	Check and modify control devices like bag filter/cyclones of hot mix plant Provide additional noise barriers	Contractor Through approved monitoring agency	Supervision Consultant, PIU
Operations Stage	• $PM_{2.5}$, PM_{10}, SO_2, NOx, CO, HC (Standards given in Annex 3) • Leq - Noise levels on dB (A) scale (Standards given in Annex 4)	Along the project road at different zone as suggested by CSC for regular monitoring	Once in a season excluding monsoon for 2 years	Continuous 24 hours/ or for 1 full working day	-	Contractor Through approved monitoring agency	Supervision Consultant, PIU
Water Quality							
Construction Stage	pH, Temperature, DO, Oil & Grease, Conductivity, TSS, TDS, Alkalinity, Total Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate,	At identified locations	Once in a season Excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor Through approved monitoring agency	Supervision Consultant, PIU

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action Plan in case criteria exceeds the standards	Responsible party	
						Implementation	Supervision
	COD, BOD, Iron, Total Coliform, Faecal Coliform, Salinity (Surface Quality Standards by CPSB as given in Annex .2)						
	pH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total, Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, Iron. (Ground Quality Standards by CPSB as given in Annex 2)	At identified locations	Once in a season Excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor Through approved monitoring agency	Supervision Consultant, PIU
Operation Stage	pH, Temperature, DO, Oil & Grease, Conductivity, TSS, TDS, Alkalinity, Total Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, COD, BOD, Iron, Total Coliform, Faecal Coliform, Salinity (Surface Quality Standards by CPSB as given in Annex 2)	At identified locations	Once in a season Excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor Through approved monitoring agency	Supervision Consultant, PIU
	pH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total, Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, Iron. (Ground Quality Standards by CPSB as given in Annex 2)	At identified locations	Once in a season Excluding monsoon for 2 years	-	Check and modify petrol interceptors, Silt fencing devices.	Contractor Through approved monitoring agency	Supervision Consultant, PIU
Soil Quality							
Construction	Chemical properties including oil and grease	At identified locations	Once in a season excluding for 2 years	-	Check oil and chemical spillage	Contractor Through approved monitoring agency	Supervision Consultant, PIU
Operation	Chemical properties including oil and grease	At identified locations	Once in a season excluding for 2 years	-	Check oil and chemical spillage	Contractor Through approved monitoring	Supervision Consultant, PIU

Environmental Features / Stage	Parameters and Standards	Location	Frequency	Duration	Action Plan in case criteria exceeds the standards	Responsible party	
						Implementation	Supervision
						agency	
Tree Plantation							
Operation	Survival rate of plants	All along the project corridor	1 samples (quadrants) for each km	-	Once every year after monsoon for 3 years	Contractor Through approved monitoring agency	Supervision Consultant, PIU

Note: PIU – Project Implementation Unit, CSC-Construction Supervision Consultant

F. Institutional Requirements

463. The Public Works Department of Manipur (MPWD) will be the executing agency (EA) as well as Implementing Agency (IA) for this subproject. The project will be implemented by PIU of MPWD based on Imphal. EA/IA will be responsible for the implementation of the Project. The Project Director of PIU will be overall responsible for EMP implementation. The following key players are involved in EMP implementation during construction stage:

- EA and its Implementation Support Consultants (ISC)
- PIU and its environmental units;
- Construction Supervision Consultants (CSC) i.e. Engineer and his representatives; and
- Contractors.

464. The PIU will have an Environmental and Social Management Unit (EMSU). It is recommended that one of the senior officers of PIU could be designated as Environmental and Social Officer for monitoring implementation of proposed safeguard measures. EMSU will be headed by the Project Director but coordinating and supervising implementation of safeguard measures will be undertaken by the designated Environmental and Social Officer. There is a need for capacity building of environmental unit through various trainings.

465. The Project Director of PIU with the assistance of designated Environmental and Social Officer will be overall responsible for ensuring compliance of safeguard measures and will be reporting to the regulatory bodies and ADB certifying that relevant environmental safeguard measures have been complied with during project implementation. At the field level, the Executive Engineer with his Assistant Engineer/s will supervise implementation of safeguard measures for this subproject and submit monthly reports to PIU.

466. PIU may engage independent agencies for carrying out pollution monitoring activities. The Supervision Consultant shall be interacting with these agencies and facilitate them in carrying out such activities.

467. The Construction Supervision Consultant (CSC) will have an Environmental Safeguards Specialist in its team and it will liaise with PIU environment unit to ensure that Contractor complies with the requirements of various environmental safeguard measures through supervision, monitoring and reporting on the same. Efforts must be made by SC to ensure that environmental mitigation and good-construction-practices are not only considered but actually implemented as integral component of each civil activity. It should be considered as day-to-day activity. Implementation of environmental safeguard measures needs team effort and as such the Team Leader of CSC will delegate the responsibilities to each member of the supervision team with respect to their core responsibilities. The project should have a provision of Environmental Specialist within CSC to supervise implementation of safeguard measures. His role would be more on advisory. He will assist the Team Leader of CSC on the following:

- Advise PIU on preparing reports to ADB and other statutory bodies;
- Preparing procedures for implementing EMP;
- review Contractor's EMP, traffic management plan and safety plan and recommend for its approval / improvements, to the Team Leader;
- provide training to PIU, CSC and Contractors' staff on implementing environmental safeguard measures;
- advise on obtaining various statutory environmental clearances on time;

- conduct periodic field visits to examine environmental compliances and suggest corrective actions ; and
- any other issues as will be required to ensure environmental compliance.

468. Besides, the Team Leader of CSC will nominate a senior engineer from the site office for being directly responsible for day-to-day supervision of implementation of stipulated safeguard measures, to ensure accountability. He will provide guidance to the field staff of SC and Contractor for implementing each of the activities as per the EMP. He will be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist Engineer for submitting reports to PIU. He will maintain a close co-ordination with the Contractor and PIU for successful implementation of the environmental safeguard measures.

469. Responsibilities of various agencies involved in the project implementation are described in following paragraphs.

1. Executing Agencies (EAs) Responsibilities

470. 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:

- Ensure that all environment safeguard requirements as given in ADB SPS 2009, and applicable laws and rules under MOEF are being complied with during all stages of respective subprojects under the loan.
- Reviewing and approving all environment safeguards related documents such as EIA or IEE, monitoring reports etc. prepared for subprojects under the investment program with recommendations and clarifications from the IA where necessary.
- 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.
- 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)
- Recruiting an external monitor to conduct third party environmental monitoring for category A and B subprojects

2. Implementing Agencies (IAs) Responsibilities

471. The IA's responsibilities will mainly be focussed on implementing environment safeguard requirements in accordance with the EIA or IEE and EMP at the subproject and site level. Specific responsibilities on environment safeguards at the IA level are:

- Where necessary hire an environmental consultant to prepare IEE or EIA report including EMP as may be required.
- Ensure that the consultant follows all procedures for conducting the environmental assessment as given in ADB's SPS.
- Review the budgetary needs for complying with the Government's and ADB's requirements on environment safeguards and ensure the proposed budget is in line with project requirements.

- 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 authorized officer in the respective EA office.
- 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.
- Provide necessary support to the consultants preparing the environmental assessment reports to facilitate smooth and efficient preparation of documents, conduction of meetings, conduction of public hearings etc. required by ADB, MOEF, SPCB, Forestry Department, Wildlife Board etc.
- Review the EIA or IEE reports including EMP and EMOP prepared by the consultant and provide comments if necessary.
- After receipt of satisfactory EIA or IEE report including EMP and EMOP forward the respective reports to the respective EA for further endorsement and forwarding to ADB for disclosure on the ADB website.
- Ensure that all necessary regulatory clearances are obtained prior to commencing any civil work of the respective contract package or road section.
- Ensure that for Engineering Procurement and Construction (EPC) based contracts updating of the EMP and EMOP based on detailed design and implementation of the EMP is included under the contractor's responsibilities.
- Ensure that the EMP which includes required mitigation measures and monitoring requirements with defined Bill of Quantity (BOQ), forms part of bidding document for the case of item rate based contracts.
- Ensure that contractors have access to the EIA or IEE report including EMP and EMOP of the subprojects.
- Ensure that contractors understand their responsibilities to mitigate environmental problems associated with their construction activities.
- Ensure and Monitor that all required permits, no objection certificates etc. are obtained by the contractor for establishment and operation of equipments and facilities as detailed in EIA/IEE.
- With the support of the EFP of the contractors and ISC ensure that the contractor implements the EMP including EMOP as given in the respective EIA or IEE report.
- In case of unanticipated environmental impacts during project implementation stage, with the support of ISC 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.
- In case during project implementation a subproject needs to be realigned, review the environmental classification and revise accordingly, and identify whether supplementary IEE or EIA study is required. If it is required, prepare the TOR for undertaking supplementary IEE or EIA and hire an environment consultant to carry out the study.
- Ensure that construction workers work under safe and healthy working environment.
- Ensure effective implementation of Grievance Redress Mechanism to address affected people's concerns and complaints.
- Submit semi-annual reports for category A subprojects and annual reports for category B subprojects on the implementation of all environment safeguard

requirements including the EMP and EMOP under the respective subproject to ADB and make these reports available for public disclosure.

3. ADB's Responsibilities

472. ADB is responsible for the following:

- Review REA checklist and endorse or modify the tranche classification proposed by the EA
- Review EIA or IEE reports and disclose the draft and final reports on the ADB website as required;
- Issue subproject's approval based on EIA or IEE reports;
- Monitor implementation of the EMP through due diligence missions;
- Provide assistance to the EA and IA of subprojects, if required, in carrying out its responsibilities and for building capacity for safeguard compliance;
- Monitor overall compliance of the subprojects to this EARF; and
- If necessary provide further guidance to the IA on the format, content, and scope of the EIA or IEE reports and annual and/or semi-annual monitoring reports for submission to ADB.

473. For ensuring that EMP is properly implemented, Contractor shall appoint a full time qualified and experienced Environmental and Safety Officer (ESO) from the commencement to completion of the project. The qualification and responsibilities of ESO as stipulated below should be considered. The qualification of ESO will be as given below:

- Diploma or Graduate in Civil Engineering with post graduate specialization in Environmental Engineering or Environmental Science or equivalent;
- 5 to 10 years of total professional experience; and
- About 3 to 5 years of experience in similar projects i.e. management of environmental issues in design and construction of road / highway / flyover / bridge projects.

474. The responsibilities of ESO of Contractor will include the following:

- Directly reporting to the Project Manager of the Contractor;
- Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
- Prepare Contractor's EMP, traffic management plan and safety plan as part of their Work Program;
- Ensure contractor's compliance with the EMP stipulations and conditions of statutory bodies;
- Assisting his project manager to ensure environmentally sound and safe construction practices;
- Assisting his project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures;
- Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers;
- Preparing a registers for material sources, labour, pollution monitoring results, public complaint and as may be directed by the Engineer;
- Assisting the PIU on various environmental monitoring and control activities including pollution monitoring; and

- Preparing and submitting monthly reports to SC on status of implementation safeguard measures.

475. As mentioned above, there will need for capacity building of PIU on various environmental and social aspects of the project through various environmental training. Recently, there has been change of statutory requirements for this similar projects based on new EIA Notification. This has changed the landscape of legal and administrative framework for implementing the projects. Thus, there is a need for the PIU staff to updating the information and keeping abreast with the changing legal and administrative requirement. The requirements of various statutory permits and clearances are mentioned in Table 54 (Chapter 4). For successful implementation of EMP, it is essential to orient engineers of PIU, CSC and Contractor who would be mobilized for this project. One day environmental orientation workshop will be conducted at Imphal by ADB supported consultant, once most of the staff has been mobilized. The training program is included in Annex 13.

G. Environmental Management Budget

476. An environmental management budget of INR 3,653,075 (Indian Rupees Three million sixty three one thousand and seventy five only) (US$ 0.59 milions) has been estimated for implementation of the environmental management plan. This budget also includes cost of environmental monitoring and associated trainings. A detail of environmental management budget is given in Table 105.

Table 105: Environmental Management Cost Estimate *

SL. No.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (Rs.)	AMOUNT (Rs.)	RESPONSIBILITY
A.	**Forest Clearance and Compensatory Afforestation**					
A.1	Payment of Forest Compensation for diversion 18 ha of forest land					PIU through Forest Department
A.1.4	Crop Compensation				712,375	
A.1.5	Compensatory Afforestation				408,500	
A.1.6	Net Present Value (NPV)				662,200	
Total (Rupees) Amount to be Deposited by MPWD					**1,783,075**[16]	
B.	**Environmental Monitoring**					
B.1	Ambient air quality monitoring during construction and operations phases as detailed in **Table 6.4** (Chapter 6)	36	No.	8,000	288,000	PIU through Approved Monitoring Agency
B.2	Ambient noise level monitoring during construction and operations phases as detailed in **Table 6.4** (Chapter 6)	36	No.	2000	72,000	
B.3	Water quality monitoring of surface water during construction and operations phases as detailed in **Table 6.4** (Chapter 6)	24	No.	5000	120,000	
B.4	Water quality monitoring of drinking water during construction and operations phases as detailed in **Table 6.4** (Chapter 6)	18	No.	5000	90,000	
B.5	Soil quality monitoring during construction and operations phases as detailed in **Table 6.4** (Chapter 6)	18	No.	10,000	180,000	
B.6	Monitoring survival rate of plantation as detailed in **Table 6.4** (Chapter 6)	3	No.	20,000	60,000	
C.	**Noise Barrier at sensitive location**					
C.1	Provide the Noise barrier at sensitive areas like schools and hospitals. The noise barriers of hollow brick wall/reinforced concrete panels with height of 3.5m. The design of the noise barrier shall be approved by the engineer in charge**.**	150	Rm	4,000	600,000	Contractor through BOQ
D.	**Enhancement of common property resources as per directed by the engineer including the following items**					
D.1	Provision and erection of cement concrete, standard sitting benches including clearing of the area around the benches.	20	No.	1,000	20,000	
D.2	Boundary fencing with barbed wire fencing of approved make and specification including provision and erection of struts	300	Rm.	550	165,000	
F.	**Environmental Training**					
F.1	Supporting widlife conservation programmes as prioritized in the management plan of the YLWLS	1	Lump Sum	200000	200,000	PIU through Supervision Consultant
G.	**Environmental Training**					

[16] Estimate based on unit rates used by Forest Department in previous projects. Exact figure will be determined by State Forest Department.

SL. No.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (Rs.)	AMOUNT (Rs.)	RESPONSIBILITY
G.1	Training at site as per Annex 13 **of EIA.**	1	Lump Sum	75,000	75,000	PIU through Supervision Consultant
		Grand Total (Rupees)			**36,53,075**	

* Cost estimate is preliminary based on the current unit rates. Therefore this estimate is tentative only.

H. Grievance Redress Mechanism

477. 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.

478. Depending on the nature and significance of the grievances or complaints, the grievance redress mechanism (GRM) will comprise procedures to address grievances i) first 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, women groups and local forestry authority.

479. All the parties involved in project implementation i.e. contractor, engineer, and employer will maintain complaint registers at their following respective offices:

- Contactor's main site offices i.e. office of the Project Manager,
- Supervision Consultants's main site office i.e. office of the Engineer's Representative; and
- Executive Engineer's office i.e. Employer's field office.

480. Environment complaints will be received through the Grievance Focal Point (GFP), these will be designated personnel from within the community and appointed by the community, who will be responsible for receiving the Environmental complaints. The Contractor will record the complaint in the onsite Environmental Complaints Register (ECR) in the presence of the GFP.

481. All public complaints regarding environmental issues received by GFP will be entered into the register with specific details such as name and address of the person or representative of the community registering a complaint, the details of complaint, and time. The Executive Engineer and Engineer's Representative will immediately communicate the details of the complaint to the Contractor. The Environemnt and Safety Officer (ESO) of the contractor will promptly investigate and review the environmental complaint and implement appropriate corrective actions to mitigate the cause of the complaints. The Engineer's Representative will decide on the exact time frame within which the action will be taken on case-to-case basis depending on the nature and sensitivity of the same. However, in all the cases, it will be responsibility of the contractor to take action immediately upon receiving any complaint. The contractor will report to Engineer's Representative about the action taken on the complaint, within 48 hours of receiving the complaint, for his further intimating to PIU and the Executive Engineer. The person making a complaint would be intimated by the complaint receiving person or his representative, about the action taken, within 48 hours, along with his/her feedback. Figure 54 shows the proposed Grievance Redress Mechanism.

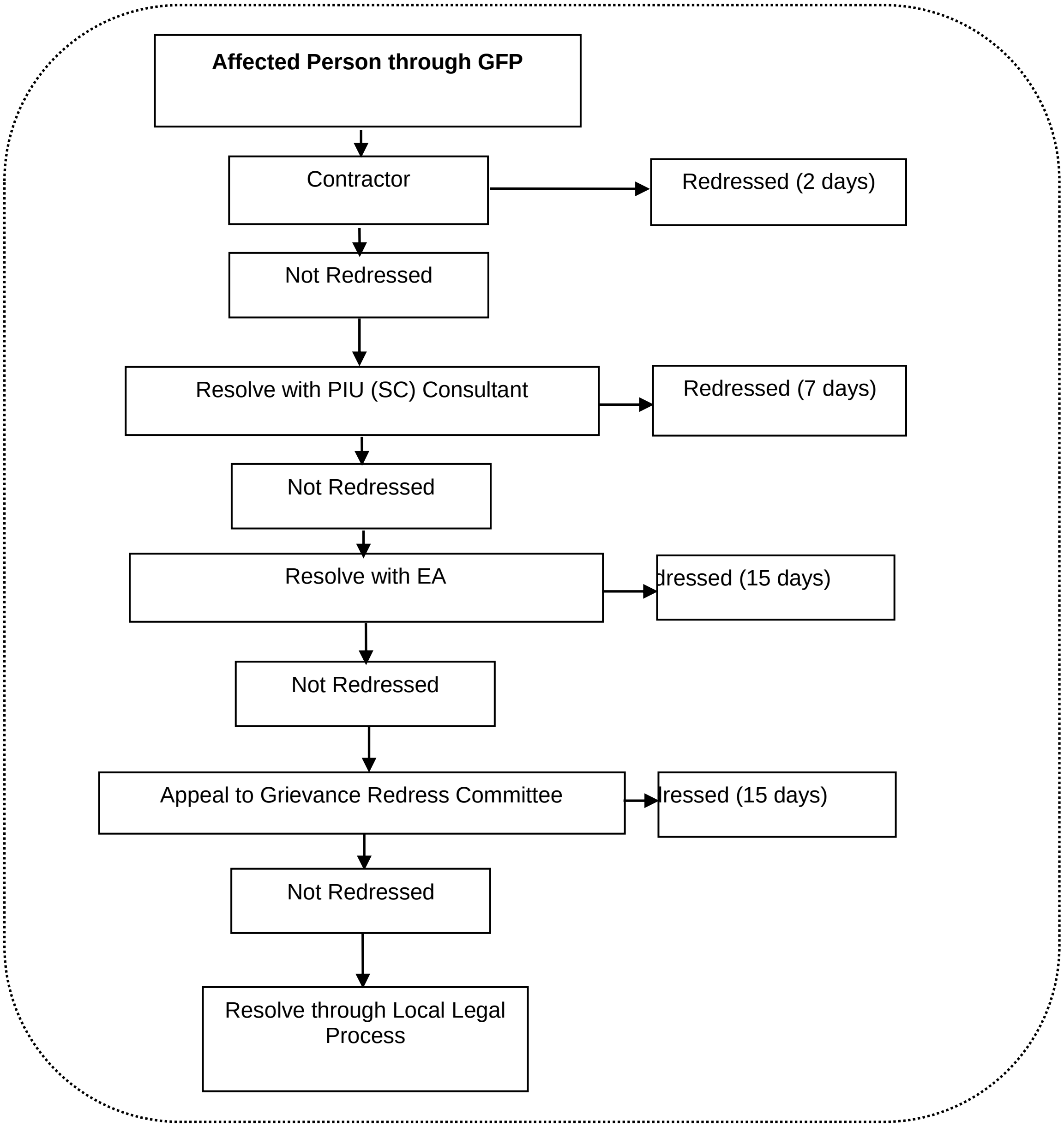


Figure 54: Grievance Redress Mechanism

X. CONCLUSIONS AND RECOMMENDATIONS

482. The proposed Imphal-Kanchup-Tamenglong subproject proposed for improvement is classified as environment Category A projects as per ADB SPS requirements, since the subproject involves construction of new road for about 90 kms. As per Government of India regulations EC is required for this subproject since the project road is located above 1000 m above mean seal level. Forest Clearance for Central/State Government is also required since the project will require acquisition of about 6.3 hectares of forest land. The categorization has been done based on environmental screening and assessment of likely impacts while the environmental impact assessment ascertains that it is unlikely to cause any significant environmental impacts. Few impacts were identified attributable to the proposed project, all of which are localized and temporary in nature and easy to mitigate.

483. About 2.1 km length of subproject roads passes through Kanchup reserve forest. There are no other ecologically sensitive areas along the subproject road neither there are any archaeological/protected monument located in the project vicinity. Except for initial 13 km section (from imphal-Kanchup), the proposed alignment passes through hilly terrain. The land use pattern around the proposed alignment is predominantly mix of forest and agriculture land.

484. The potential adverse impacts of the road section upgrading are:

- Impacts from acquisition of about 270 hectares of land for construction of new road between Kanchup and Tamenglong.
- Impacts on surrounding area due to tree cutting (2732) for the proposed widening;
- Impacts on endangered species existing in the project area
- Impacts due to conversion of about 6.3 hectare of forest land for non-forest purpose;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
- Impacts on roadside flora and fauna particularly on sections of road passing through forest area;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all on-site and off-site construction works.

485. Measures such as use of EFRC slope protection measures are proposed to minimize the impacts of slope instability, use of bioengineering technique, compensatory afforestation, measures to minimize impacts on wildlife movement, engineering alternatives to limit impacts on forest areas etc. are proposed to minimize the potential impacts.

486. Besides, series of mitigation measures have been proposed that are described in the EIA Report and addressed comprehensively in the environmental management plan. These include provision of bioengineering applications for stabilizing slopes, use of spoil disposal areas to minimize destruction of forests down-slope of the alignment, proper sizing of hydraulic structures to assure adequate capacity and prevent destruction of adjacent land, provision of sign boards along migratory paths of animals and other precious ecological zones, provision of

bridges and culverts designed especially for facilitating the movement of animals, identification of vulnerable community infrastructure that must be preserved or replaced under construction contracts, limits on location and access of workers and other provisions regarding construction to assure minimum impact, and other basic provisions found in the EMP. All the above observations and mitigation measures will be included in the tender documents for contract works.

487. Application of these measures in parallel with MoRTH environmentally friendly road construction practices will reduce significantly any potential environmental impact. Impacts remaining on the physical environment (air and water pollution) are temporary and often occur away from the presence of people. The biological environment will reconstitute itself following any residual or remaining impacts on it.

488. Potential adverse effects during operations of the roadways have been minimized by aligning the road in optimal locations in relation to roadway safety and community impact, through provision of designs and budgets for superior roadway drainage structures.

489. In case of ARD issue identified EMP will be amended to include appropairte mitigation measures to minimize ARD impacts on water quality.

490. A systematic approach for surveillance and monitoring is provided by means of a management framework, and monitoring and reporting protocol. In general, the project received good support from local people. The local people appreciated that besides providing an all-weather efficient connectivity to large rural populations and improving the traffic scenario in the region, it will bear out several other socio-economic positive benefits. Follow-up public consultation is intended to provide future input to the identification of environmental impact during the construction phase as well as a grievance redress mechanism for project affected persons. The social component of the project has identified the numbers of affected persons and households, the amount and locations requiring total and partial land acquisition, and the amount of damage costs. The EMP is a living document and the same will be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB during the construction period. The environmental mitigation measures are itemized in the EMP and the EA and IA shall ensure that EMP and EMoP are included in Bill of Quantity (BOQ) and forms part of bid document and civil works contract.

491. Before the start of civil works for the any section of the project road the project proponent (PWD Manipur) must obtain necessary clearances / permits from staturoty authorities.

ANNEX 1: RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Country/Project Title: INDIA/ SASEC Road Connectivity Sector Project

Sector / Division: South Asia Transport and Communication Division (SATC)

Road Section: Imphal-Kanchup-Tamenglong Road Section in the State of Manipur (Tranche 2 Subproject)

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	
▪ Protected area		X	About 2.1 km section of the project road passes through reserve forest area. There are no environmentally sensitive/ protected areas exist along the project road. Mitigation measures are included in the EMP to avoid impacts on flora and fauna in the forest areas. EA will obtain environmental and forest clearence from statutory authority at State and Central Level.
▪ Wetland		X	
▪ Mangrove		X	
▪ Estuarine		X	
▪ Buffer zone of protected area		X	
▪ Special area for protecting biodiversity		X	
B. Potential environmental impacts ▪ Will the project cause…			
▪ Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?	X		The topography of project road section from Kunchup to Tamenglong is hilly and this section is mostly new alignment. Hilly sections are vulnerable to landslide. Impacts of landscape by road embankments, cuts and fills are anticipated. Proper management plan for will be required during construction to sustain the quarries.
▪ Encroachment on precious ecology (e.g. Sensitive or protected areas)?		X	
▪ 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		Imphal-Kanchup section of the project road low lying areas and is high rainfall zone prone to flood. Also rivers crosses the this section of the project road. Controlled construction activities will ensure sediment discharge into streams.

Screening questions	Yes	No	Remarks
▪ Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?		X	During construction period suitable mitigation measures will be required to control the silt runoff. Adequate Sanitary facilities and drainage in the workers camps will help to avoid this possibility. As the construction activity in this project will not contain any harmful ingredients, no impact on surface water quality is anticipated.
▪ Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels.
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation during project construction and operation?	X		Possible. With appropriate mitigation measures such risks would be minimized.
▪ Noise and vibration due to blasting and other civil works?	X		Short term minor impact may occur during construction period, Suitable mitigation measures will be required to minimize the adverse effects
▪ Dislocation or involuntary resettlement of people	X		Likely. A Resettlement Plan will be prepared and compensation shall be paid as per approved entitlement matrix.
▪ dislocation and compulsory resettlement of people living in right-of-way?	X		Likely. A Resettlement Plan will be prepared and compensation shall be paid as per approved entitlement matrix.
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	Possible. Gender Action Plan and Indigenous People Development Plan shall be prepared as part of the Project.
▪ Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?	X		Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
▪ Hazardous driving conditions where construction interferes with pre-existing roads?		X	To minimized the impact suitable traffic management plan will be required
▪ 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, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility. Workers will be made aware about communicable diseases
▪ Creation of temporary breeding habitats for mosquito vectors of disease?		X	
▪ Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?	X		Adoption of suitable traffic signage system at sensitive places will reduce such possibility.

Screening questions	Yes	No	Remarks
▪ Increased noise and air pollution resulting from traffic volume?	X		Due to improvement in Riding Quality & Comfort in driving due to unidirectional traffic such pollution will be reduced. Mitigation measures along with monitoring plan will be required
▪ Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?	X		Controlled construction activities and proper drainage system will reduce this possibility.
▪ social conflicts if workers from other regions or countries are hired?		X	Not anticipated. Local labors would be hired to the extent possible.
▪ 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		Possible.
▪ 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		Possible. EMP shall be followed to minimize this risk.
▪ 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	Not anticipated.

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	Yes	No	REMARKS
• Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)	X		Project is vulnerable to raifall and landslides.
▪ Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., increased erosion or landslides could increase maintenance costs, permafrost melting or increased soil moisture content could affect sub0-grade).	X		Likely. Increase in rainfall will reduce lifespan of the project as this is a landslide prone area.

▪ Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (eg., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		X	
▪ Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by encouraging settlement in areas that will be more affected by floods in the future, or encouraging settlement in earthquake zones)?		X	

ANNEX 2. INDIAN STANDARD DRINKING WATER SPECIFICATION: IS 10500:1991

Sl. No.	Substance/ Characteristic	Desirable Limit	Permissible limit	Remarks
1	Colour, Hazen units, Max	5	25	Extended to 25 if toxic substance are not suspected in absence of alternate sources
2	Odour	Unobjectionable		a) Test cold and when heated
				b) Test at several dilution
3	Taste	Agreeable		Test to be conducted only after safety has been established
4	Turbidity NTU, Max	5	10	
5	pH value	6.5 to 8.5	No relaxation	
6	Total Hardness (as $CaCO_3$ mg/lit)	600	600	
7	Iron (as Fe mg/lit, Max	0.3	1.0	
8	Chlorides (as Cl mg/lit Max	250	1000	
9	Residual Free Chlorine, mg/lit Max	0.2		To be applicable only when water is chlorinated. Treated at consumer end. When protection against viral infection is required, it should be Min 0.5 mg/lit
10	Dissolved Solids mg/l, Max	500	2000	
11	Calcium (as Ca) mg/l, Max	75	200	
12	Copper (as Cu) mg/l, Max	0.05	1.5	
13	Manganese (Mn) mg/l Max	0.1	0.3	
14	Sulphate (As SO_4), Max	200	400	May be extended up to 400 provided (as Mg) does not exceed 30
15	Nitrate (as NO_3) mg/l, Max	45	100	
16	Fluoride (as F) mg/l, Max	1.0	1.5	
17	Phenolic Compounds (as C_6H_6OH) mg/l Max	0.001	0.002	
18	Arsenic (as As mg/l	0.05	No relaxation	To be tested when pollution is suspected
19	Lead (as Pb) mg/l	0.05	No relaxation	
20	Anionic Detergents (as MBAS) mg/l	0.2	1.0	
21	Chromium (as Cr) mg/l	0.05	1.0	To be tested when pollution is suspected
22	Mineral Oil mg/l	0.01	0.03	
23	Alkalinity mg/l	200	600	
24	Total Coliform	95% of the sample should not contain coliform in 100 ml. 10 coliform /100 ml		

ANNEX 3: NATIONAL AMBIENT AIR QUALITY STANDARDS (MOEF, 2009)

Pollutant	Time Weighted Average	Concentration in Ambient air ($\mu g/m^3$)	
		Industrial, Residential, Rural and Other Areas	**Ecologically Sensitive Areas**
Sulphur Dioxide (SO2)	Annual Average*	50	20
	24 hr**	80	80
Oxides of Nitrogen (as NO2)	Annual Average *	40	30
	24 hr**	80	80
Particulate Matter: PM10 (<10 µm)	Annual Average *	60	60
	24 hr**	100	100
Particulate Matter: PM2.5 (<2.5 µm)	Annual Average *	40	40
	24 hr**	60	60
Lead	Annual Average *	0.5	0.5
	24 hr**	1.0	1.0
Carbon monoxide mg/m3	8 hr	2.0	2.0
	1 hr	4.0	4.0

* Annual Arithmetic mean of minimum 104 measurement in a year taken for a week 24 hourly at uniform interval.

** 24 hourly or 8 hourly or 1 hourly monitored values should meet 98 percent of the time in a year

Source: MoEF notification Central Pollution Control Board (1997) National Ambient Air Quality Monitoring Series, NAQMS/a/1996-97.

ANNEX 4. NATIONAL AMBIENT NOISE LEVEL STANDARDS

Area Code	Category	Limits in Decibels (dB A)	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

Note: (1) Daytime: 6 AM to 9 P.M., Night-time 9 PM to 6 AM;
(2) Silence zone is an area up to 100 m around premises as hospitals, educational institutions and courts.

Source: Central Pollution Control Board, New Delhi

ANNEX 5: AIR QUALITY IMPACT PREDICTION

A. Introduction

1. The major impact on the air quality during the operation stage will be due to plying of vehicles on the proposed high corridor. The impact on air quality depends upon traffic volume, traffic fleet including fuel type and prevailing atmospheric conditions. An unstable atmospheric condition disperses pollutants more and results in to low pollutant concentrations while stable atmospheric conditions buildup the pollution level. To assess the likely impacts on the ambient air quality due to the proposed highway project, the prediction of the carbon monoxide (CO) and particulate matter (PM) concentrations have been carried out using line source dispersion modelling approach, based on Gaussian equation. CO is an indicator pollutant for vehicular pollution. So, prediction of CO concentration is representative of the impacts of air pollution due to traffic movement. The modeling for this project has been carried out using CALINE-4, line source model developed by the California Transport Department. It has been setup and run by using emission factors prevalent for Indian vehicles (ARAI, 2007) and hourly traffic volumes as predicted for the project. The study is conducted to predict 1-houly increment in CO concentrations for the year 2014 (base year) and future traffic, i.e., 2019, 2024, 2029 and 2034. Improvement in fuel quality i.e., sulphur free fuel, is used in vehicles now a days which reduce the SO2 emission from vehicles. The impacts of other pollutant concentrations is also insignificant. Therefore, this study only focus on the CO, PM2.5 and PM10 dispersion, generated from the traffic on the proposed highway.

B. Model descriptions

2. CALINE-4 is the fourth generation simple line source Gaussian plume dispersion model (Benson, 1984). It employs a mixing zone concept to characterize pollutant dispersion over the roadway. The main purpose of the model is to assess air quality impacts near transportation facilities. The input parameters are emission source strength, meteorology and road geometry. It can predict the pollutant concentrations at selected receptors locations for 1 hour and 8-hour average up to 500 meters of the roadway. For most applications, optional inputs can be bypassed and many other inputs can be assigned assuming worst-case values. More complex approaches to dispersion modeling are unnecessary for most of the applications because of the uncertainties in the estimation of emission factors and traffic volumes for the future years. CALINE- 4’s accuracy is well balanced with the accuracy of state-of-art predictive models for vehicular pollution.

C. Source information

1. Traffic data

3. The fleet wise traffic volumes for the present study have been taken from the detailed feasibility report of the project. The annual average daily traffic (AADT) data is available for the proposed road through traffic survey. CALINE 4 model needs hour average traffic volume. However, model has been setup for peak traffic hours assuming 25% of average daily traffic volume. The total traffic hour volume is further categorized in to two wheeler, four wheeler, Light commercial vehicles (LCVs), Bus and high commercial vehicles (HCVs), based on the traffic survey at different road stretched along the highway (Figure 1).

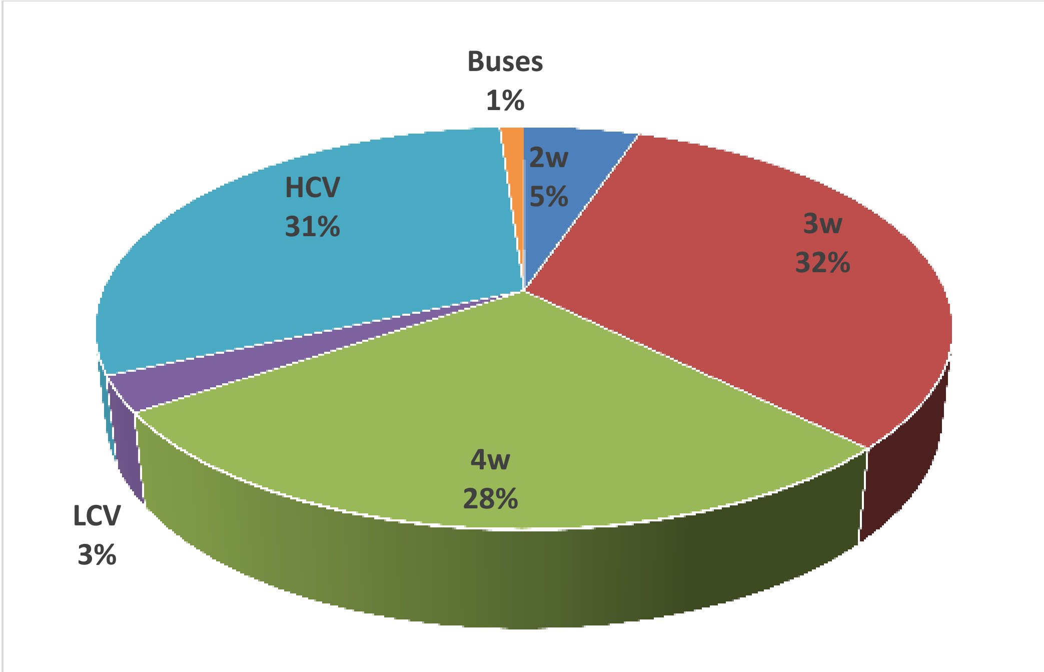


Figure 1: Traffic Fleet on the highway

4. The annual average daily motorized traffic data are given in table 1 at five locations along with future traffic growth.

Table 1: Annual average daily motorized traffic data

Year	2w	3w	4w	LCV	HCV	Buses
	Homogeneous Section I					
2014	155	5486	9686	345	167	35
2017	682	6634	12034	510	1004	63
2019	830	8212	15019	626	1224	75
2024	1197	12530	23322	895	1770	104
2029	1523	17129	32177	1162	2274	126
2034	1899	21836	42174	1410	2847	146
	Homogeneous Section II					
2014	172	3240	2579	515	185	15
2017	702	3924	3404	713	1026	40
2019	855	4857	4266	872	1251	47
2024	1235	7410	6681	1249	1813	65
2029	1573	10130	9299	1625	2331	80
2034	1962	12911	12262	1976	2918	93
	Homogeneous Section III					
2014	106	817	1350	59	110	8
2017	626	996	1902	170	939	31
2019	762	1234	2386	208	1143	36
2024	1099	1886	3747	296	1655	50
2029	1399	2579	5229	381	2130	60
2034	1745	3286	6908	460	2669	70

Year	2w	3w	4w	LCV	HCV	Buses
	Homogeneous Section IV					
2014	429	161	201	86	690	21
2017	502	193	240	101	810	23
2019	625	243	303	125	1006	28
2024	920	377	469	177	1486	40
2029	1173	515	638	226	1909	50
2034	1464	657	828	271	2387	60
	Homogeneous Section V					
2014	431	161	210	94	692	21
2017	506	193	253	110	814	24
2019	630	244	320	137	1013	29
2024	928	379	498	193	1496	42
2029	1182	517	675	247	1920	52
2034	1474	659	875	297	2400	62

2. Road geometry

5. In the CALINE-4 model the entire length of the selected road section is divided into various links. The terrain is hilly. The division of sections into links has been done in such way, so that the link can be fairly considered as straight stretch of road having homogenous geometry with uniform road width, height, route alignment and traffic volume. The coordinates of end points of links specify the location of the links in the model. The maximum numbers of link in each road section can be 20. The mixing zone width calculated for selected highway corridor is 12m (3 m + 3 m + 6 m) as per guideline provided in CALINE4 model.

3. Emission factors

6. Emission factor is one of the important input parameter in Caline-4 model. In the present study, the emission factors specified by the Automotive Research Association of India (ARAI, 2007) have been used for calculation of weighted emission factors. These emission factors have been expressed in terms of type of vehicles and type of fuel used (for petrol and diesel driven passenger cars). Since, there is only one input requirement for total no. of vehicles in the CALINE 4 model, whereas, there are different categories of vehicles (viz., Two wheelers, Cars, Bus and trucks) with different year of manufacture and fuel used, it is essential that a single value representing the equivalent or weighted emission factors for all the vehicles is input into the model. The emission factor used to estimate WEF are given below in Table 3. The traffic data are not available for fuel types, therefore average emission factor are used in this study. Thus, WEF expressed in g/mile (converted from gm/km) has been calculated for the present study using methodology given by Sharma et al., 2013. For PM_{10}, emission from re-suspension of road dust of paved road have been estimated using following empirical equation (USEPA 2011).

$E = k\,(sL)^{0.91} \times (W)^{1.02}$

Where:

E= particulate emission factor (g/VKT)

K =particle size multiplier (g/VKT), default value of “k” for $PM_{2.5}$ is 0.15 g/VKT

sL = road surface silt loading (g/m^2) = 0.531 g/m^2 (Sahu et al., 2011)

W = Average weight of vehicles (in tons) on road = 1.41 Ton (Sahu et al., 2011)

7. The emission factor for CO, and $PM_{2.5}$ used in the present study for different vehicles type are given in table 2. The calculated WEF for CO, $PM_{2.5}$ and PM_{10} for peak traffic hours is given in Table 3.

Table 2 Emission factors for different types of Vehicle (ARAI, 2007)

Vehicle type	CO Emission factor (gm/km)	$PM_{2.5}$ Emission factor (gm/km)
Two wheeler	3.08	0.20
Three Wheeler	2.50	0.24
Cars/Jeep	1.53	0.06
LCV	2.02	0.49
BUS	8.40	1.08
HCV	12.65	1.60

Table 3: Weighted Emission Factor for proposed traffic

Year	Weighted Emission factor for CO (g/mile)	Weighted Emission factor for $PM_{2.5}$ (g/mile)	Weighted Emission factor for PM_{10} (g/mile)
2014	4.37	0.40	2.16
2017	5.32	0.52	2.29
2019	5.29	0.51	2.27
2024	5.19	0.49	2.25
2029	5.07	0.48	2.24
2034	5.01	0.52	2.29

4. Meteorological data

8. The study was conducted to predict pollutant concentration for worst meteorological conditions. The meteorological parameters such as wind speed, wind direction standard deviation, temperature, mixing height and stability condition are used in model. The wind direction standard deviation was calculated to know the flexibility of wind direction and used as input parameters in worst case run condition. The model has been run with worst case, in which models predicted maximum pollutant concentration.

5. Receptors

9. A set of link receptors were taken at various receptor locations within each section at a distance of 5 m, 10 m, 20 m, 40 m, 70m, 100 m and 200 m both sides from edge of the carriageway to know the dispersion of pollutant from the road. The monitoring station are marked as receptor points to compare the monitoring and predicted pollutant concentrations.

D. Results

10. The model has been setup and run to predict hourly average CO, $PM_{2.5}$ and PM_{10} concentrations for year 2014, 2019, 2024, 2029 and 2034 using forecasted traffic data on proposed highway. The predicted hourly average concentration of CO, $PM_{2.5}$ and PM_{10} during peak traffic are shown in tables 4, 5 and 6 for proposed highway project, respectively at four selected receptor locations. The graphical representation of hourly average pollutant concentrations on both side of the road sections shown in figures 2, 3 and 4 at different locations.

Table 4: CO predicted concentrations (ppm) along the proposed road for peak traffic hour

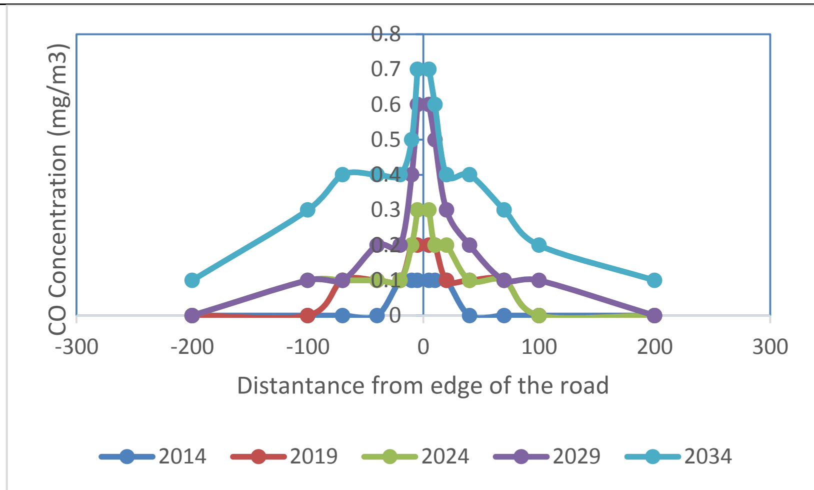
Road Stretch	Year	CO concentrations (ppm)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	**-100**	**-70**	**-40**	**-20**	**-10**	**-5**		**5**	**10**	**20**	**40**	**70**	**100**	**200**
Section 1	2014	0	0	0	0	0.1	0.1	0.1		0.1	0.1	0.1	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2024	0	0.1	0.1	0.1	0.1	0.2	0.3		0.3	0.2	0.2	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.4	0.6		0.6	0.5	0.3	0.2	0.1	0.1	0
	2034	0.1	0.3	0.4	0.4	0.4	0.5	0.7		0.7	0.6	0.4	0.4	0.3	0.2	0.1
Section II	2014	0	0	0	0	0	0	0.1		0.1	0	0	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.3	0.3		0.3	0.3	0.3	0.2	0.1	0.1	0
	2034	0.1	0.2	0.3	0.3	0.3	0.4	0.4		0.4	0.4	0.3	0.3	0.2	0.1	0.1
Section III	2014	0	0	0	0	0.1	0.1	0.1		0.1	0.1	0.1	0	0	0	0
	2019	0	0	0	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.3		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0	0.1	0.1	0.1	0.3	0.3		0.3	0.2	0.1	0.1	0.1	0	0
	2034	0.1	0.1	0.2	0.2	0.3	0.4	0.4		0.4	0.3	0.2	0.2	0.1	0.1	0.1
Section IV	2014	0	0	0	0	0	0	0.1		0.1	0	0	0	0	0	0
	2019	0	0	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0	0
	2024	0	0	0.1	0.1	0.1	0.2	0.2		0.2	0.2	0.1	0.1	0.1	0	0
	2029	0	0.1	0.1	0.2	0.2	0.3	0.3		0.3	0.3	0.3	0.2	0.1	0.1	0
	2034	0.1	0.1	0.3	0.3	0.3	0.4	0.4		0.4	0.4	0.4	0.3	0.3	0.1	0.1

Table 5: PM2.5 predicted concentrations (µg/m3) along the proposed road for peak traffic hour

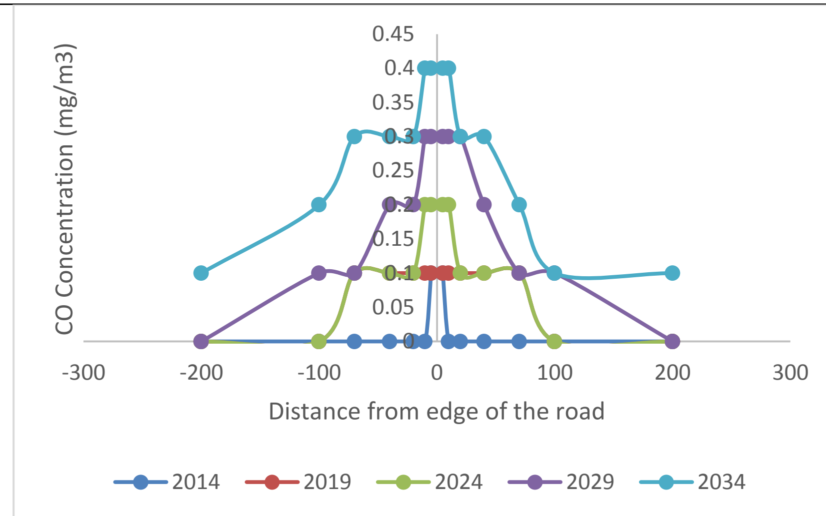
Road Stretch	Year	PM$_{2.5}$ concentrations (µg/m^3)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	**-100**	**-70**	**-40**	**-20**	**-10**	**-5**		**5**	**10**	**20**	**40**	**70**	**100**	**200**
Section 1	2014	6.57	13.14	18.77	23.46	26.07	29.96	34.84		36.63	31.50	30.56	27.50	22.03	11.01	4.41
	2019	6.93	13.86	19.80	24.75	27.50	31.61	36.76		38.55	33.15	32.16	28.94	23.18	11.59	4.64
	2024	7.50	15.01	21.44	26.80	29.78	34.23	39.8		41.59	35.77	34.69	31.22	25.01	12.51	5.00
	2029	8.38	16.76	23.95	29.93	33.26	38.23	44.45		46.24	39.77	38.57	34.72	27.81	13.90	5.56
	2034	9.99	19.99	28.56	35.70	39.66	45.59	53.01		54.8	47.13	45.71	41.14	32.96	16.48	6.59
Section II	2014	6.43	12.86	18.37	22.97	25.52	29.33	34.11		35.86	30.84	29.92	26.92	21.57	10.78	4.31
	2019	6.79	13.57	19.39	24.23	26.93	30.95	35.99		37.74	32.46	31.48	28.33	22.70	11.35	4.54
	2024	7.35	14.69	20.99	26.24	29.15	33.51	38.96		40.72	35.02	33.97	30.57	24.49	12.24	4.90
	2029	8.20	16.41	23.44	29.30	32.56	37.42	43.52		45.27	38.93	37.76	33.99	27.22	13.61	5.44
	2034	9.78	19.57	27.96	34.95	38.83	44.63	51.90		53.65	46.14	44.75	40.28	32.26	16.13	6.45
Section III	2014	6.30	12.59	17.99	22.49	24.98	28.72	33.39		35.11	30.19	29.29	26.36	21.11	10.56	4.22
	2019	6.64	13.29	18.98	23.72	26.36	30.30	35.23		36.95	31.78	30.82	27.74	22.22	11.11	4.44
	2024	7.19	14.38	20.55	25.69	28.54	32.81	38.15		39.86	34.28	33.25	29.93	23.97	11.99	4.79
	2029	8.03	16.07	22.95	28.69	31.88	36.64	42.60		44.32	38.11	36.97	33.27	26.65	13.33	5.33
	2034	9.58	19.16	27.37	34.21	38.01	43.69	50.81		52.52	45.17	43.81	39.43	31.59	15.79	6.32
Section IV	2014	6.16	12.33	17.61	22.01	24.46	28.11	32.69		34.37	29.56	28.67	25.80	20.67	10.33	4.13
	2019	6.50	13.01	18.58	23.23	25.81	29.66	34.49		36.17	31.11	30.17	27.16	21.75	10.88	4.35
	2024	7.04	14.08	20.12	25.15	27.94	32.12	37.34		39.02	33.56	32.55	29.30	23.47	11.73	4.69
	2029	7.86	15.73	22.47	28.09	31.21	35.87	41.71		43.39	37.31	36.19	32.57	26.09	13.05	5.22
	2034	9.38	18.76	26.80	33.49	37.22	42.78	49.74		51.42	44.22	42.89	38.60	30.92	15.46	6.18

Table 6: PM10 predicted concentrations (µg/m3) along the proposed road for peak traffic hour

Road Stretch	Year	PM_{10} concentrations (µg/m^3)														
		Distance from the edge of the road, m. (Left side)								Distance from the edge of the road, m. (Right side)						
		-200	-100	-70	-40	-20	-10	-5		5	10	20	40	70	100	200
Section 1	2014	13.59	27.19	38.84	48.55	53.95	62.01	72.1		73.89	63.55	61.64	55.48	44.44	22.22	8.89
	2019	14.34	28.69	40.98	51.23	56.92	65.42	76.07		77.86	66.96	64.95	58.46	46.83	23.41	9.37
	2024	15.53	31.06	44.37	55.46	61.63	70.83	82.36		84.15	72.37	70.20	63.18	50.61	25.30	10.12
	2029	17.34	34.69	49.55	61.94	68.83	79.11	91.98		93.77	80.65	78.23	70.41	56.40	28.20	11.28
	2034	20.68	41.37	59.10	73.87	82.08	94.34	109.70		111.4	95.88	93.01	83.71	67.05	33.52	13.41
Section II	2014	13.31	26.62	38.02	47.53	52.81	60.70	70.59		72.34	62.21	60.34	54.31	43.50	21.75	8.70
	2019	14.04	28.08	40.12	50.15	55.72	64.05	74.48		76.23	65.56	63.59	57.23	45.84	22.92	9.17
	2024	15.20	30.41	43.44	54.30	60.33	69.35	80.63		82.39	70.85	68.73	61.85	49.55	24.77	9.91
	2029	16.98	33.96	48.51	60.64	67.38	77.45	90.06		91.81	78.96	76.59	68.93	55.21	27.61	11.04
	2034	20.25	40.50	57.86	72.32	80.36	92.36	107.40		109.1	93.87	91.05	81.95	65.64	32.82	13.13
Section III	2014	13.03	26.06	37.23	46.53	51.70	59.43	69.10		70.82	60.90	59.08	53.17	42.59	21.29	8.52
	2019	13.75	27.49	39.28	49.10	54.55	62.70	72.91		74.63	64.18	62.25	56.03	44.88	22.44	8.98
	2024	14.88	29.77	42.53	53.16	59.06	67.89	78.94		80.66	69.37	67.28	60.56	48.51	24.25	9.70
	2029	16.62	33.25	47.49	59.37	65.96	75.82	88.16		89.88	77.30	74.98	67.48	54.05	27.03	10.81
	2034	19.82	39.65	56.64	70.80	78.67	90.42	105.14		106.8	91.90	89.14	80.23	64.26	32.13	12.85
Section IV	2014	12.76	25.51	36.44	45.56	50.62	58.18	67.65		69.33	59.63	57.84	52.05	41.69	20.85	8.34
	2019	13.46	26.92	38.45	48.07	53.41	61.39	71.38		73.06	62.83	60.95	54.85	43.94	21.97	8.79
	2024	14.57	29.14	41.63	52.04	57.82	66.46	77.28		78.96	67.91	65.87	59.28	47.49	23.74	9.50
	2029	16.27	32.55	46.50	58.12	64.58	74.23	86.31		87.99	75.67	73.40	66.06	52.92	26.46	10.58
	2034	19.41	38.82	55.45	69.31	77.02	88.52	102.93		104.6	89.97	87.27	78.54	62.91	31.46	12.58



Homogenous Section I



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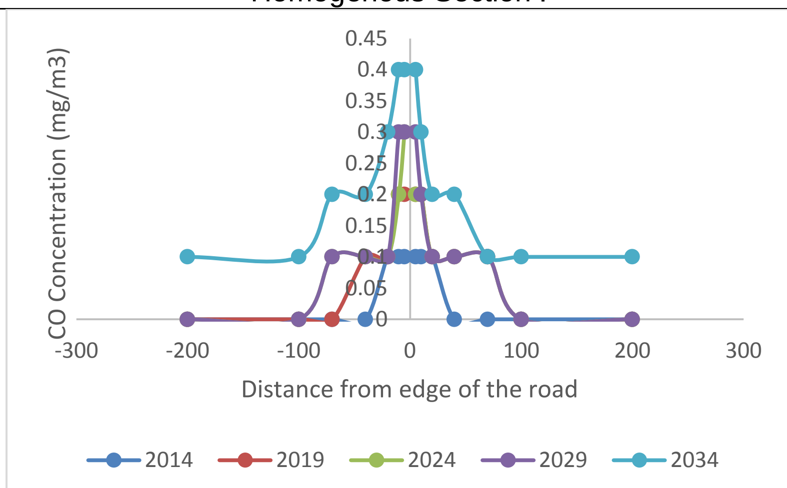

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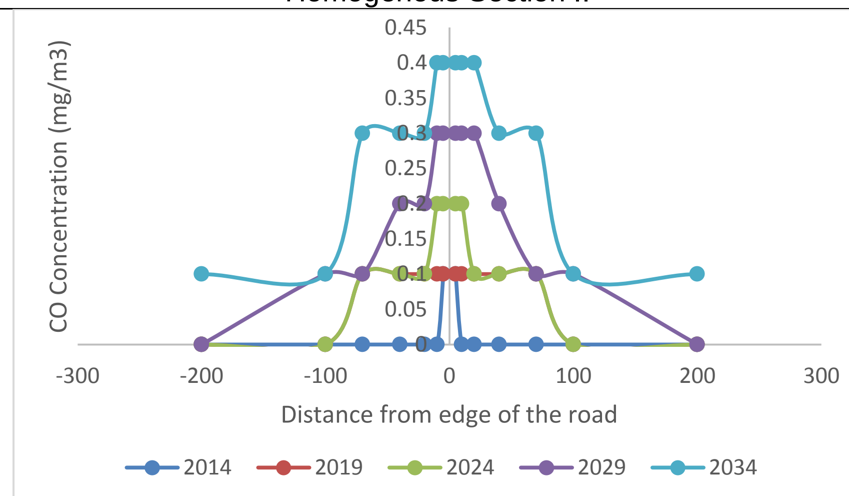
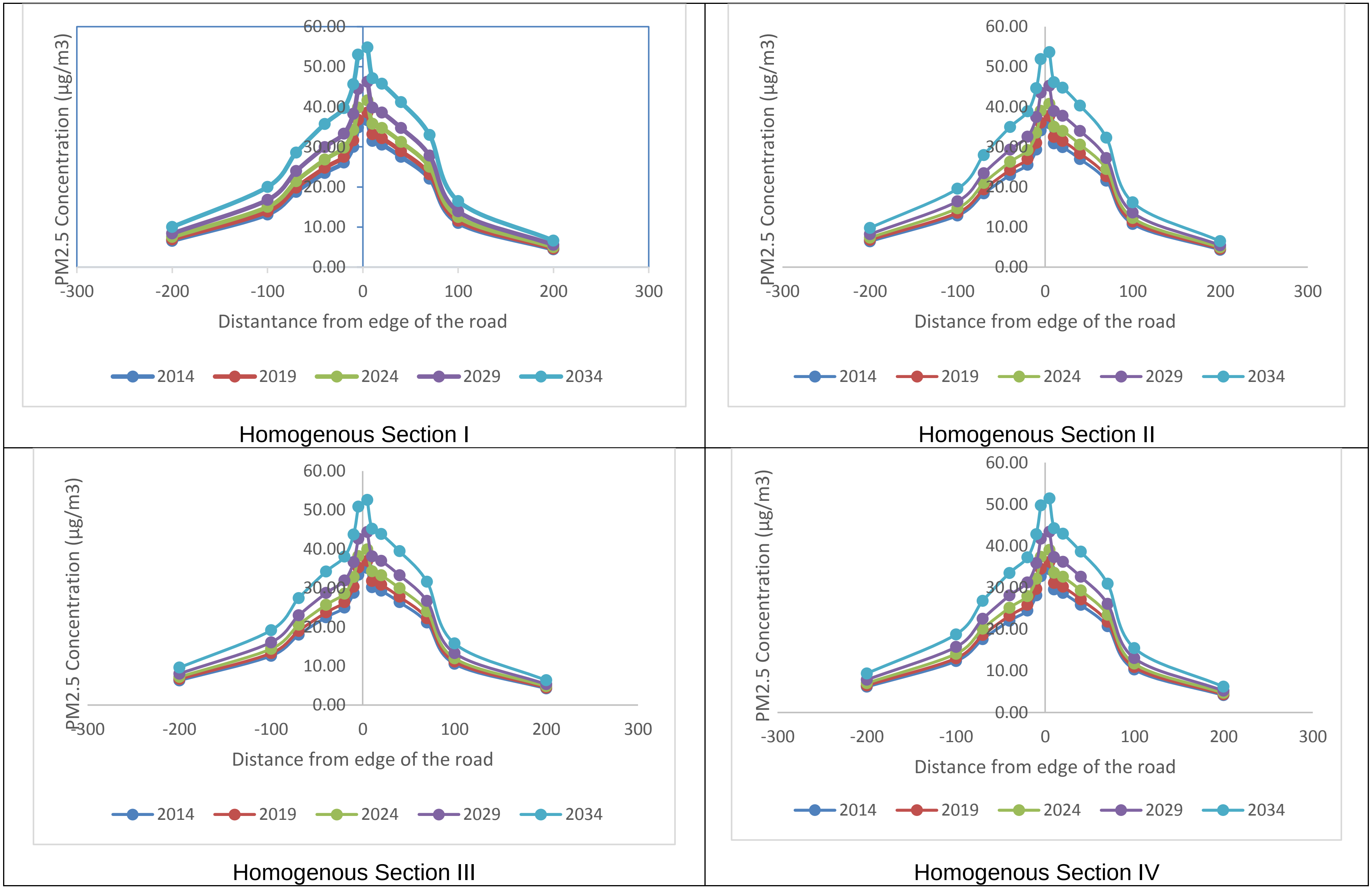


Homogenous Section IV

Figure 2: CO predicted concentrations (ppm) along the highway corridor



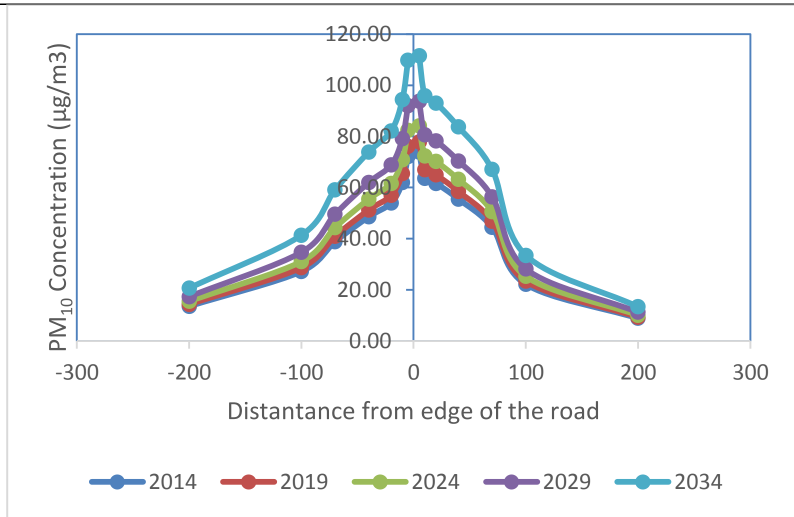
Homogenous Section I

Homogenous Section II

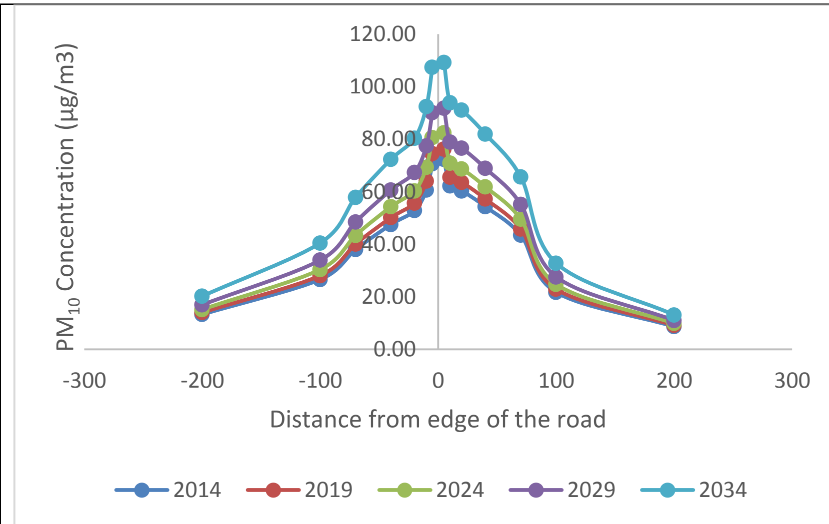
Homogenous Section III

Homogenous Section IV

Figure 3: $PM_{2.5}$ predicted concentrations (µg/m^3) along the highway corridor



Homogenous Section I



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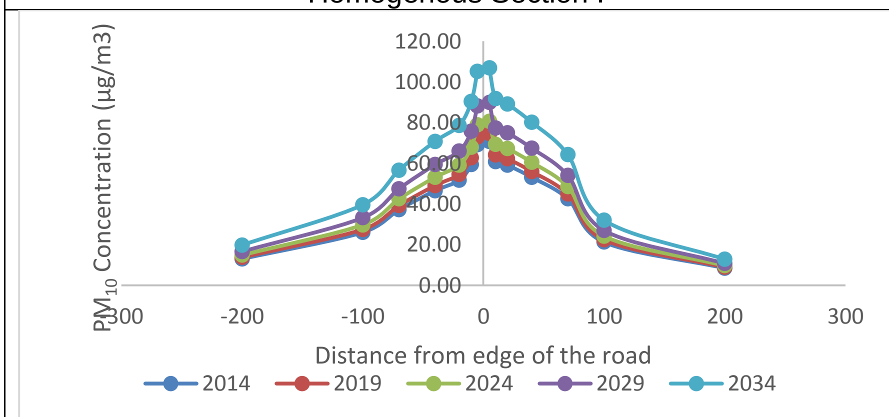

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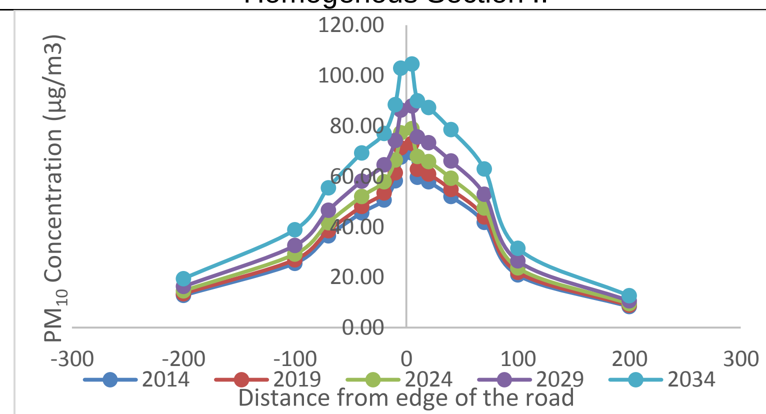
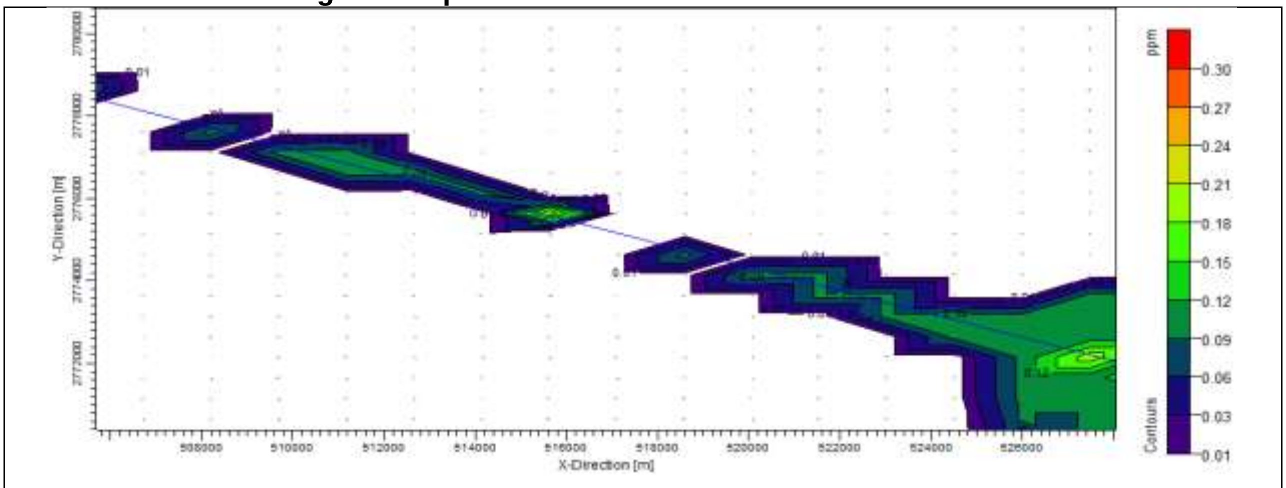


Homogenous Section IV

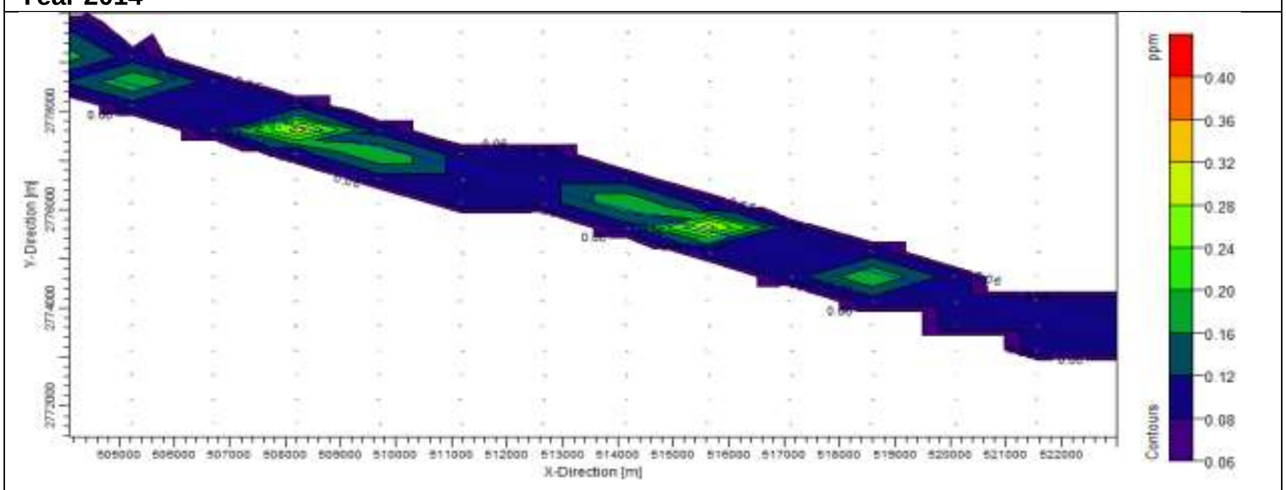
Figure 4: PM10 predicted concentrations (µg/m3) along the highway corridor

11. In addition, the spatial distribution of hourly average predicted CO, $PM_{2.5}$ and PM_{10} concentrations have been plotted in figures 5, 6 and 7, respectively for peak traffic hour which shows that pollutant concentrations is decreasing when goes away from the kerb side. A section of road corridor has been selected to show the spatial dispersion of pollutant concentrations.

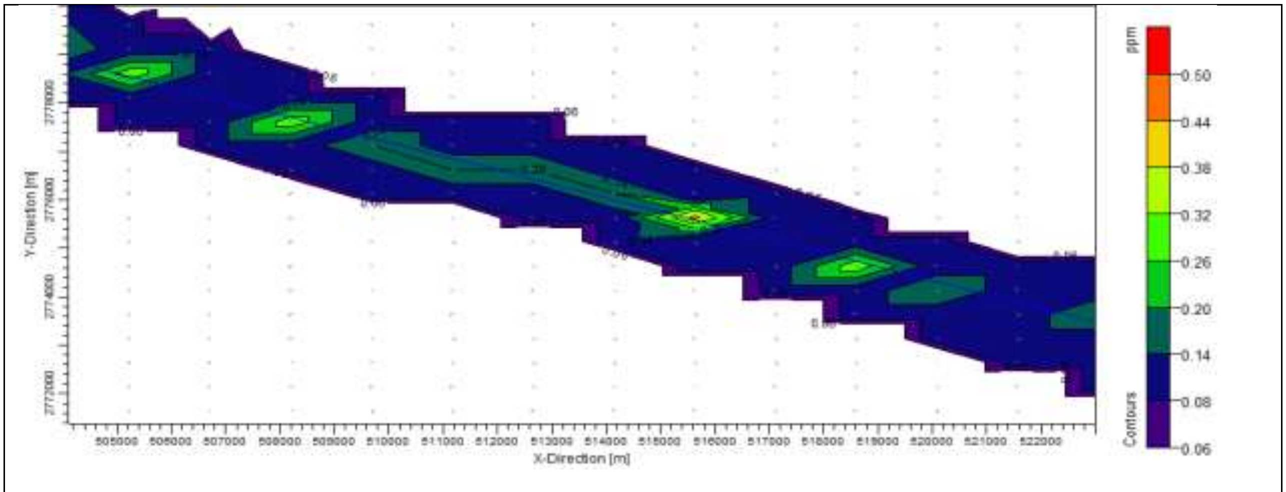
Figure 5: Spatial distribution of CO concentrations



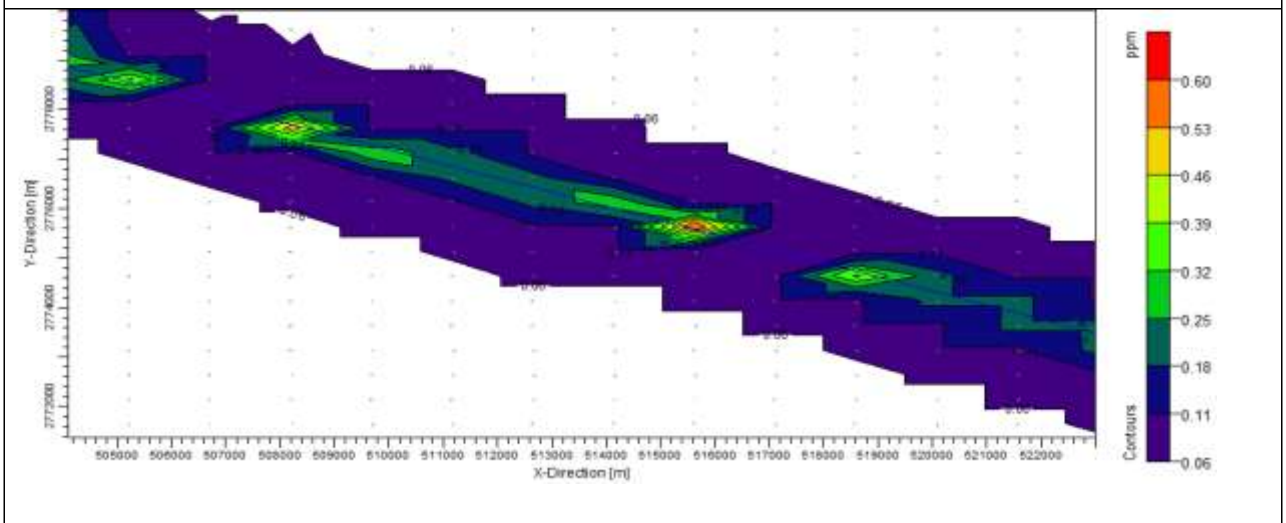
Year 2014



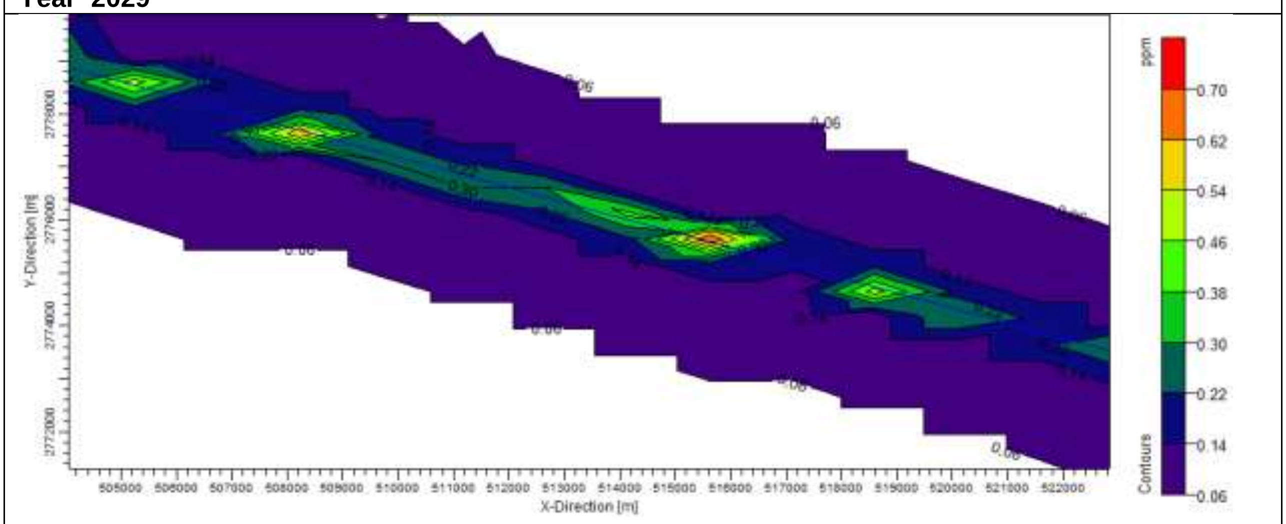
Year 2019



Year 2024

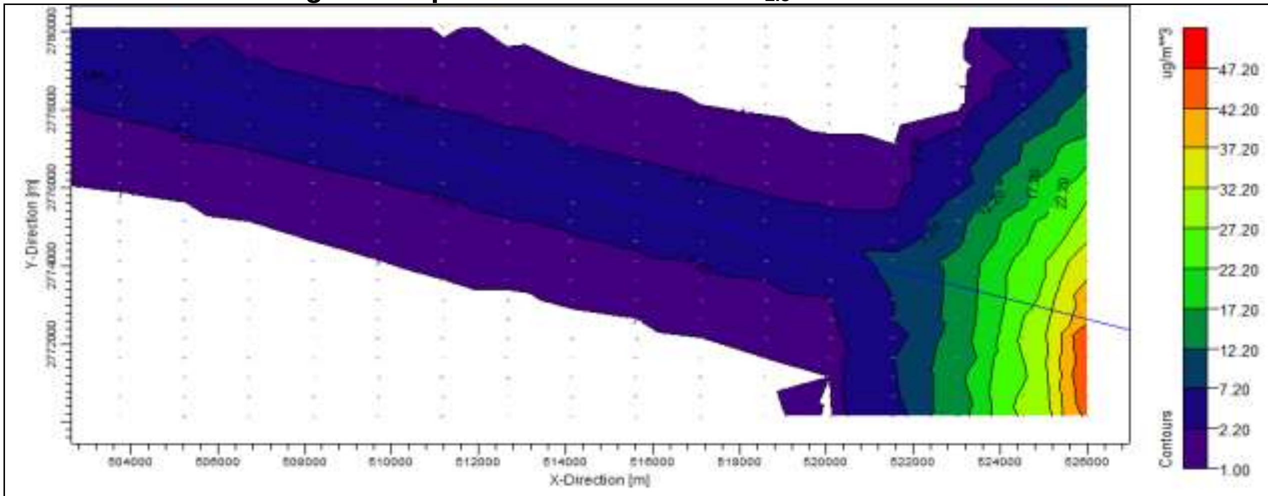


Year 2029

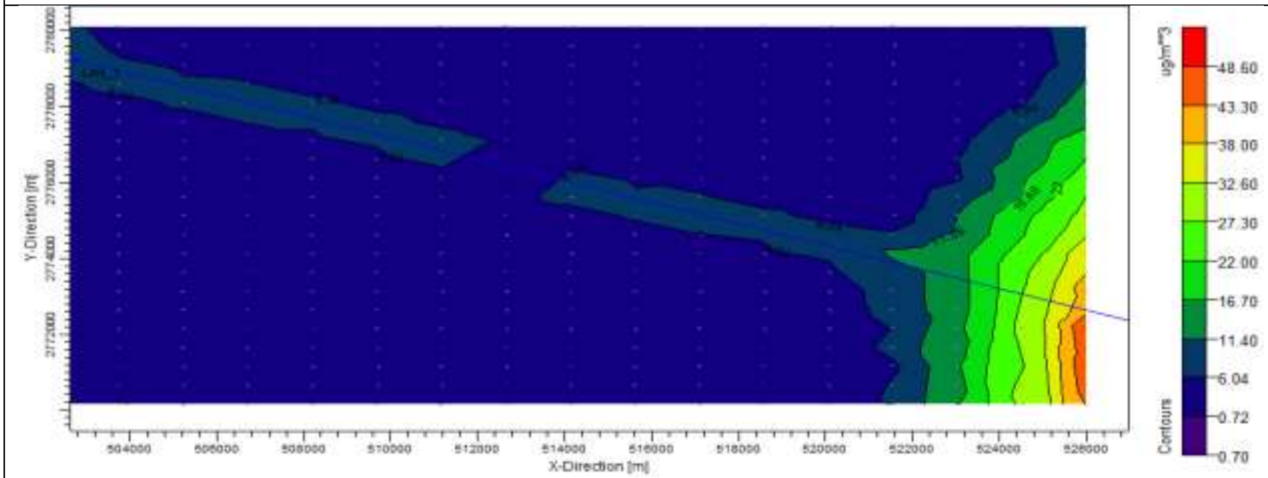


Year 2034

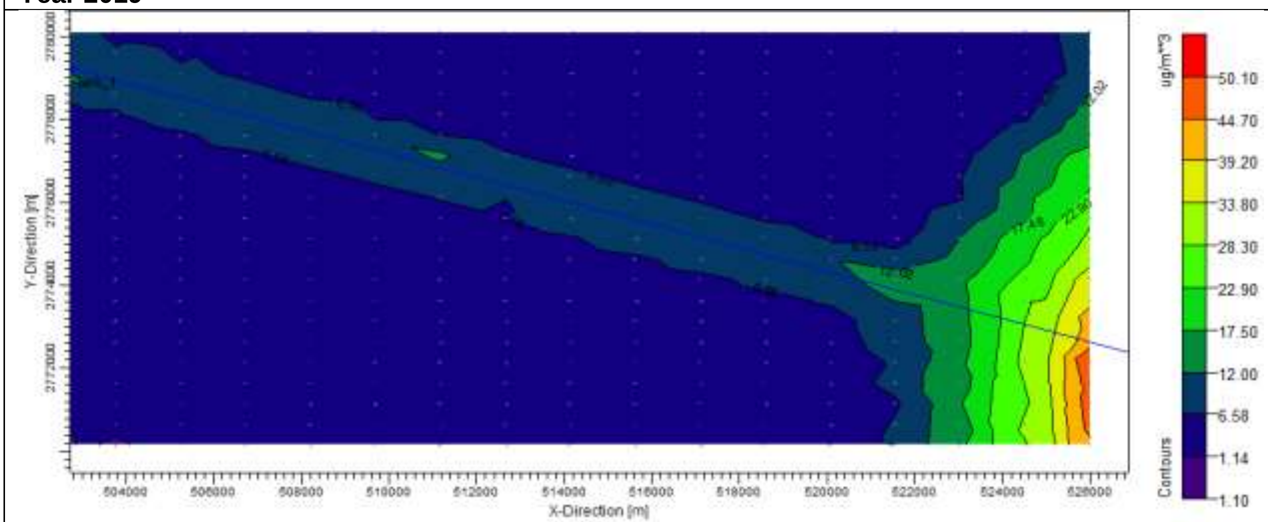
Figure 6: Spatial distribution of $PM_{2.5}$ concentrations



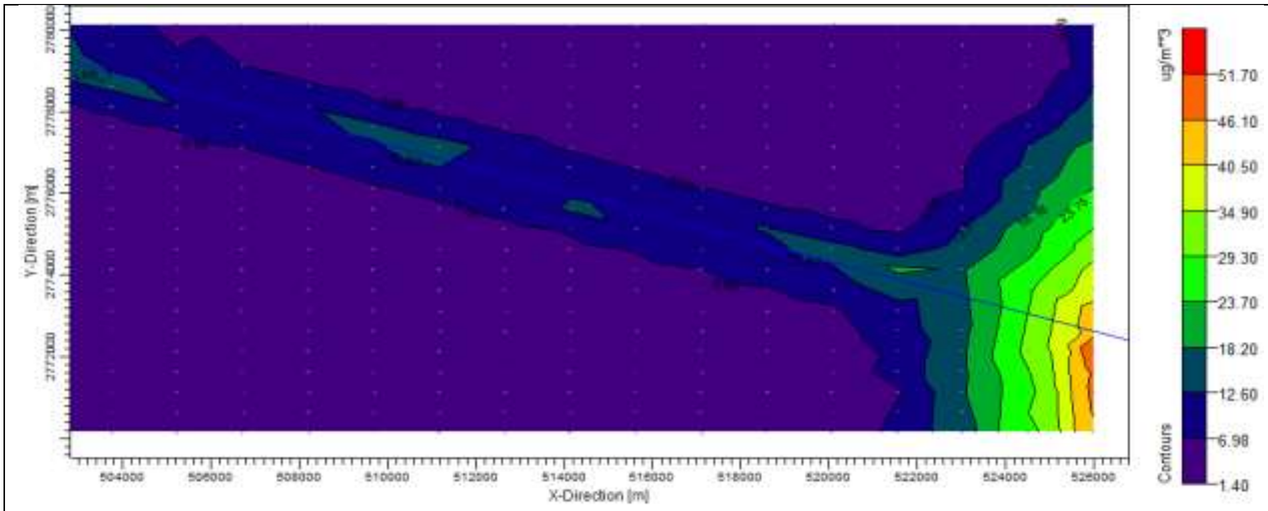
Year 2014



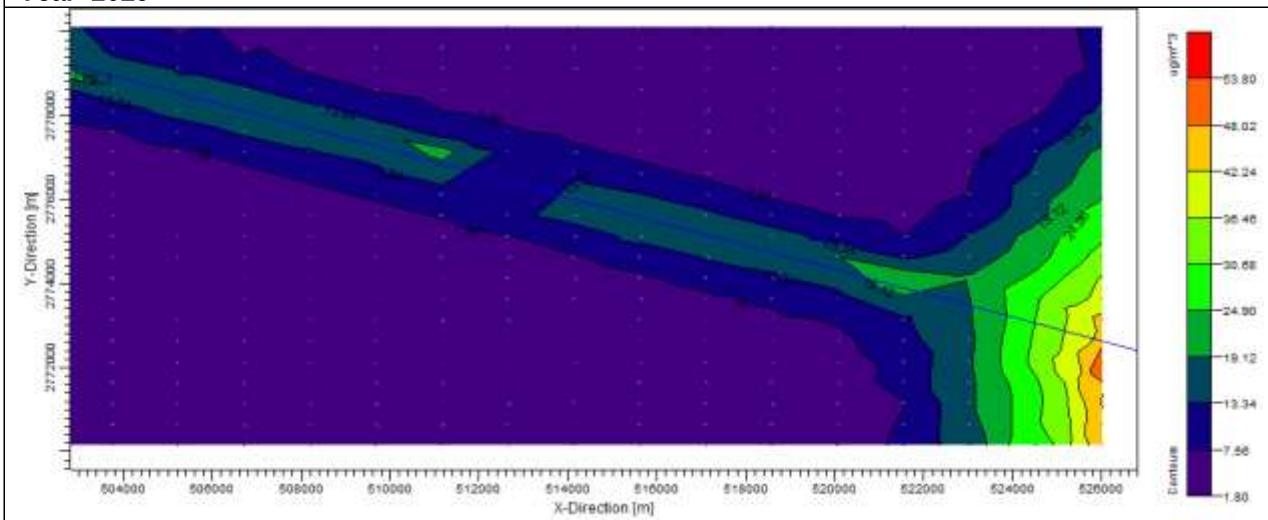
Year 2019



Year 2024

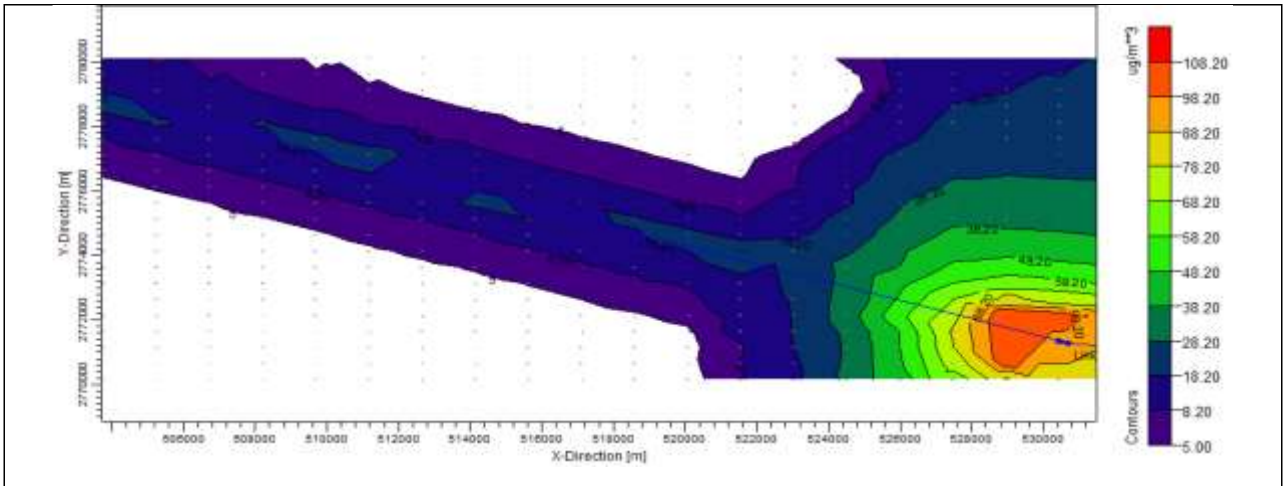


Year 2029

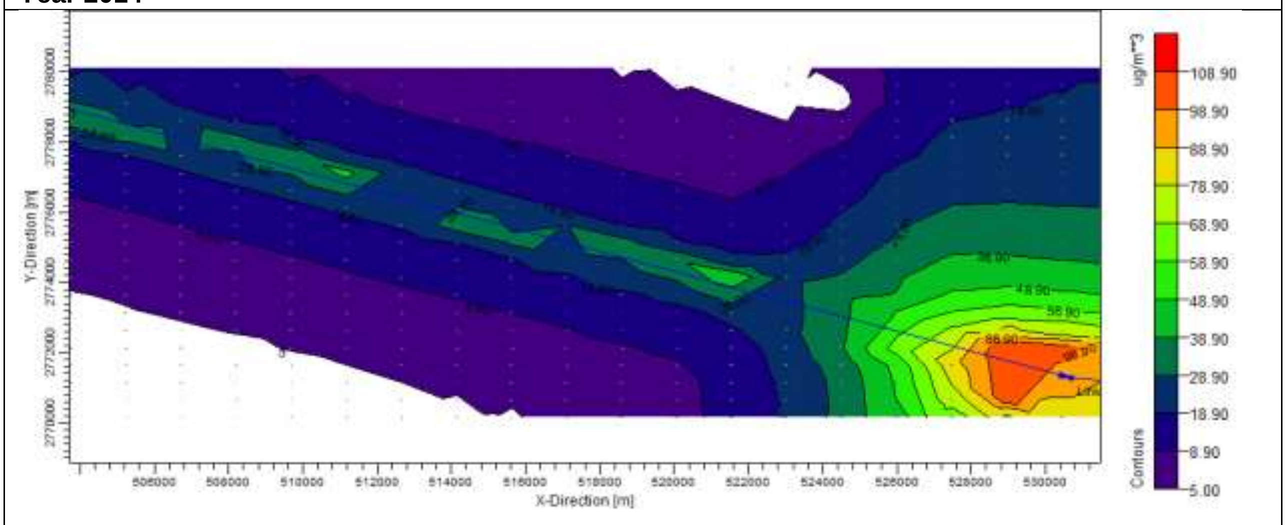


Year 2034

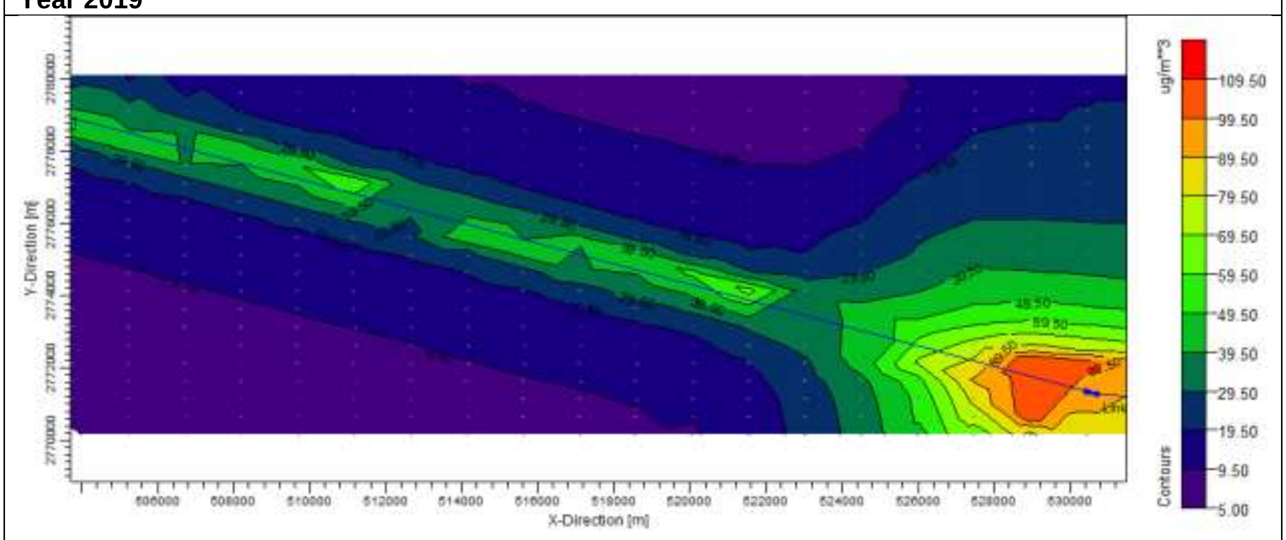
Figure 7: Spatial distribution of PM_{10} concentrations



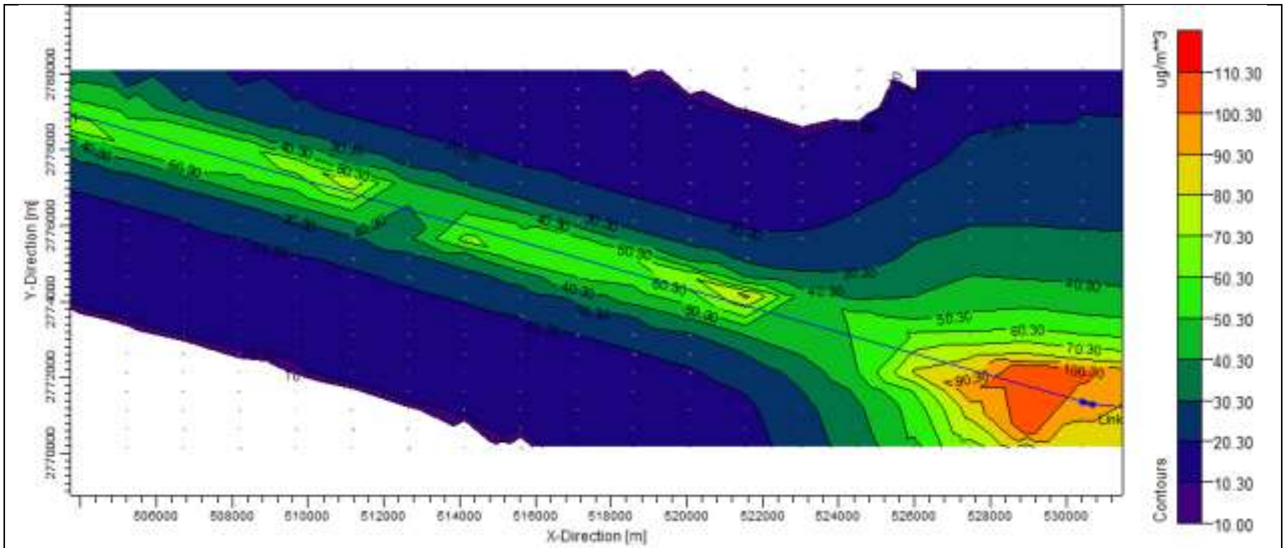
Year 2014



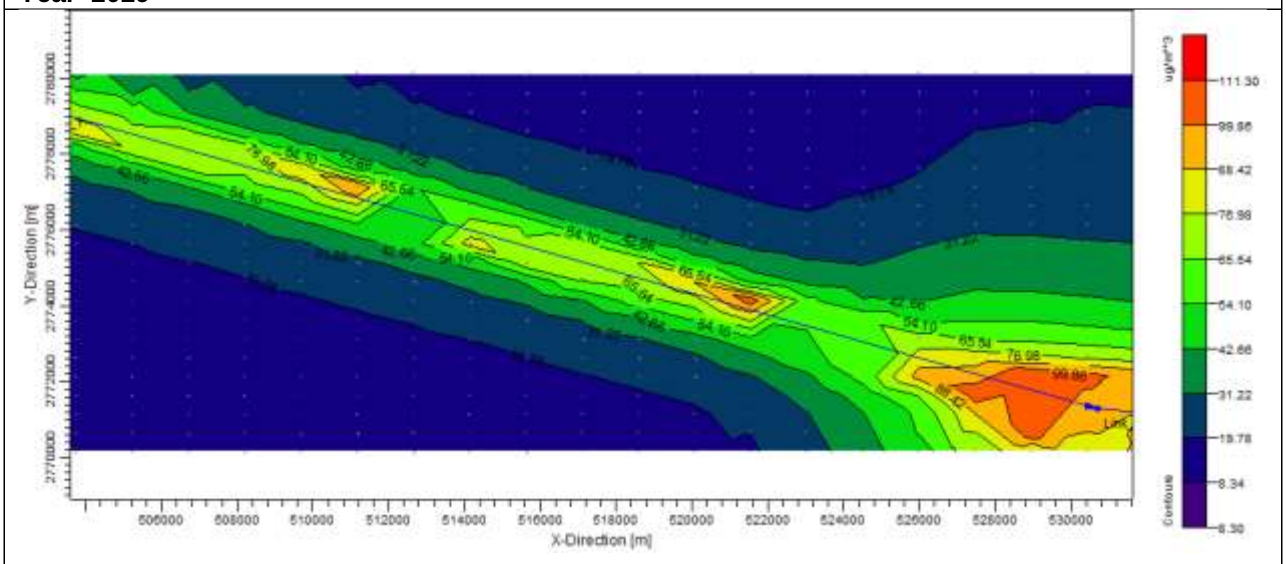
Year 2019



Year 2024



Year 2029



Year 2034

ANNEX 6: PREDICTED NOISE LEVELS

1. Federal Highway Administration's Traffic Noise Model (FHWA TNM) helps for highway traffic noise prediction and analysis. TNM computes highway traffic noise at nearby receivers. As sources of noise, it includes noise emission levels for the following vehicle types:

- Automobiles: all vehicles with two axles and four tires -- primarily designed to carry nine or fewer people (passenger cars, vans) or cargo (vans, light trucks) -- generally with gross vehicle weight less than 4,500 kg (9,900 lb);
- Medium trucks: all cargo vehicles with two axles and six tires -- generally with gross vehicle weight between 4,500 kg (9,900 lb) and 12,000 kg (26,400 lb);
- Heavy trucks: all cargo vehicles with three or more axles -- generally with gross vehicle weight more than 12,000 kg (26,400 lb);
- Buses: all vehicles designed to carry more than nine passengers; and
- Motorcycles: all vehicles with two or three tires and an open-air driver / passenger compartment.

2. The procedure for prediction of noise levels involves the following steps:
   1. Identification of various receivers
   2. Determination of landuses and activities which may be affected by the noise generated
   3. Assemble input parameters
   4. Application of the model

3. The description of the components to predict noise level are as follows:
   a. Receivers: TNM calculates the sound levels at the input receivers. In this study two type of receivers selected to assess the impacts of moving traffic on surrounding noise level. One, discrete receptor and second, grid receptor.
   b. Land uses: Land use along the road is obtained from the topographic drawings. This information provides the range of shielding and absorption factors to be applied at the various receivers.
   c. Input Parameters: Traffic volume for the projected period is obtained from the traffic projections. The total number of vehicles passing per hour by type - light, medium and heavy along with their average speed is used for predictions.
   d. Average Noise Level: All vehicles produce noise, which is taken as the base, and the cumulative noise at the receiver distance due to the whole traffic is estimated. The average noise level varies depending on the type of vehicle.
   e. Application of Model: Equivalent noise levels due to traffic at the receivers are estimated using Federal Highway Noise model. Equivalent Sound Level (T_{EQ}, denoted by the symbol, L_{AeqT}): Ten times the base-10 logarithm of the square of the ratio of time-average, mean-square, instantaneous A-weighted sound pressure, during a stated time interval, T (where $T=t_2-t_1$), and the reference mean-square sound pressure of 20 : Pa, the threshold of human hearing, e.g., 1HEQ, denoted by the symbol, LAeq1H, represents the hourly equivalent sound level. L_{AeqT} is related to LAE by the following equation :

$$L_{AeqT} = L_{AE} - 10*\log10(t_2-t_1)$$

where LAE = Sound exposure level in dB

Sound Exposure Level (SEL, denoted by the symbol, L_{AE}): Over a stated time interval, T (where $T=t_2-t_1$), ten times the base-10 logarithm of the ratio of a given time integral of squared instantaneous A-weighted sound pressure, and the product of the reference sound pressure of 20:Pa, the threshold of human hearing, and the reference duration of 1 sec. The time interval, T, must be long enough to include a majority of the sound source's acoustic energy. As a minimum, this interval should encompass the 10 dB down points. Traffic data used in noise modelling are given below in table 1

Table 1: Annual average daily motorized traffic data

Year	2w	3w	4w	LCV	HCV	Bus
	Homogeneous Section I					
2014	155	5486	9686	345	167	35
2017	682	6634	12034	510	1004	63
2019	830	8212	15019	626	1224	75
2024	1197	12530	23322	895	1770	104
2029	1523	17129	32177	1162	2274	126
2034	1899	21836	42174	1410	2847	146
	Homogeneous Section II					
2014	172	3240	2579	515	185	15
2017	702	3924	3404	713	1026	40
2019	855	4857	4266	872	1251	47
2024	1235	7410	6681	1249	1813	65
2029	1573	10130	9299	1625	2331	80
2034	1962	12911	12262	1976	2918	93
	Homogeneous Section III					
2014	106	817	1350	59	110	8
2017	626	996	1902	170	939	31
2019	762	1234	2386	208	1143	36
2024	1099	1886	3747	296	1655	50
2029	1399	2579	5229	381	2130	60
2034	1745	3286	6908	460	2669	70
	Homogeneous Section IV					
2014	429	161	201	86	690	21
2017	502	193	240	101	810	23
2019	625	243	303	125	1006	28
2024	920	377	469	177	1486	40
2029	1173	515	638	226	1909	50
2034	1464	657	828	271	2387	60
	Homogeneous Section V					
2014	431	161	210	94	692	21
2017	506	193	253	110	814	24
2019	630	244	320	137	1013	29
2024	928	379	498	193	1496	42
2029	1182	517	675	247	1920	52
2034	1474	659	875	297	2400	62

Table 2: Noise prediction in dB (A) along the road corridor

Receptor locations	Year	Predicted LAeq in peak hour dB(A)								
		Distance from the edge of the road, m. (Left side)					Distance from the edge of the road, m. (Right side)			
		60	40	20	10		10	20	40	60
Section 1	2014	56.5	59.5	62.8	66.2		65.5	62.4	60.7	57.2
	2019	58.1	61.7	65.4	69.1		68.3	64.9	63.1	59
	2024	56.7	59.9	63.6	67.6		66.8	63.1	61.2	57.5
	2029	61.2	64.2	67.5	70.9		70.2	67.1	65.4	61.9
	2034	62.8	66.3	70	73.8		73	69.6	67.8	63.7
Section II	2014	58.1	61.7	65.4	69.1		68.3	64.9	63.1	59
	2019	56.7	59.9	63.6	67.6		66.8	63.1	61.2	57.5
	2024	61.2	64.2	67.5	70.9		70.2	67.1	65.4	61.9
	2029	62.8	66.3	70	73.8		73	69.6	67.8	63.7
	2034	61.4	64.6	68.3	72.3		71.5	67.8	65.9	62.2
Section III	2014	56.7	59.9	63.6	67.6		66.8	63.1	61.2	57.5
	2019	61.2	64.2	67.5	70.9		70.2	67.1	65.4	61.9
	2024	62.8	66.3	70	73.8		73	69.6	67.8	63.7
	2029	61.4	64.6	68.3	72.3		71.5	67.8	65.9	62.2
	2034	62.8	65.8	69.1	72.6		71.9	68.8	67	63.6

Observations

4. Noise levels (Leq) near the receivers are found to be marginally higher than desired levels for the respective categories. The maximum predicted value 65.5 dB(A) is recorded at the receiver located close to section 1 monitoring site for base year 2014 (Table 2). The predicted levels show increase in noise levels for future years at all receivers considering increase in traffic volume.

Noise dispersion

5. A small road corridor has been selected to develop noise contour for base year as well as future years also. The contour lines are generated by plotting a contour zone within 30 m distance from edge of the road on both side of the road. Due to model limitation, it is not possible to select the whole road corridor in the modelling domain. Therefore, spatial dispersion of noise have been show with a small stretch of road. Figure 1 to 5 shows noise level contour around a small road corridor for year 2014, 2019, 2024, 2029 and 2034 respectively. The selected road stretch is small part of section -I, i.e., Imphal- Kangchup road stretch. These predicted results are for peak traffic hours. During non-peak traffic hours, the noise level are very less compared to noise level for peak traffic hours.

Figure 1: Noise contour for year 2014

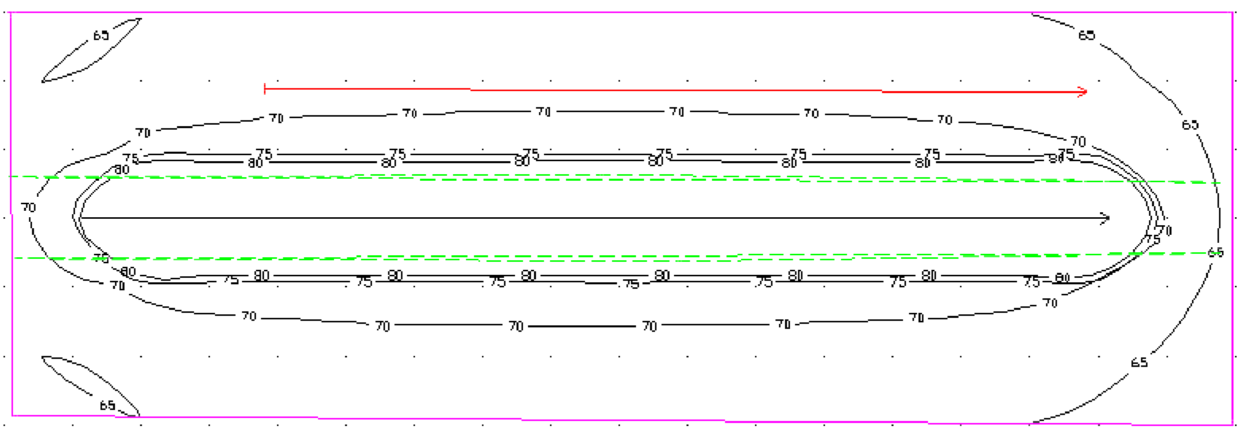


Figure 2: Noise contour for year 2019

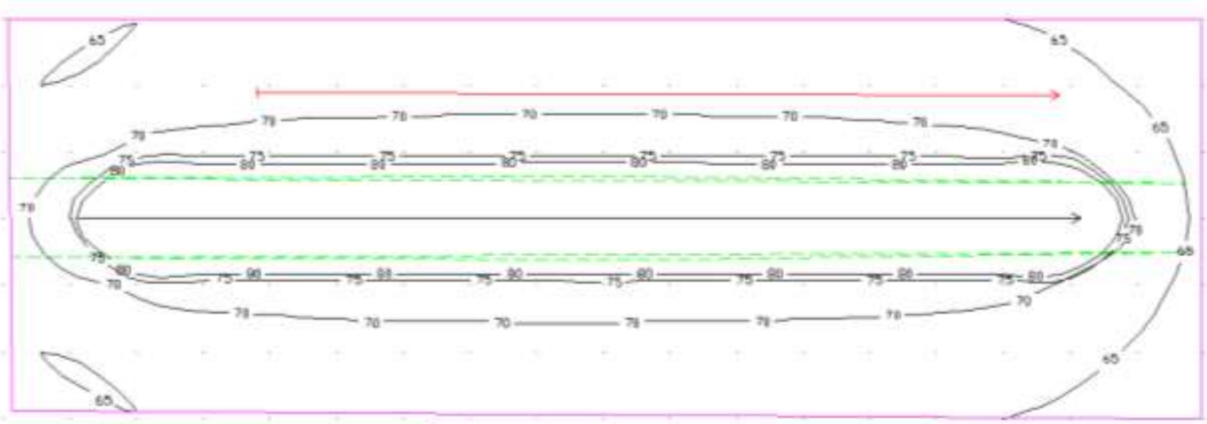


Figure 3: Noise contour for year 2024

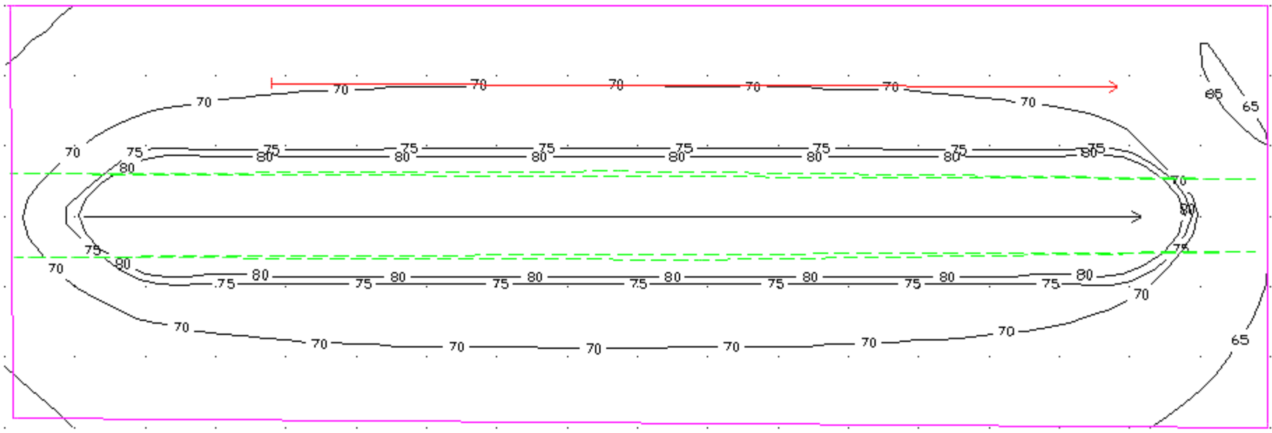


Figure 4: Noise contour for year 2029

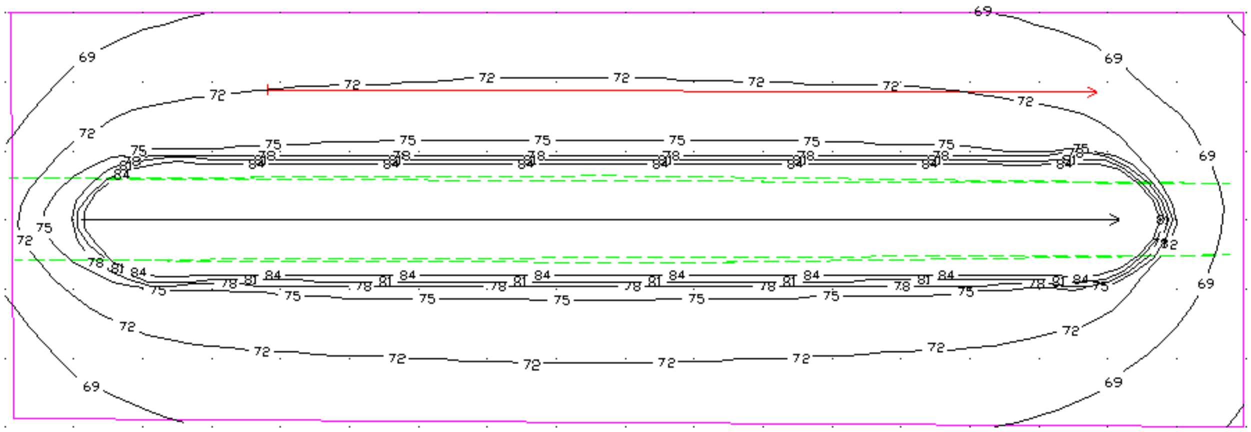
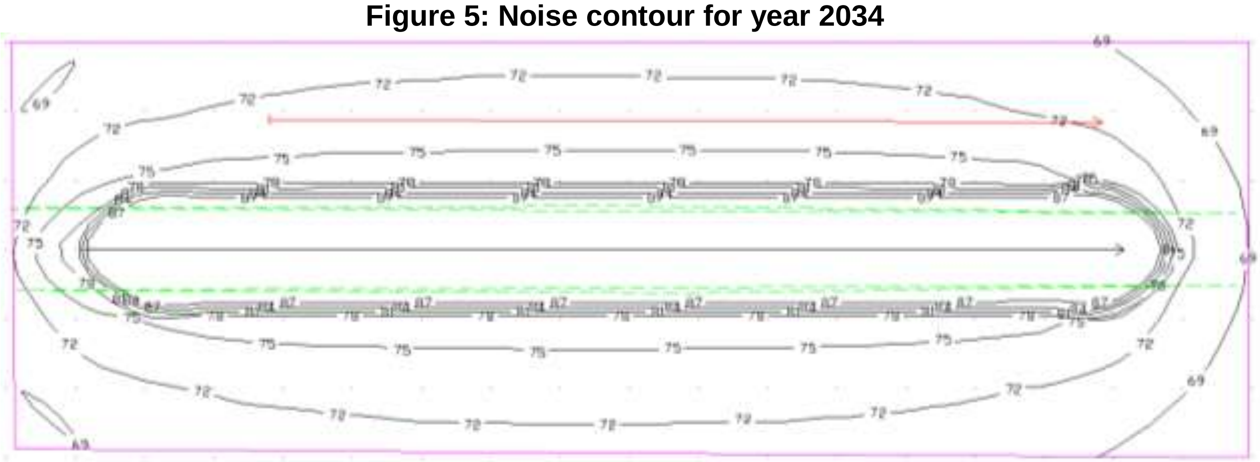


Figure 5: Noise contour for year 2034



ANNEX 7: GUIDELINES FOR PLANT MANAGEMENT

A. Purpose

- To ensure that statutory / regulatory requirements are complied with
- To ensure that safeguard measures are taken to avoid / mitigate / minimize environmental impacts

B. Site selection criteria

1. Following criteria are to be met wherever possible for crusher and HMP:
   - 1.5 km away from settlement, school, hospital on downwind directions
   - 1.5 km from any archaeological site
   - 1.5 km from ecologically sensitive areas i.e. forest, national park, sanctuary etc.
   - 1.5 km from rivers, streams and lakes
   - 500 m from ponds
   - 250 m from State and National Highway boundary
   - away from agricultural land
   - preference to barren land

2. Concrete batching plant should be located at least 200 m from the settlement, preferably on leeward side, whenever possible.

3. The format for submission of details to the Engineer during finalisation of plant site is given as follows (Site identification for Plants).

C. Statutory Requirements

- Obtaining Consent-for-Establishment (CFE) under Air and Water Acts from the State Pollution Control Board (SPCB) before start of installation
- Obtaining Consent-for-Operation (CFO) under Air and Water Acts from the State Pollution Control Board (SPCB) before start of commissioning and trial run
- Complying with the terms and conditions laid down in the CFE and CFO, which generally include providing metallic road inside plant campus for movement of vehicles, plantation, periodic (monthly) pollution monitoring i.e. ambient air, noise and stack emission
- The suspended particulate matter contribution value at a distance of 40 m from a controlled isolated as well as from a unit located in a cluster should be less than 600 μg/m3 or as shall be prescribed by SPCB.
- Obtain certificates from manufacturer for Type Approval and Conformity of Production for Diesel Generator (DG) set/s.
- For DG sets of capacity up to 1000 kVA, the noise level at 1 m from the enclosure surface shall not exceed 75 dB (A).

D. Pollution control measures

- Dust control measures in stone crusher plant i.e. water sprinkling at primary crusher and secondary crusher, conveyor & return belts, covered conveyor system, chute at outfall of aggregates, cyclone separator, wind braking wall etc.
- For HMP, ensure adequate stack height as stipulated in CFE, install emission control devices such as bag house filters, cyclone separators, water scrubbers etc., as attached with the plant by the manufacturer or stipulated in CFE.

- Prefer bulk bitumen storage with mechanized handling facilities that storage in drums with manual operation at HMP to prevent / minimize bitumen spillage and thereby contaminating soil and ground water.
- Impervious platform for storage of bituminous and other liquid hazardous chemical
- Bag house filter / multi-cone cyclone for emission control. For bag house, cartridge filters reported to be more efficient than fabric filters
- Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc.
- Greenbelt along the periphery of plant site.

SITE IDENTIFICATION FOR PLANTS

Construction Stage Report: One Time Date:
Installed Capacity (tph): Location of Plant (Ch. & offset):

Sl. No.	Item / Requirement	Details as per Actual
1	Predominant wind direction	
2	Size and area of the proposed plant site (m xm & Sq.m)	
3	Present land use (barren or fallow land having no prominent vegetation should be preferred)	
4	No dwelling units within 1.5km from the plant boundary in downwind direction	
5	Distance of nearest boundary of State Highways and National Highways (should be at least 250 m from the plant boundary)	
6	Sensitive areas such as religious places, schools/educational institutions, reserved / protected forest, sanctuary etc. within 1.5 km (should be nil)	
7	River/Stream/Lake within 1.5 km and ponds within 500 m	
8	No other trees of girth>0.3m present and will be affected (no tree should be affected)	
9	Width of Haul road (m)	
10	Total Length of Haul Road (km)	
11	Length of non-metal Haul Road (km) (should be as minimum as possible)	

Documents to be attached:
Site plan showing wind direction, haul road and other environmental features.
Certified that the furnished information is correct and all relevant information as required is attached.

Contractor:

ANNEX 8: GUIDELINES FOR CAMP SITE MANAGEMENT

A. Purpose

1. Campsite of a contractor represents the single potentially most polluting location during implementation of any road project. Air pollution may be caused by emissions from Crushers, Hot-Mix, and Concrete Batching Plants. Water pollution may be caused by discharge of sediment, oil & grease, and organics laden run-off from these plants and their ancillary facilities as well as workshops, residential quarters for the labor. Land may be polluted due to indiscriminate disposal of domestic waste or (accidental) release of hazardous solids from storage areas.

2. While the installation and operation of Crushers and Hot-Mix Plants are regulated by the respective Pollution Control Boards, the other sources described above usually do not appear to be causes of significant concern. Items to be considered for labor camps are mentioned briefly in Clause 105.2 (as part of 105: Scope of Work) of the Ministry of Road Transport and Highways (MoRTH) publication: Specifications for Road and Bridge Works. Some specific requirements for labor accommodation and facilities are to be met by the Contractor in line with Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Currently, there is no one-point guidance regarding the environmental management aspects of the Contractor's campsite. This guideline on Campsites is designed to fill this gap.

B. Scope

3. This guideline covers the Contractors' camp sites – whether used by in-house crew or by any sub-contractors' crew. It covers siting, operation, maintenance, repair and dismantling procedures for facilities for labor employed on project (and ancillary) activities as well as equipment and vehicles. ***It does not include siting, operation, maintenance, repair and dismantling of major plants – Hot-mix Plant, Concrete Batching Plant, Crusher or Wet Mix Macadam Plant.***

1. Siting, Establishing, Operation and Closure of Construction Camp

a. Potential Environmental Impacts

4. Construction camps require large areas for siting facilities like major plants, storage areas for material, residential accommodation for construction labor and supervisors, and offices. Removal of topsoil and vegetation from the land to be utilized for camps is the first direct impact of any such establishment. In addition, local drainage may be impaired if proper drainage is not effected by grading. Other impacts may include damage to ecologically important flora and fauna, if campsites are located close to such areas. Water pollution because of discharge of sediment, fuel and chemicals is also a possibility. Pollution of land due to indiscriminate disposal of construction wastes including scarified pavement, concrete and even substantial quantities of domestic wastes from residential areas can also be potentially disastrous, especially if the site is reverted to its original use after the project (mostly agriculture).

b. Mitigation Measures

2. Siting of Construction Camps

5. The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1.5 km from boundaries of designated Reserved Forests, Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain 1.5 km from river, stream and lake and 500m from ponds
- Maintain 250 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses.
- Locate campsites in the (most prevalent) downwind direction of nearest village(s). The boundary of the campsite should be at least 1.5 km from the nearest habitation so that the incoming labor does not stress the existing local civic facilities.
- The ground should have gentle slope to allow free drainage of the site.
- Recorded consultations should be held with residents of the nearest settlement and/or their representatives to understand and incorporate where possible, what they would like to see within their locality.

3. Establishment, Operation, and Closure of Camps

- The facilities within the camp site should be laid out so that the separation distances suggested in other guidelines are maintained. A notional lay-out of the facilities except the major plants is included in this guideline.
- Topsoil from the area of the plant shall be stored separately for the duration of the operation of the camp and protected from being washed away, unless agreed otherwise in writing with the owner. If stored, it will be returned on to its original location at the time of closure of the site.
- The Contractor shall prepare, make widely available (especially to staff responsible for water and material management), and implement a Storm water Management Plan (SWMP) for (all) the site(s) following approval of the same by the Engineer. .
- The Contractor shall prepare an Emergency and Spill Response Plan as per the requirements of Appendix 1 to Clause 501 of Specifications for Road and Bridge Works to cover the spillage of bitumen and/or chemicals like retarders, curing compounds, etc.
- The Contractor shall prepare a Waste Management Plan describing the types and quantities that are likely to be generated from within the camp site, with the period and duration during the construction schedule; methods to be adopted to minimize these; methods of removal, treatment and (on-site or off-site) disposal for each type; as well as location of final disposal site, if any.
- The Contractor shall provide safe ingress and egress for vehicles from the site and public roads and shall not impact existing through traffic.
- Water tankers with sprayers must be available at the camp site at all times to prevent dust generation.
- In case of stockpiles of stored material rising higher than wind-breaking perimeter fencing provided, sprinklers shall be available on site to prevent dusting from the piles during windy days.
- On completion of works, the Contractor shall restore the site to the condition it was in before the establishment of the campsite, unless agreed otherwise in writing with the owner(s) of the site(s). If such a written agreement has been

made, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.

- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

4. Equipment and Vehicle-related issues

a. Potential Environmental Impacts

6. The maintenance and repair of equipment and vehicles in Contractor's camp are activities that can have significant adverse impacts if not carried out properly. The concern mainly arises from discharge of wash water contaminated with oil and grease, whether from washing of vehicles or degreasing of equipment and vehicle parts. Vehicle washing, especially dirt from tires, also gives rise to sediment-laden run-off. No such discharges should be directly allowed into surface water bodies since they can be harmful to aquatic species.

b. Mitigation Measures

i. Vehicles

- All vehicles used by the Contractor must have copies of currently valid Pollution Under Control Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract.
- All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.

ii. Workshop and Maintenance areas

- These areas must have impervious flooring to prevent seepage of any leaked oil & grease into the ground. The area should be covered with a roof to prevent the entry of rainwater.
- The flooring shall be sloped to from both directions to one corner where an oil-and-grease trap with sufficient capacity should be installed. All discharges from the workshop area must pass through the trap to remove the floating oil and grease before entering the drainage system of the site. The trap should be designed to provide a hydraulic residence time of about 20 minutes for the peak hourly discharge anticipated from the area (as per following figure).
- Alternatively, degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used as shown in the adjacent photograph. This arrangement will require some initial investment and running cost for the pump, but the payback period, in terms of the use of diesel, under Indian conditions, has been reported to be less than 1 year.

1.
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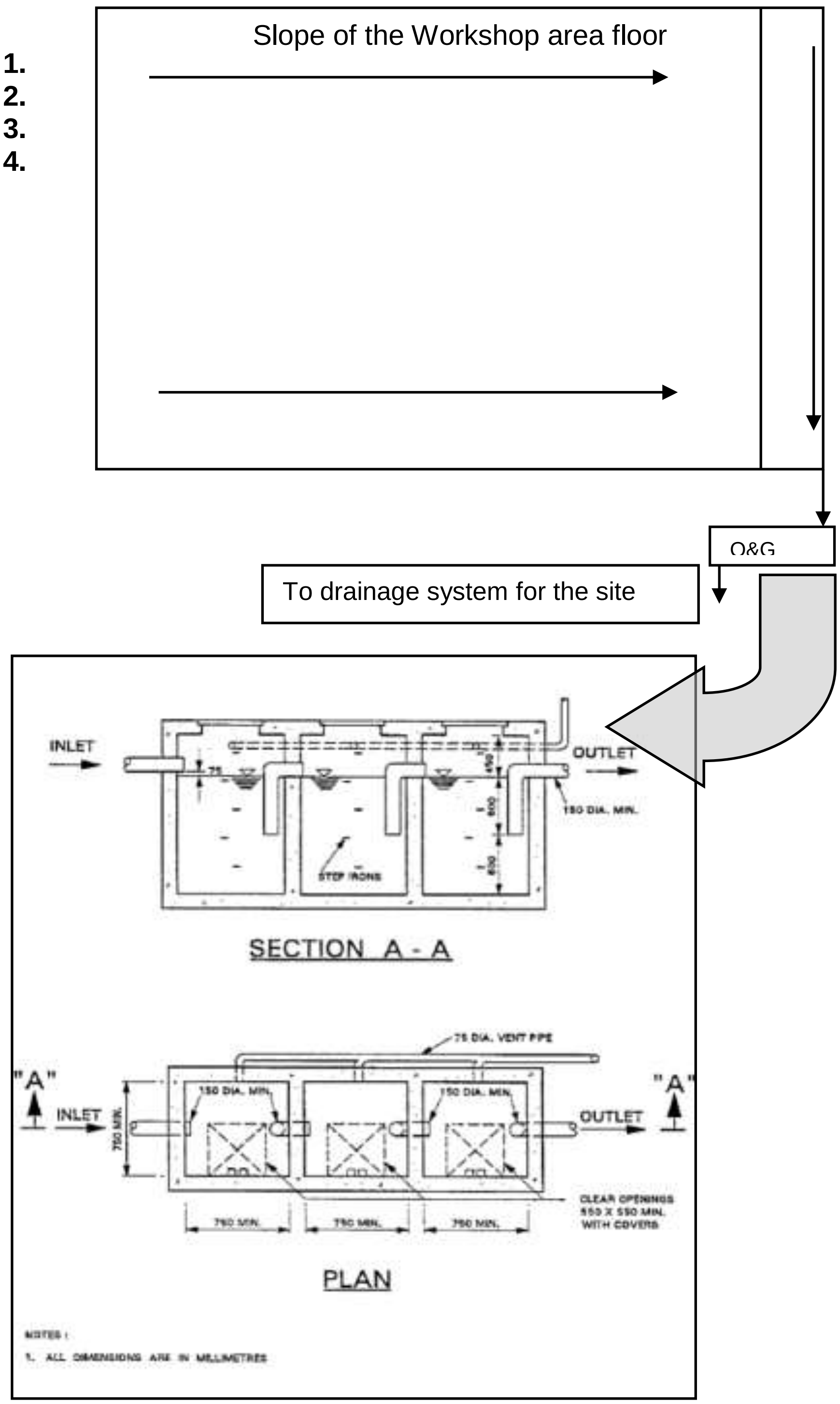
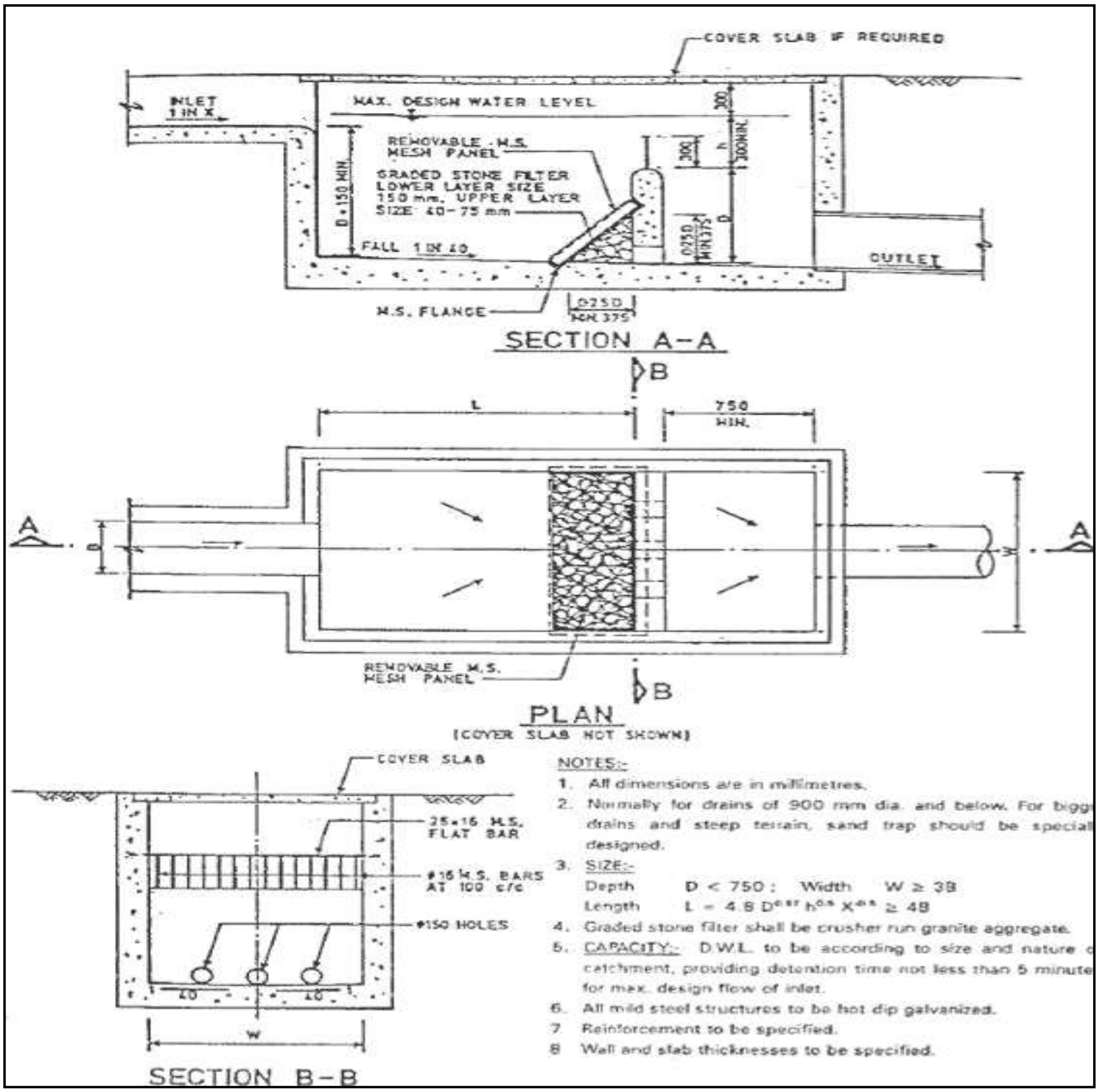


Figure 1: Workshop Area Pollution Control

- All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. For this purpose, metallic drums should be used. These should be stored separately in sheds, preferably bunded. The advantage of this arrangement is that it allows for accurate accounting in case the waste material is sold to oil waste recyclers or other users like brick-kiln owners who can burn such inferior fuel.

- A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any, after each day's construction is over, or as required. This ramp should have an impervious bottom and it should be sloped so that it drains into a separate chamber to remove the sediment from the wash water before discharge. The chamber should allow for a hydraulic residence time of about 10 minutes for discharge associated with the washing of each truck. Following figure 2 shows an outline sketch for a sedimentation chamber.

Figure 2: Sedimentation Chamber for vehicle washing ramp discharge



5. Facilities for Labour

a. Potential Environmental Impacts

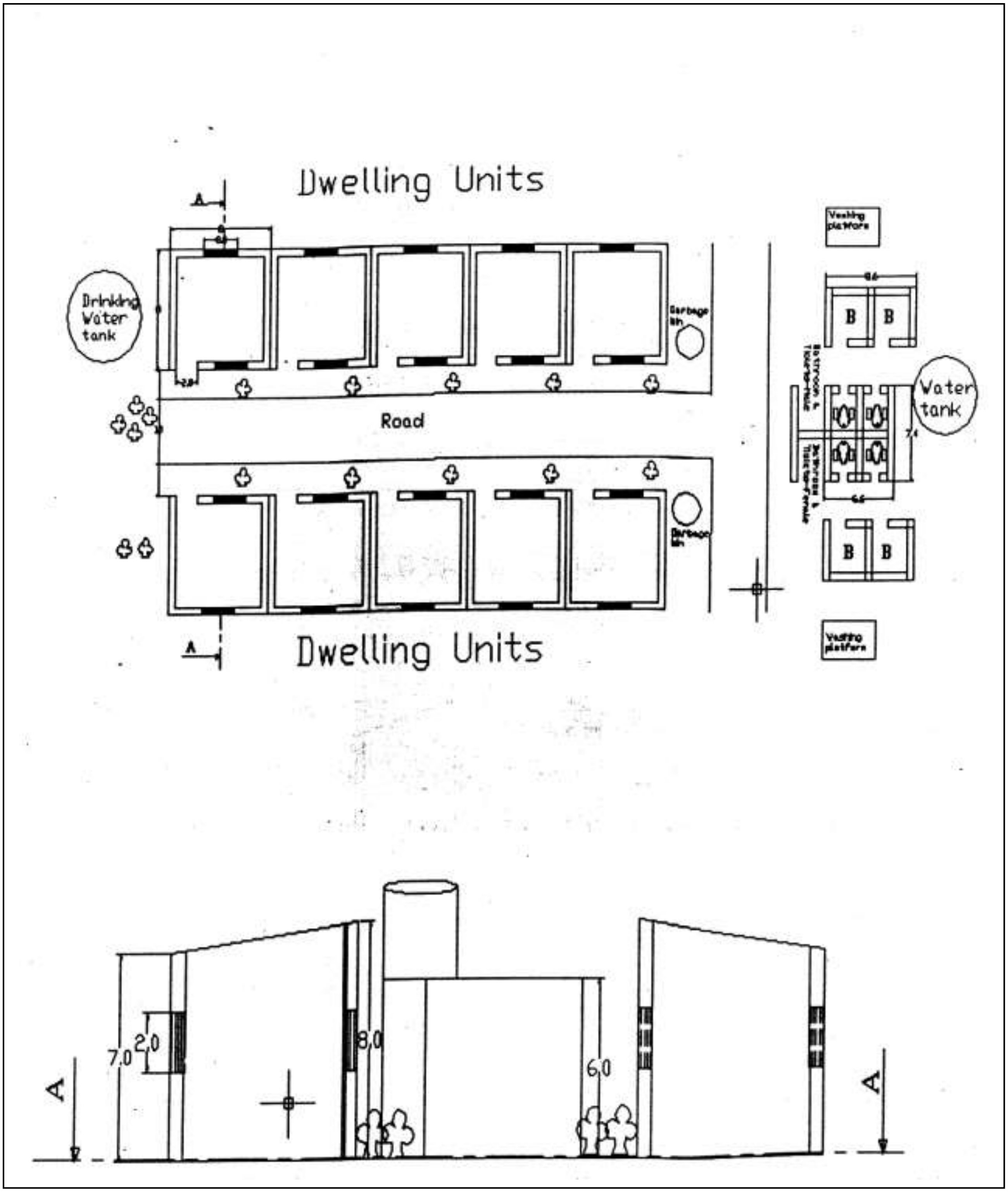
7. The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and may harm the crew themselves as well as local residents. Improper sanitation and inadequate health care also potential bottlenecks that the Contractor can eliminate with relatively little effort.

b. Mitigation Measures

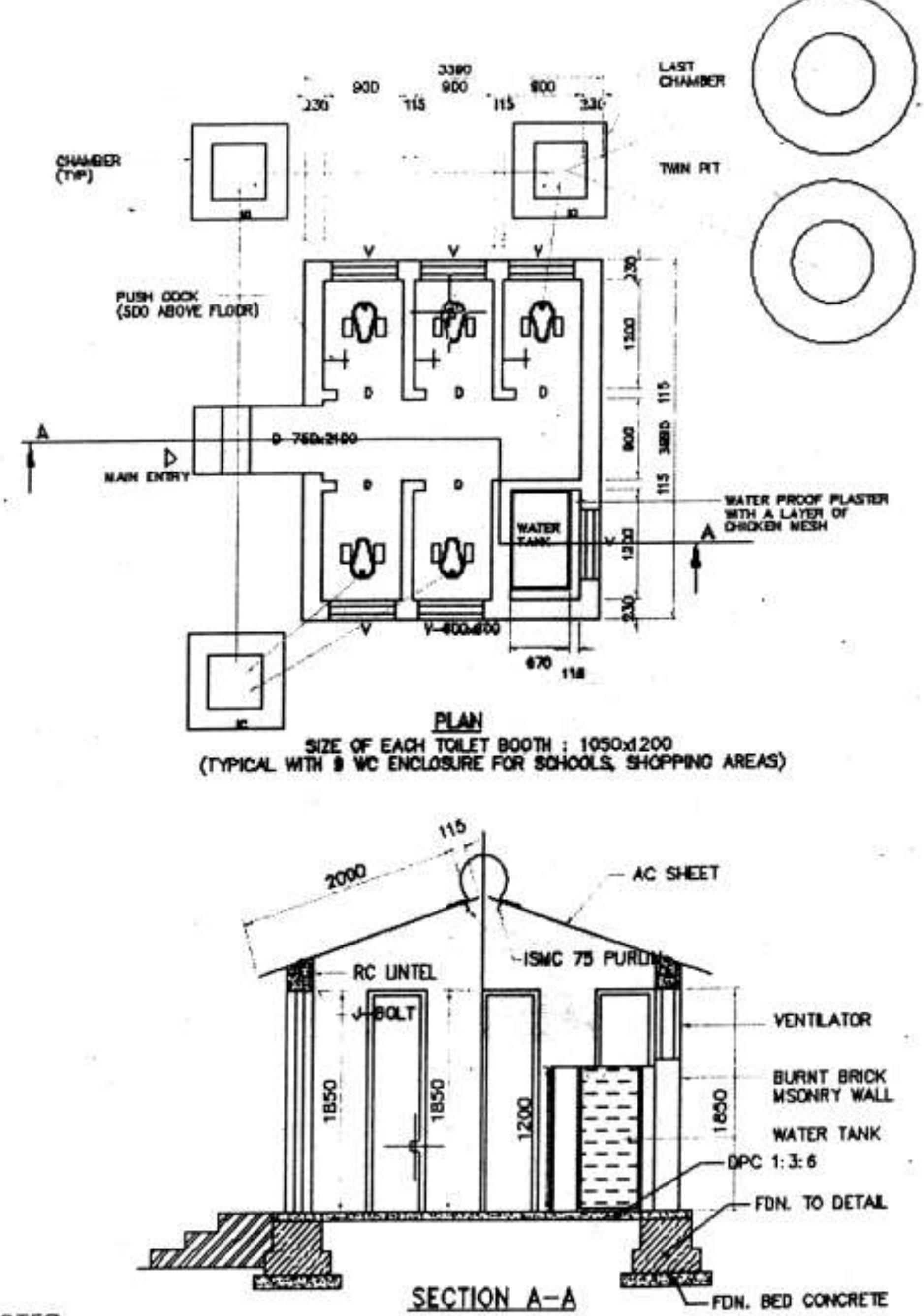
8. It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as benchmark for improved environmental performance of road projects:

- The contractor shall provide free-of-charge temporary accommodation to all the labour employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for every 20 persons. More toilets and/or urinals may have to be provided if the Engineer decides that these numbers are insufficient. In case female labourers are employed, separate toilet and urinals will be provided in locations clearly marked “Ladies Toilets” in a language understood by most labourers.
- The contractor shall ensure the supply of wholesome water for all the labour, including those employed by any other agency working for the contractor. These locations will be marked “Drinking Water” in the language most commonly understood among the labour. In hot season, the contractor shall make efforts to ensure supply of cool water. No water point shall be located within 15 m of any washing place, urinal, or latrine.
- The contractor shall ensure that adequate cooking fuel, preferably kerosene or LPG, is available on-site. The contractor will ensure that wood/ coal are not used as fuel on the site. Workers need to be made aware of this restriction. In cases where more than 250 labours are employed, canteen facility should be provided by the Contractor.
- A crèche must be provided in each campsite where more than 50 female labourers are employed, whether directly or indirectly, for the project or its ancillary activities.
- Contractor must provide adequate facilities for first-aid treatment at the campsite. A doctor / ambulance should be available on call for the duration of project implementation.
- The contractor shall obtain the approval of the Engineer for these facilities within 30 days of mobilization.

TYPICAL DRAWING OF WORKERS' CAMP SANITARY FACILITY



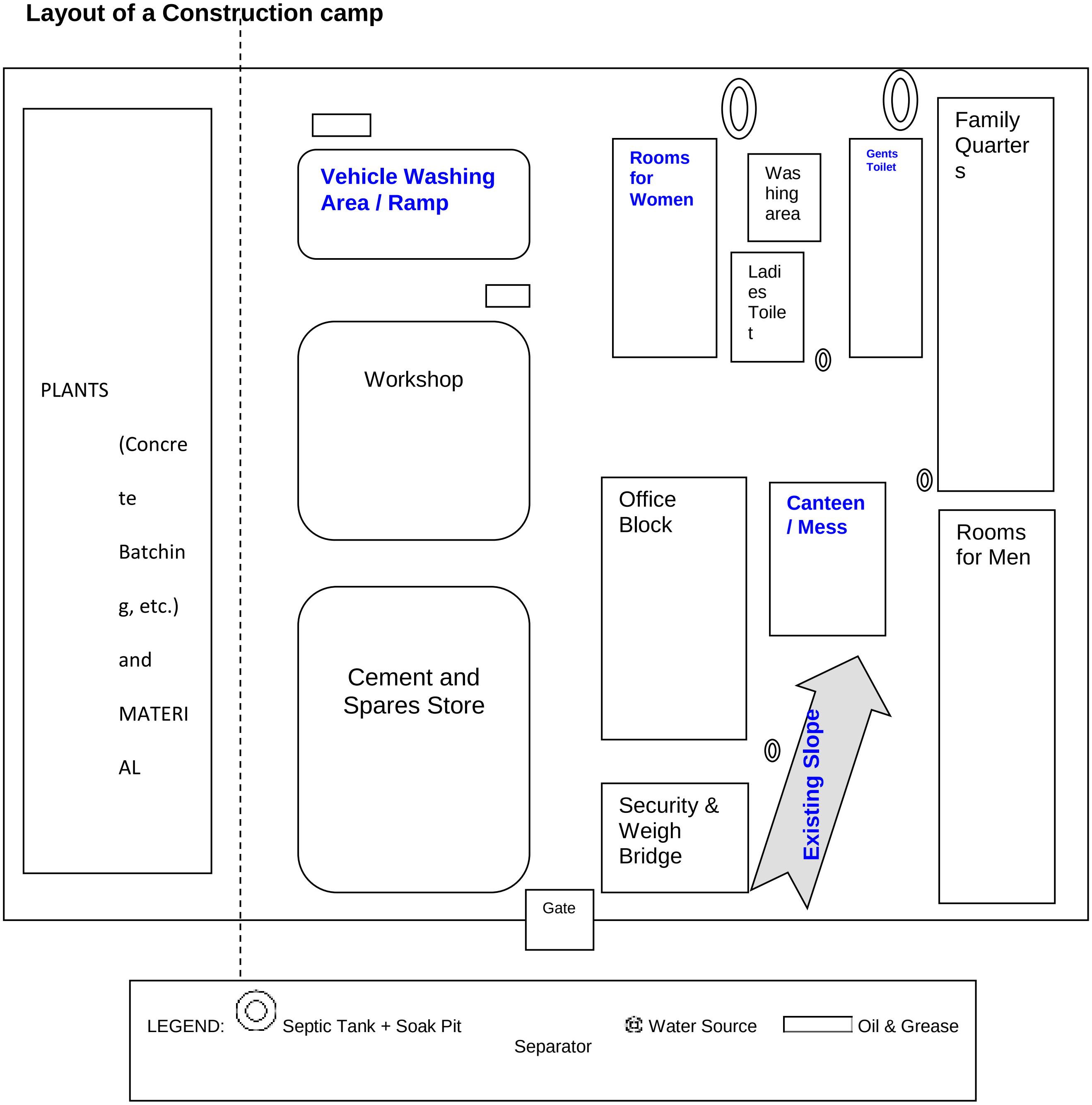
Sanitary facility



NOTES:

1. INSPECTION CHAMBER (IC) 600x600x600 DEEP WITH AIRTIGHT MH COVER
2. SEPTIC TANK & SOAK PIT AS PER SITE CONDITIONS

Layout of a Construction camp



ANNEX 9: GUIDELINES FOR DEBRIS DISPOSAL MANAGEMENT

A. Purpose

- To maximize re-use of material generated during construction and
- To avoid environmental hazards due to improper disposal of construction waste material.

B. Procedure

1. The following procedures should be followed for upkeep of storage and disposal sites:

- Contractor shall maintain register for keeping records on kilometer-wise quantities of material generated during grubbing, stripping, excavation and scarifying;
- Contractor shall re-use construction material to the extent possible based on engineering properties. Possible re-use areas are fill sections, embankment slope, village approach roads etc. Debris without bitumen could be used for backfilling of quarry / borrow areas as recommended by the Engineer. At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60mm thick layer of rammed clay so as to eliminate the possibility of the leaching of the wastes into the ground water. The contractor shall ensure that the filled area is covered with a layer of preserved topsoil layer of preserved topsoil.
- Contractor shall estimate the chainage-wise quantities of various waste material to be disposed of;
- Contractor shall restrict waste disposal strictly at approved site/s only;
- Contractor shall prepare a plan including detailed lay out plan and cross-section for disposal of debris and bitumen waste and get approval of the same by the Engineer;
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area;
- Contractor and Engineer shall ensure that disposal areas are properly treated as per agreed plan;
- Contractor and Engineer’s representatives shall undertake joint weekly inspection to ensure compliance of various environmental requirements.
- Engineer’s representatives shall issue non-compliance if disposal site is not managed as per agreed plan;
- All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the SC.
- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

C. Site Inspection

2. Weekly joint site inspection shall be undertaken for all the storage areas. The details of attributes, which are to be inspected, are given as follows. The Contractor shall ensure compliance of the requirements.

Details to be inspected for Monitoring Construction Material Reuse & Disposal

Attributes	Requirements
Construction material generation and re-use	• Segregating debris and bitumen during generation; • Segregating re-usable portion of debris and bitumen and storing preferably near areas of re-use; and • Temporary storage of waste material at sites as directed by the Engineer.
Waste disposal	• Disposal of waste material at approved disposal site within a week of generation; • Disposal site should be properly demarcated; • Proper leveling / grading at disposal site/s; • Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented; • Recommended / agreed safeguard measures to avoid soil erosion are to be implemented; • Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.

ANNEX 10: GUIDELINES FOR BORROW AREA MANAGEMENT

A. Purpose

1. Borrow areas are generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Borrow areas can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and social impacts of borrow areas.

B. Scope

2. These guidelines for borrow areas cover:
- statutory approvals
- environmental and social impacts of borrow areas
- selection of borrow areas
- operation of borrow areas
- rehabilitation of borrow areas

3. The guidelines seek to ensure that Contractors:
- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

C. Impacts

4. Some of the potential impacts of borrow areas are:
- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations
- agriculture land and productive soils being lost, especially in paddy field areas

5. Borrow areas are not generally specified in Contract documents but rather it is generally the responsibility of Contractors to identify borrow areas and obtain the necessary consent from land owner and approval from SC.

6. In IRC: 10 and Clause 305.2.2.2 of MoRTH Specification, exclusive guideline has been given for borrow areas located alongside the road and only some of the requirements have been indicated for borrow areas located outside the road land. Following guideline is proposed to supplement the existing stipulation in IRC:10 and Clause 305.2.2.2 of MoRTH Specification for Roads and Bridge Works:

D. Location

- Identify areas having present land use as barren land, riverside land. Otherwise, un-irrigated agriculture land or land without vegetation and tree cover;
- Prefer borrow areas on bed of irrigation water storage tank;

- Prefer areas of highland with respect to surroundings;
- Avoid locating borrow area close to any road (maintain atleast 30 m distance from ROW and 10 m from toe of embankment, whichever is higher);
- Should be at least 1.5 km away from inhabited areas;
- Maintain a distance of about 1.5km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, wetland etc.;
- Maintain a distance of about 1.5 km from school, hospital and any archaeological sites;
- Having adequate approach road with minimum length of earthen road;
- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult;
- Depth of excavation should be decided based on natural ground level of the land and the surroundings, and rehabilitation plan. In case higher depth of excavation is agreed with backfilling by unsuitable excavated soil (from roadway), then filling should be adequately compacted except topsoil which is to be spread on topmost layer (for at least 20cm thick).

E. Operation

- Controlled operation as per agreed / approved plan;
- Preservation of topsoil at designated areas e.g. corners of the area etc.;
- Maintain necessary buffer zone in all directions and go for vertical cut within this area. Final cut slope should be maintained within the buffer zone;
- Step-wise excavation if borrow area is located on inclined area having more than 2% slope;
- Restricting excavation up to 2m for each stages of operation if allowed depth is more;
- Avoid cutting of any tree of girth size > 30cm17. if any tree cutting is inevitable, prior permission (written) from the competent authority should be taken and compensatory plantation has to be raised.

F. Rehabilitation

- Prior approval of Rehabilitation Plan considering terrain, land use and local need;
- Restricting operation as agreed by landowner and approved by the Engineer;
- Rehabilitation within agreed timeframe and before taking over;
- Integrate debris disposal and borrow area redevelopment.

G. Management Procedure

7. The important aspects of this procedure are:
   - The first and foremost thing is to have tentative estimate of borrow material requirement chainage-wise. For this, BoQ quantity for earth work, which is given as total quantity for the entire package/milestone, has to be distributed chainage-wise. The requirement of borrow material chainage-wise then has to be estimated based on the suitability of roadway excavation material for reuse and BoQ.
   - Contractor to site borrow areas fulfilling environmental requirements and obtaining one time approval of the Engineer both on quality as well as

[17] Plant having girth size more than 30cm is considered as tree.

environmental consideration thereby integrating environmental safeguard measures into day-to-day activities;

- Contractor to submit environmental information in prescribed format for obtaining Engineer's approval, as given in the following format (Borrow Area Identification). The format has been so designed that it stipulates the requirements as well as what is actual for each borrow areas and could be easily understood by any person, whoever in-charge of identifying borrow areas;
- Contractor to submit Borrow Area Layout Plan as attachment to the format showing the land use of the proposed and surrounding area along with the presence of other environmental features such as water bodies, forests, settlement, temple and any sensitive receptor i.e. health and educational institution, roads etc. within a radius of 1.5km area from the boundary of the borrow area;
- Contractor to prepare and submit Block Contour Map of each borrow area (especially which are located close to road and on undulating terrain) for deciding on operation and redevelopment plan;
- Contractor to prepare Operation Plan and submit as attachment to the format including cross sections on both directions (x,y) mentioning natural ground level, depth of topsoil (if any), total depth of excavation, cut side slope and bed slope;
- Contractor to prepare Redevelopment Plan and submit as attachment to the format include cross sections on both directions (x,y) mentioning natural ground level, excavated profile, finished profile after redevelopment etc.;
- Contractor to maintain Borrow Material Register;
- Periodic joint inspections of each borrow area until rehabilitation is complete as agreed and approved.
- The checklist for periodic inspection is given in this appendix.

Borrow Areas Identification

Construction Stage Report: One Time Date:
Location of Borrow Area (Ch. & Offset): Revenue Survey No.:

Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor & checked by Engineer)
1	Date of Borrow Area planned to be operational	
2	Current Land use (preference to barren land, riverside land, otherwise, un-irrigated agriculture land or land without tree cover)	
3	Size (Sq.m) and area (m x m) of Borrow Area	
4	Proposed maximum depth of pit in m (IRC 10 & Clause 305.2.2 of MoRTH Spec.)	
5	Details of riverside borrow area (inner edge should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top)	
6	Borrow area in cultivable land (should be avoided or restricted to total depth of 45cm including preservation of 15cm topsoil)	
7	Quantity Available (Cum)	
8	Quantity of top soil to be removed (Sq.m & depth in cm)	
9	Details of preservation (storage) and management (re-use / re-laid) of top soil	
10	Width of Haul road (m)	
11	Total Length of Haul Road (km)	
12	Length of Non-metal Haul Road (should be as minimum as possible)	
13	No of settlements within 200 m of Non-metal Haul Road (should be as minimum as possible)	
14	Distance from settlement (should be minimum 1500 m)	
15	Should be away from water bodies. Give details of water bodies within 250 m.	
16	Details of water sources for dust suppression	
17	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on haul road (Cum)	
18	Availability of water required for dust suppression (Cum)	
19	Details of ecologically sensitive area i.e. RF, PF, Sanctuary etc. within 1500m (should be nil)	
20	Details of school, hospital and any archaeological sites within 1500m (should be nil)	
21	Distance from nearby road embankment, fence line / boundary (should be minimum 30m from ROW and 10m from toe of embankment, whichever is higher)	
22	No of Trees with girth more than 0.3 m (No tree should be affected)	

Documents to be attached:

1) Site plan and layout plan of borrow area;
2) Proposed borrow area operation and redevelopment plan;
3) Written consent from competent authority for use of water for dust suppression
4) Written consent of landowner on agreed operation and redevelopment plan

Certified that the furnished information is correct and all relevant information as required is attached

Contractor’s Representative:

Checklist For Monitoring Borrow Area Operation & Management

Attributes	Requirements
Access road	• Only approved access road shall be used
Top soil preservation	• Top soil, if any, shall be stripped and stored at corners of the area before start of excavation for material collection; • Top soil should be re-used / re-laid as per agreed plan
Depth of excavation	• For cultivable (agriculture) land, total depth of excavation should be limited to 45 cm including top 15 cm for top soil preservation; • For riverside borrow area, the depth of excavation shall be so regulated that the inner edge of any borrow pit should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top; • If borrow area is located within 1500 m of towns or villages, they should not exceed 30 cm in depth and should be properly drained; • Borrow areas close to ROW should be rectangular in shape with one side parallel to center line of the road and depth should be so regulated that it should not cut an imaginary line having slope of 1 in 4 projected from the edge of the final section of the embankment.
Damage to surrounding land	• Movement of man & machinery should be regulated to avoid damage to surrounding land.
Drainage control	• The surface drainage in and around the area should be merged with surrounding drainage; • No water stagnation shall occur.
Dust suppression	• Water should be sprayed on *kutcha* (earthen) haul road twice in a day or as may be required to avoid dust generation during transportation of material; • Depending on moisture content, 0.5 to 1.5% water may be added to excavated soil before loading during dry weather to avoid fugitive dust emission.
Covering material transport vehicle	• Material transport vehicle shall be provided with tarpaulin cover
Personal Protective Equipment	• Workers should be provided with helmet, gumboot and air mask and their use should be strictly enforced.
Redevelopment	• The area should be redeveloped within agreed timeframe on completion of material collection as per agreed rehabilitation plan.

ANNEX 11: GUIDELINES FOR QUARRY AREA MANAGEMENT

A. Purpose

1. Quarries generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Quarries can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and social impacts of quarries.

B. Scope

2. These guidelines for quarries cover:
- statutory approvals
- environmental and social impacts of quarries
- selection of quarries
- operation of quarries
- rehabilitation of quarries

3. The guidelines seek to ensure that Contractors[18:]
- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

C. Impacts

4. Some of the potential impacts of quarries are:
- rock blasting causing air pollution, and noise and vibrations
- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations

5. The procedure for identification and finalization of quarry site/s shall be as given below:
- Estimating the quantity of quarry material to be collected from each quarry area
- Only licensed quarry will be used
- New quarry will be at least 1.5 km away from the settlement, forest and other ecologically sensitive areas
- Away from water body
- Contractor shall identify alternative quarry sites along the whole corridor based on required quantity and environmental consideration as given in the following prescribed format of Quarry source identification.

[18] The EMP stipulations will be applicable even if contract use existing licensed quarry. In case contractor use the existing licensed quarry a copy of the quarry license and lease / sub-lease agreement should be submitted to the Project Proponent. Contractor shall submit a plan delineating how he shall comply with requirements stipulated in this plan and elsewhere in the EMP on quarrying activity.

- Contractor shall submit to the Engineer the detailed information / documents as prescribed in the format;
- Engineer shall undertake site inspection of alternate quarry sites and convey to Contractor on accepting a particular quarry site on environmental consideration;
- Contractor shall then take apply and obtain Quarry Lease Deed / License from the Department of Mines and Geology and provide copy of the same to the Engineer prior to operation;
- Contractor shall estimate water requirement for dust suppression at quarry sites during operation and for water spraying on kutcha (non-metal) haul road and ensure availability water by identifying sources and obtaining necessary permission;
- Contractor shall prepare quarry sites operation and redevelopment plan considering surrounding land uses, local needs and agreement with the landowner;
- Only licensed blaster i.e. short-firer certificate holder will be responsible for quarry blasting
- Permits for transportation, storage and use of explosive, as will be required, shall be obtained from the Controller of Explosive;
- Whenever so advised by the Engineer, controlled blasting e.g. using less charge, restricting depth and dia or drill holes, cut-off blasting etc., shall be undertaken.
- Quarry operation will be undertaken in stages with adequate benching

6. The procedure for environmentally sound operation and management of quarry sites is given below:

- Estimating the quantity of quarry material to be collected from each quarry area;
- Demarcating the entire quarry area by fencing and putting red-flag poles;
- Providing adequate metallic access road;
- Preserving topsoil from the quarry compound, if any, by stripping and stacking aside separately at corners;
- Carrying out blasting as per agreed operational plan complying with the requirements of MoRTH Specification (Clause 302 & 303) and Ministry of Environment & Forests (MoEF) as given below;
- Maintaining a Quarry Material Collection Register on daily material collection for each of the quarry area, which shall be produced to Engineer's representative as and when requested;
- Redeveloping the area within 2 months (or as will be agreed upon) of completion of quarry material collection;

D. Use of Explosive for Blasting

1. General

7. Blasting shall be carried out in a manner that completes the excavation to the lines indicated in drawings, with the least disturbance to adjacent material. It shall be done only with the written permission of the Engineer. All the statutory laws, regulations, rules, etc., pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.

8. The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements. Prior to starting any phase of the operation the Contractor shall provide information describing pertinent blasting procedures, dimension and notes.

9. The magazine for the storage of explosives shall be built as per national / international standards and located at the approved site. No unauthorized person shall be admitted into the magazine which when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be displayed in the lobby of the magazine:

- A copy of the relevant rules regarding safe storage in English, Portuguese and in the language with which the workers concerned are familiar.
- A statement of up-to-date stock in the magazine.
- A certificate showing the last date of testing of the lightning conductor.
- A notice that smoking is strictly prohibited.

10. All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided to the satisfaction of the Engineer and in general not closer than 300 m from the road or from any building or camping area or place of human occupancy. In addition to these, the Contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer and shall be responsible for damage to property and any accident which may occur to workmen or the public on account of any operations connected with the storage, handling or use of explosives and blasting. The Engineer shall frequently check the Contractor's compliance with these precautions.

2. Materials, Tools and Equipment

11. All the materials, tools and equipment used for blasting operations shall be of approved type. The Engineer may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a length being cut as will permit sufficient time to the firer to reach safety before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators, fuses, etc., shall be fresh and not damaged due to dampness, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed from the site immediately.

3. Personnel

12. The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

4. Blasting Operations

13. The blasting shall be carried out during fixed hours of the day preferably during the mid-day luncheon hour or at the close of the work as ordered in writing by the Engineer. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.

14. The Contractor shall notify each public utility company having structures in proximity to the site of the work of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury. In advance of any blasting work within 50 m of any railway track or

structures, the Contractor shall notify the concerned Railway Authority of the location, date, time and approximate duration of such blasting operations.

15. Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200m and 500m from the blasting site in all directions for blasting at work site and quarry, respectively. People, except those who actually light the fuse, shall be prohibited from entering this area, and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning siren being sounded for the purpose.

16. The charge holes shall be drilled to required depths and at suitable places. Blasting should be as light as possible consistent with thorough breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

17. When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.

18. When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd of the copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire or twine. The primer shall be housed into the explosive. Boreholes shall be such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive inserted. The space of about 200 mm above the charge shall then be gently filled with dry clay, pressed home and the rest of the tamping formed of any convenient material gently packed with a wooden rammer.

19. At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a siren in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charges shall be lighted by the man-in-charge only. The man-in-charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the blasting site.

5. Misfire

20. In case of misfire, the following procedure shall be observed:

- Sufficient time shall be allowed to account for the delayed blast. The man-in-charge shall inspect all the charges and determine the missed charge.
- If it is the blasting powder charge, it shall be completely flooded with water. A new hole shall be drilled at about 450 mm from the old hole and fired. This should blast the old charge. Should it not blast the old charge, the procedure shall be repeated till the old charge is blasted.
- In case of charges of gelignite, dynamite, etc., the man-in-charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively, the hole may be cleared of 300 mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150 mm away and parallel to it.

This hole shall then be charged and fired when the misfired hole should explode at the same time. The man-in-charge shall at once report to the Contractor's office and the Engineer all cases of misfire, the cause of the same and what steps were taken in connection therewith.

- If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer for inspection to ascertain whether all the remaining materials in the box are also defective.

6. Account

21. A careful and day to day account of the explosive shall be maintained by the Contractor in an approved register and manner which shall be open to inspection by the Engineer at all times.

22. During quarry operation, periodic joint inspection should be carried out by the Contractor and Engineer's representatives.

23. A typical checklist for the same is given here.

Quarry Source Identification

Construction Stage Report: One Time Date:
Supervision Consultant: SMEC Contractor: Contract Package:
Location of Quarry (Ch. & Offset):

Sl. No.	Item / Requirement	Details as per Actual
1	Present land use (bare land with no prominent vegetation is preferred)	
2	Predominant wind direction	
3	Size and area of Quarry (m xm & Sq.m)	
4	Quantity Available (Cum)	
5	Quantity proposed to be collected (Cum)	
6	No of Trees with girth more than 0.3 m	
7	No Settlement within 1500 m of Quarry	
8	No water body within 1500 m of Quarry	
9	Width of Haul road (m)	
10	Total Length of Haul Road (km)	
11	Length of Non-metal Haul Road (km) (should be as minimum as possible)	
12	No of Settlements within 200m of Non-metal Haul Road (should be as minimum as possible)	
13	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on non-metal haul road (Cum)	
14	Details of Water sources for dust suppression	
15	Availability of water required for dust suppression (Cum)	

Documents to be attached:

1) Site plan and layout plan of quarry site
2) Proposed quarry site operation and redevelopment plan
3) Written consent / lease agreement with the Department of Mines & Geology
4) Written consent from competent authority for use of water for dust suppression

Certified that the furnished information is correct and all relevant information as required is attached

Contractor's Representative:

Details to be inspected for Monitoring Quarry Area Operation & Management

Attributes	Requirements
Access road	• Only approved access road shall be used
Top soil preservation	• Top soil, if any, should be stripped and stored at designated area before start of quarry material collection; • Top soil should be re-used / re-laid as per agreed plan
Controlled blasting & safety	• Storage of explosive magazine as per threshold quantity with all the safety measures; • Handling of explosive by licensed blaster only; • Use low intensity explosive; • Check unfired explosive, if any, before drilling; • Carryout blasting at lean time only; • Cordoned the area within 500m radius with flagmen having whistle for signaling preparedness; • Using properly designed audio visual signal system i.e. siren and flagmen for blasting; • Keep ready an emergency vehicle near blasting area with first aid facility and with active emergency response system.
Damage to surrounding land	• Movement of man & machinery should be regulated to avoid damage to surrounding land.
Drainage control	• The surface drainage in and around the area should be merged with surrounding drainage;
Dust control	• Haul road should be made metallic; • Suitable dust arrester for drilling; • Water spraying at quarry complex, if required.
Covering material transport vehicle	• Material transport vehicle should be provided with tail board, and cover
Personal Protective Equipment	• Workers shall be provided with helmet, safety shoes, ear muffler and air musk and their use should be strictly enforced.
Redevelopment	• The area should be redeveloped within two months (or as agreed) on completion of material collection as per agreed plan.

ANNEX 12: DETAILS OF THE PUBLIC CONSULTATIONS AND ISSUED DISCUSSED

A. Details of Public Consultations

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
1.	Date: 17 September 2014 Village: Bhalok District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn't acquire more than 30M (100 ft).	19 Participants (12 man and 7 women) from village community including village heads, teachers, housewife, business owners, labours, farmers and students.

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
2.	Date: 15 September 2014 Village: Dailong District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	13 Participants (8 man and 5 women) from village community including village housewife, business owners, labours, and farmers.

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
3.	Date: 16 September 2014 Village: Gadailung District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	09 Participants (6 man and 3 women) from village community including villages heads, councillors, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
4.	Date: 16 September 2014 Village: Puching District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	11 Participants (8 man and 3 women) from village community including villages heads, ward members, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
5.	Date: 05 October 2014 Village: Wairangba District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	21 Participants (16 man and 5 women) from village community including villages heads, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
6.	Date: 06 October 2014 Village: Waphong District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn't acquire more than 30M (100 ft).	16 Participants (9 man and 7 women) from village community including village heads, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
7.	Date: 06 October 2014 Village: Yairong District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	14 Participants (06 man and 08 women) from village community including government servants, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
8.	Date: 07 October 2014 Village: Bakuwa District: Tamenglong	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	08 Participants (05 man and 03 women) from village community including government servants, housewife, business owners, labours, farmers and students

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
9.	Date: 08 October 2014 Village: Kunchup Bagla District: West Imphal	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn’t acquire more than 30M (100 ft).	09 Participants (07 man and 02 women) from village community including government servants, housewife, business owners, labours, farmers and students

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Sl. No.	Date and Location	Issues Discussed	Measures Taken	Participants
10.	Date: 08 October 2014 Village: Kunchup Chiru District: West Imphal	• Presence of protected areas around project areas, • Environmental issues in the areas, • Impacts of the project in environmental quality, • Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village. • Importance of road to the development of village • Peoples are aware about the project. • People perceived that subproject road will provide better transport facility and save time, money, and generate employment • No negative impacts perceived by the people. • An underpass/foot over bridge has been demanded by peoples due to major transition of the peoples, Pets, including children and women to both side of the Market. • Compensation should be in mode of cash for land and structure both. • Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered. • People will provide social and moral support to the project authority. • Local people will protest if govt will acquire more than 30M (100 ft)	• The subproject road will provide better road connectivity to the nearby facilities. • Proper safety measures for new road should be proposed in the design and it should be strictly follow during construction. • Employment to local skilled and unskilled laborers should be preferred during road construction and operation. • Compensation should be given for structure loss at earliest. • Effected CPR should be built by Govt. before starting of construction. • Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons. • Compensation should be distributed at least 6 month before from demolish of structure. • Compensation should be paid by Cheque to genuine person. • Govt. shouldn't acquire more than 30M (100 ft).	13 Participants (09 man and 04 women) from village community including government servants, housewife, business owners, labours, farmers and students

B. Photographic record of Public Consultation

Consultation at Kanchup Chiru

Consultation at Kanchup Bangla

Consultation at Gadailung

Consultation at Khebuching

Consultation at Khebuching

Consultation with Women Group in Tamenglong


Consultation at Wairangba


Consultation at Wairangba


Consultation at Wapong


Consultation at Yairong

C. Attendance sheet of Public Consultation

BHALOK-III

4. List of Participants

Name	Profession	Age	Sex	Signature
Agarian	Chairman	53		Agarian
Nampinin	Farmer	52	m	[illegible]
Kinglin	N/A	39		Kinlin
R. Lengi	Farmer	39	M	R. Lengi
Nandiaf	"	53	m	[illegible]
Nam Thmrei	"	56		Nam Thmi
Maneigong	"	60		Maneigong
Gaichampou.	Village Sec	30	m	[illegible]
Thinlinang	N/A	35	M	[illegible]
Pouyangliung	farmer	60	M	Poujangliung
Rajuak	"	40	M	Rajuak

FGD Questionnaire

Page 3 of 4

DAILONG

Name	Profession	Age	Sex	Signature
Songampou	Village Secy	46	M	Songampou Pamei
Keijinbui	DVA chairman	40	M	Keij
Huthonang	DVA Member	47	M	[illegible]
Sangpingmang	-do-	50	M	[illegible]
Rikeu	-do-	48	M	Rikiu
Manipou	-do-	48	M.	Manipou
Ahumi	-do-	50	M	Ahumi
Gaidim	do-	56	M	Gaidim
Chunghlungang	-do	49	M	[illegible]
Lungliang	-d-	55	M	[illegible]
Daiaogoaing	-do-	54	M.	[illegible]
Pr. Magupou	DVA Joint Secy	M	40	Pr. Magupou
Dinman	Youth Secy	M	32	Din
Hiamkamang	Youth Vice-President	M	36	Hiamkamang
Keikofpou	Youth Member	M	28	Keikofpou
Somdiyang	-do-	M	26	Somdi

UIADAILUNU

	Name	Profession	Age	Sex	Signature
1	Furkoulung Ngoitu	Chairman	54	M.	[illegible]
2	Namloi Gabmei	Secy, Gadailong	40	M	K. Gamlo
3.	Keiheyoung	NMC chairman	45	M	Keiheyoung
4.	T.P. Ngoudiu	Ex-Chairman	56	M	[illegible]
5.	Ramsung.	Ex chairman	64	M.	[illegible]
6.	Thuidimang Gonmei		33	M	[illegible]
7	Neamseikeiliu	Housewife	50	F	Niamseikeiliu
8	Neithonliu	Housewife	30	F	Meithonliu
9	Ludia	House wife	27	F	Ludia
10.	Azeiliu	House wife	30	F	Azeiliu
11.	Nino	House wife	25	F	Nino
12	Azin	House wife	24	F	Azin
13.	Lukin	Housewife	31	F	Lukin
14.	Chingkhinliu	Housewife	50	F	Chingkhinliu
15.	Sakimliu	Housewife	53	F	Sakimliu
16.	Pousong NG.	# SERVICE	56	M	Pousong NG.
17.	Liangmunbou	Student	15	M	Liangmunbou
18	L.K. Kaguigai	Student	17	M	L.K. Kaguigai
19	Gaithanlung.	Service.	38	M	[illegible]
20.	Ph. Athani	unemployed	33	M	[illegible]

VILL- PUCHINUI (KHEBUCHINUI)

Mbl. No 9402735988

Name	Profession	Age	Sex	Signature
Ramichonang Gonme	Vill. chief	48	M	[signature]
N. GONMEI POUJAN	Khunbu	70	M	W. Gonmei 14/X/14
GAIGONGLUNG	Teacher	35	M	[signature] 14/10/14
Ramjuang	Vill. Member	50	M	[signature]
Thuankamang	vill member	30	M	[signature]
Gaiseilung	- do -	40	M	[signature]
Akhaengmei	- do -	40	M	Atesmy
Shangpinliu	- do -	40	F	Ajin
Lungchuiliu	- do -	30	F	Achui
Shangjwanang	'do'	35	M	[signature]
Gairiliu	'do'	34	F	Gairiliu
Kahaolung	- do -	32	M	Kahaolung

VILL- WAIRANUTBA - II

Name	Profession	Age	Sex	Signature
Peilanlung Panmei.	V/A. Sec.	39	m	
Dingiam.	V/A.	60	m	
Ramdum	–	56	m.	
Meingun	•	78.	m.	
Riangsingam	Peipou	72	M	Rengsingam
Hupandi	Youth Scy	31	m	
Dinthuilung	Farmer	39	m	Dinthuilung
Phenrongdin	Farmer	54	m	Pom
Ringsinlung	Farmer	62		Asin
Kiusang	Caticist	50	m	
Gaisondai	Farmer	28	M	Gaisondai
Gamthuan	Farmer	39	m	Gamthuan
Kiuchuangsei	Farmer	36	m	Kiung
Ajuam Kamei.	V/A. Vice Chair.	53	m	
Singbonang		50	m	
Akhi.	Pastor	63	M	Akhin

ANNEX 13: DETAILS OF TRAINING PROGRAM

Module	Title	Objectives	Duration (Day)	Participants
1	Environmental Legislations and Bank's Safeguard Policies	• Brush up latest on environmental legislations • Brush up safeguard policies	1	PIU and CSC staff
2	Environmental Supervision and Monitoring	• EMP requirements • Implementation, Supervision and Monitoring Mechanism • Provision made in Contract Documents for Works • Provision made in contract Agreement for Supervision Services	1	PIU and CSC staff
3	Orientation Workshop on EMP Implementation	• EMP requirements • Implementation, Supervision and Monitoring Mechanism • Roles and Responsibilities of Contractors and SCs	1	PIU, Contractor and CSC
4	Focused Training on Specific Issue/s (three during course of implementation)	• Analyzing problems, referring stipulations in Contract and EMP and agreed to feasible solution within specified timeframe	0.5	PIU, Contractor and CSC

ANNEX 14: REPORT ON VEGETATION ASSESSMENT STUDY

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ADB	-	Asian Development Bank
CAMP	-	Conservation Assessment Management Planning
CITES	-	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cu m	-	cubic meters
DBH	-	Diameter at Breast Height
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
GoI	-	Government of India
ha	-	hectare
IUCN	-	The World Conservation Union
m	-	meter
sq m	-	square meter

I. INTRODUCTION

A. Project Background

1. This report summarizes the findings and results of the vegetation surveys carried out along the proposed alignment of Imphal-Kanchup-Tamenglong Road (subproject) section. This is a non-sample subproject covered under Tranche 1 of Asian Development Bank's (ADB's) SASEC Regional Road Connectivity Investment Program in India. The subproject road is located in Manipur State of India.

2. The project road starts at Imphal City and ends at Tamenglong covering a total length of 111.055 kms. The alignment passes through districts of West Imphal, Senapati, and Tamenglong connecting major settlements Imphal, Kangchup, Haochong, Bhalok and Tamenglong. The initial 15 km of project road alignment from Imphal to Kangchup is an existing road in plain terrain, whereas alignment between Kangchup to Tamenglong (about 96 km) is new green-field alignment mostly located in mountainous terrain. The present road section is proposed for improvement and upgradation to four lane (in plain areas) and two lane (in hilly terrain) configurations with shoulders and side drains.

B. Study Background

3. About 96 km length of the proposed alignment is new green-field passing through hilly terrain mostly with patches of vegetation and forest areas. It is reported that the proposed alignment passes through protected forest /reserve forests of Senapati Forest Division and Western Forest Division (Tamenglong) of Manipur. About 1.9 km length passing through Kanchup Reserve Forest and remaining section passing through protected (unclassed) forests of Tamenglong Forest division.

4. This vegetation study has been carried out as an integral part of the environmental impact assessment (EIA) study[19] of the subproject road. The vegetation study covers assessment of existing floral habitats and species along the proposed alignment of the project road and likely impacts of road construction and operations on the existing flora in the project areas.

C. Objectives of the Study

5. The main objectives of this vegetation study are to focus on valuable forest resources and other significant vegetative features along the proposed alignment of the road project. Specific objectives are:

- To access the vegetation pattern of different forest patches along the proposed alignment,
- To calculate volume of the tree species, which are likely to impacted during the construction of project road and inundated after the construction of road,
- To enumerate protected, endangered and rare plant species in the forest patches along the proposed project road,
- To determine the possible ecological significant areas along the proposed alignment, and
- To find the mitigation measures of loss of plant species during road construction.

[19] The Environmental Impact Assessment (EIA) for the proposed subproject has been carried out as part of project preparation and in compliance with Environmental Assessment and Review Framework (EARF) for the Project.

D. Limitations

6. The study was planned to carry out in dry season (winter in month of December14 – January 15) and executed accordingly. Efforts were made to lay sample plots in proposed right of way but due to slope in hilly terrain some of the areas were not accessible. Therefore vegetation study for such sloppy areas was taken within the vicinity of the proposed alignment.

Picture 1: Measuring DBH on existing Imphal -Kangchup road section

II. METHODOLOGY

7. The focus of this vegetation assessment was a corridor of 100m along the proposed alignment and specifically areas within the proposed right of way (RoW) of the road or on the both sides along the proposed alignment. The number and location of sample plots were predetermined on the basis of existing diversity and density of floral / vegetative species. Therefore most of the sample plots were laid exactly on the predetermined location whereas few sample plots were laid along the proposed alignment due to difficulty in accessibility. Altogether 22 sample plots were laid along the survey area.

A. Vegetation Survey (Tree, Shrub, Herb)

8. Out of 22 sample plots, two were laid in Kangchup Reserve Forest area, seven were laid in Tairenpokpi Tamenglong Protected Forest area, seven were laid in the area of Kangchup Leimakhong Irang Protect Forest and six sample plots were laid in un-class forest area of Tamenlong district. Each sample plot was located in such a way that it either within the proposed RoW of the alignment or in close to the right of way of the alignment. Synopsis of all sample plot taken is given in Appendix A.

9. The number and location of sample plot were already determined therefore point sampling method was applied during the survey.

B. Sample Size

10. Samples were taken within the sample plot of 400 sq m area (20 m × 20 m). Sample plot of 400 sq m was for the enumeration of tree species, shrub species and herb species (Figure 1). In total 22 sample plots, (400 sq m) were laid for the vegetation study.

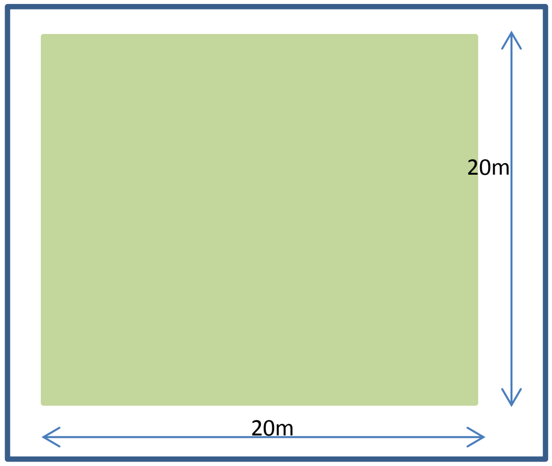

Figure 55: Diagrammatic representation of sample plot

C. Data Collection

11. The environmental variables at each sample plot such as aspect, slope (inclination), latitude, longitude, altitude etc were measured by Global Positioning System (GPS), visual observation and with the help of Topo sheet and subsequently plots taken were marked in Topo sheet.

12. In the survey forms data on trees and undergrowth (herbs and shrubs) were collected and documented. Diameter at Breast Height (using DBH meter), approximate height, crown coverage (visual estimation) and number of seedlings were measured for trees. Number of plant species, average height and coverage percentage were recorded for undergrowth. Format for the vegetation survey is given in Appendix B.

13. Most of the plant species were identified during field survey. Local name of the plants were identified with consultation of local people. Plant samples were made and photographs were taken for unidentified species in the field. These were identified by consultation with experts and using reference of books by Polunin and Stainton (1984), Stainton (1988) and Ghimire *et al.* (2008). Local, English and Scientific name and their proper citation were made with the help of working plans of Department of Forests (Manipur) and books by Shrestha (1998) and Press *et al*. (2002).

D. Analysis of Data

14. Ecological study of herbs was conducted following the methodology proposed by Raunkiaer (1934) and Zoebel *et al*. (1987) while the percentage coverage was estimated by employing visual observation.

1. Frequency and relative frequency:

$$\text{Frequency} = \frac{\text{No. of quadrats in which species occured}}{\text{Total Number of quadrats studied}} \times 100$$

$$\text{Relative Frequency (RF)}\,\% = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100$$

2. Density and relative density:

$$\text{Density Pl/ha} = \frac{\text{Total number of plant of any species}}{\text{Total number of quadrat studied} \times \text{area of quadrat}} \times 10000$$

$$\text{Relative Density (RD)}\,\% = \frac{\text{Density of individual species}}{\text{Total density of all species}} \times 100$$

15. Calculation of basal area was performed using the formulae being used by forest department for similar work.

Basal Area (BA) = Area occupied at breast height = $\pi d^2/4$ *or* πr^2

16. Volume (V) will be calculated with the help of volume table published by the Government of Nepal, Ministry of Forest and Soil Conservation, Forest Survey and Statistics Division, Publication number 48, (Sharma and Pukkala 1990).

*Ln (V) = A + B * Ln (D) + C * Ln (H)*

In this equation,

V= Total stem volume with bark

A, B and C are constant numbers which vary according to species. In our case, we kept the values of A, B and C as per the constant given to trees of midhills.

D= Diameter at Breast Height (in cm)

H= Height in Meter

17. To obtain the stem volume in cubic meters, as it is presented in the volume tables, the model prediction must be divided by 1000.

3. Volume of individual trees survey area

18. Volume of individual trees was calculated using the equation proposed by Sharma and Pukala (1990). Average DBH and average height of all trees of particular area was taken and the same was used in the equation. Finally, average volume was calculated by multiplying the density with volume in cu m.

 

Picture 2: Determining the sample plot size (left) and taking the data of sample plot (right).

III. FINDINGS

19. This chapter is divided into five parts. First part describes the vegetation and flora of the study area in holistic manner. Second part is about the volume of trees. Similarly, third part focuses on specific observations. Fourth part identifies the sensitive taxa or habitat and fifth part recommends the mitigation measures.

A. Existing Vegetation and Flora

20. Secondary information was used to understand the vegetation and flora of Kangchup Reserve Forest areas in Senapati district and Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest areas and unclass forest in Tamenglong districts.

1. Kangchup Reserve Forest

21. Kangchup Reserve Forest is located between latitudes The Kangchup Reserved Forest is situated between $24^{0}52'$N to $24^{0}54'$N Latitude and $93^{0}46'$E to $93^{0}49'$E Longitude towards west of Imphal valley on Imphal-Kangchup Road. It covers an area of over 960 hectare with highest elevation of about 1907m above MSL. The Reserve Forest represents low to mid-hill flora, fauna and ecosystems. The Kangchup RF is under jurisdiction of Northern Forest Division, Senapati District.

22. The forests of Senapati District consists of forests types viz. Tropical moist deciduous, Northern sub tropical broad leaved hill forests and Northern Montane wet temperate forests. Table 1 describes the major forest types of Northern Forest Division, Senapati District, along with altitude and dominant species.

Table 106: Forest and Vegetation Types in Northern Forest Division, Senapati District, Manipur (as per Champion & Seth Classification)

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
1	Upto 900	Group-3 (Tropical moist deciduous forests)	Sub-group 3C/3b	East Himalayan moist deciduous forests	*Quercus semiserrata Q. griffithii, Castanopsis hystrix, C. armata, Q. pachyphylla, Schima wallichii, Engelherdtia spp. Alnus nelpalensis, Amoora rohituca,*

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					Eugenia precox, Lagestroemia spp., Termanalia myriocarpa, Duabanga grandiflora, Cinnamomum spp., Sterculia villosa, Cedrella serrata. Phyllanthus excelsa, Ficus cunii, Bauhinia purpurea, B. variegata, Callicarpa arborea, Macaranga peltata, Mussaenda frondosa, Ficus glomerata, Celtis australis, Erythrina indica, Pterocarpus acerifolium, Terminalia citrina, Albizzia lebbeck, Mallotus philippensis, Hymenodictyon excelsum, Rhus semialata, Pandanus spp, Aphanomixis polystachya, Canarium strictum, Careya arborea, Chukrassia tabularis, Dillenia pentagyna, D. indica, Macaranga denticulata, Stereospermum personatum, Desmodium, Impatiens, Mimosa, Oxalis, Melastoma malabathricum etc.
2	1000-1800	Group-8 (Sub tropical broad leave forest)	Sub-group 8b	Northern sub tropical wet hill forests	*Alnus nepalensis, Albizzia spp., Betula alnoides, Castanopsis tribuloides, Cinnamomum glauceseens, Elacocarps spp., Engelherdtia spicata, Erythrenia stricta, Magnolia insignis, Michelia cathcartii, Termanalia myrioacarpa, Schima wallichii, Pheobe hainesiana, Albizzia spp., Rhus semialata, Syzygium Jambos, recea, Balsaminaceae, Bignoniaceae, Commelinaceae, Zingiberaceae, etc*
3	1500-2500	Group-11 (Montane wet temperate forests)	Sub-group C 1	East Himalayan wet temperate forests.	*Acer oblongum, Alnus nepalensis, Betula alnoides, Castanopsis armata, C. castanicarpa, C. pupurella, Cinnamomum, Eleocarpus, braclanus, Engelherdtia spicata, Magnolia insignes, Quercus griffithii, Phoebe hainesiana etc. Prunus cerasoides, Rhododendran arboreum, R. Johnstoneanum, R. triflorum, Vibernum spp., Ardisia depressa, Clerodendron wallichii, Celastrus peniculatus, Panax pseudoginseng, Mountain bamboo, (Yushania maleng) etc.*
4	Above 2500		Sub-group	Northen	*Aconitum elwesii, A nogarum,*

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
			11b	Montane wet temparate forests	*Berberis manpuana, B. sublevis, Corydalis chaerophyllas, Dichroa febrifuga, Mahonia manipurensis, M. roxburghii. Rhododendrom elliotii, R. macabeanum, R. maddenii, R. wattii, Selinum striatum, Carex manipurensis, Cephalotaxus graffithii, C. manii, Taxus allichiana*

Source: Working Plan of Northern Forest Division Kangpokpi and Senapati Forest Division

2. Vegetation and Flora of Forests of Tamenglong District

23. The working plan for Western Forest Division describes forest flora of the forest under forest division of the Indo-Myanmar realm amalgamated with the floral diversity of Eastern Himalayas. The main species like *Michelia champaca, Phoebe hainesiana, Terminalia myriocarpa.* etc. is quite good in the northern areas. *Artocarpus chaplasha* and other miscellaneous species like *Cynometra polyandra, Gmelina arborea, Duabanga sonneratioides,* etc. are found growing particularly in the southern part of the Division.

24. As per Champion and Seth’s classification, the forest types of the Western Forest Division (Tamenglong) may be categorized as:

(a) Cachar Tropical Semi Evergreen Forest (2B/C2),

(b) East Himalayan Moist Mixed Deciduous Forest (3C/C3b), and

(c) Assam Sub-Tropical Pine Forest (9/C2).

Table 107: Forest and Vegetation Types in Western Forest Division, Tamenglong District, Manipur (as per Champion & Seth Classification)

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
1	Upto 760	Group-2 (Tropical Semi-Evergreen Forests)	Sub-group 2B/C2	Cachar Tropical Semi Evergreen Forest	*Michelia champaca, Phoebe hainesiana, Terminalia myriocarpa, Artocarpus chaplasha, Palaquium polyanthum, Bombax ceiba, Stereospermum personatum, Anthocephalus cadamba, Duabanga sonneratioides, Trewia nudiflora, Cordia odoratissima, Canarium resiniferum, Podocarpus neriifolia, Bischofia japonica, Alnus nepalensis, Machilus bombycina, Cynometra polyandra, Eugenia species, Vitex peduncularis, Pterospermum acerifolium, Pterygota alata, Protium serratum, Albizzia procera, Premna bengalensis, Gmelina arborea, Mesua ferrea, Dillenia indica, Melocanna baccifera, Dendrocalamus hamiltonii, Ficus cunea, Bauhinia purpurea, Aquilaria agallocha,*

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					Terminalia bellirica, Trema orientalis, Lagerstroemia speciosa, Sterculia vilosa, Aralia armata, Moubi/Muli (Malocanna baccifera), Hydrocotyle javanica, Eryngium foetidum, Andrographis paniculata, Cardamine hirsuta, Polygonum hpeceui, Amaranthus spinoses, Ophiopogon intermidims, Prunella vulgaris, Cyperus tegetum, Heliotropium indicum, Blumeopsis flora, Cymbopogon flexuosus, Fragaria species, Gerardiana heterophylla, Ranunculus seleratus, Primula species, Butea minor, Achyranthes aspera, Spilanthes acmella, Lycopodium indicum, Arisaema tortuosum, Hedychium flavum, Asclepias curassavica, Solanum nigrum, Amomum aromaticum, Linaria ramosissima, Desmodium microphyllum, Asperagus sps, Alpinia allughas, Begonia picta, B. palmata, Gynura cusimbua. Thysanolaena maxima, Plantago erosa, Polygonum barbatum, Scutellaria discolor, etc.
2	500-650	Group-3 (Tropical Moist Deciduous Forests)	Sub-group 3C/C3b	Moist Mixed Deciduous forest	*Quercus serrata, Q. griffithii, Castanopsis hystrix, Schima wallichii, Acer oblongum, Engelhardtia spicata, Alnus nepalensis, Syzygium cuminii, Eugenia praecox, Xanthoxylum budrunga, Cinammomum species, Bombax ceiba, Albizzia procera, A stipulata, Garuga pinnata ,Lannea grandis, Litsaea sebifera, Melia azaderach, Garcinia xanthochymus, Juglans regia, Celtis australis, Sapindus mukorossii, Kydia calycina, Litsaea polyantha, Albizzia lebbeck, Toona ciliata, Stereospermum chelonioides, Baccaurea raniflora, Bauhinia purpurea, Macaranga peltata, Erythrina indica, Terminalia citrina, Mallotus phillipensis, Rhus semialata, Ficus hispida, Spondias mangifera, Elaeocarpus floribundus, Syzygium jambos, Ficus auriculata, Trema orientalis, Emblica officinalis,*

SN	Altitude (m)	Group	Sub-Group	Forest types	Major Species
					Ficus semicordata, Microcos paniculata, Murraya paniculata, Canthium gracilipes, Symplocos paniculata, Zanthoxylum alatum, Wendlandia glabra, Oroxylum indicum, Magnolia pterocapa, Eurya japonica, Saurauja roxburghii, Morus alba, Melocanna baccifera and Dendrocalamus hamiltonii
3	800-1600	Group-9 (Subtropical Pine Forests.)	Sub-group C 2	Assam Sub-Tropical Pine Forest	*Pinus insularis, Syn. P. khasya, Syn. P. kesia, Quercus griffithii, Q.serrata, Q.species, Castanopsis species,* *Betula alnoides, Acer oblongum, Schima wallichii, Rhus species, Salix tetrasperma, Engelhardtia spicata, Lyonia ovalifolia, Rhododendron arboretum, Eurya japonica, Pittosporum, Photinia, Myrsine, Viburnum, Rubus, Indigofera, Agrotis, Brachypodium sylvaticum, etc.*

Source: Working Plan of Western Forest Division

B. Vegetation and Flora along the alignment of the Project Road

25. Primary data were analyzed to describe the vegetation of forests affected due to proposed alignment in Senapati & Tamenglong districts. While tree inventories done along the Imphal-Kangchup existing road. Vegetation survey started from Kangchup Reserve Forest area under Senapati district. A total of 22 sample plots were laid in Reserve, Protected & Unclass forest areas leading to active survey for 97 km long alignment. List of all the plant species along with scientific name, availability and IUCN status is given in Appendix C.

1. Flora along the project road in Kangchup Reserve Forest Area

26. Two sampling plots of 20x20 sq.m. size were laid in forest area where proposed alignment transverse the Kanchup Reserve Forest (RF). First sample plot was laid at (km 19+300), the entry point proposed alignment in the Kangchup RF area, and second was laid at (km 21+600). In total about 1.6 km length (19+100 to 21+700) of project road passes through this reserve forest area.

27. Although the land use for this section of the project road is classified as reserve forest, it is being used by local communities for agriculture purpose with patches of shrubs & trees in between. Taibangngou is most abundant shrub grown in the forest area. *Schima wallichii* (Usoi), *Eucalyptus citriodora Hook (Nasik) and Psidium guajava (Pungdon)* are dominant tree species of Kangchup RF area with a tree density of 125, 88 and 75 plants per hectare respectively. *Quercus lamellosa (Uyung) and Parkia timoriana (Yongchak) are* the major associated species in this area. All three dominant species are homogenously distributed along the proposed alignment in the reserve forest area (Table 3).

Table 108: Population parameters of major trees in Kangchup RF area

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	*Usoi*	*Schima wallichii*	125	29.41	100	18.18
2	*Nasik*	*Eucalyptus citriodora Hook*	87.5	20.59	50	9.09
3	*Pungdon*	*Psidium guajava*	75	17.65	50	9.09
4	*Uyung*	*Quercus lamellosa*	25	5.88	50	9.09
5	*Yongchak*	*Parkia timoriana*	25	5.88	50	9.09
6	*Kurao*	*Erythrina strica Roxb.*	25	5.88	50	9.09
7	*Nobab*	*Citrus maxima.*	25	5.88	50	9.09

Source: Field survey

2. Flora along the proposed alignment in Protected Forest Area

28. A total of twenty sampling plots (20x20 sq.m. sized) were laid in Senapati and Tamenglong districts in the protected (unclassed) forest along the proposed alignment. Out of these twenty plots, fourteen plots were laid in protected forest areas of Tairenpokpi Tamenglong and Kangchup Leimakhong Irang, seven sample plots in each forest area and other six were laid in unclass forest of Wairangba-Bhalok area under Tamenglong district. Vegetation along the protected forest area consists of bushes and shrubs with Jhum cultivation activities in between on less slope hills and hillside. Wa (Bamboo) is grown natural and also planted by local communities. While in agriculture fields Komla (Citrus sinensis) and Banana are commonly cultivated plants in this region.

29. Schima wallichii (Usoi), Cinnamomum zeylanicum (Ushingsha) and Nakaything were dominant tree species of tree species of Tairenpokpi Tamenglong Protected Forest area with the density of 168, 65 and 47 plants per hectare respectively. Wendlandia tinctoria (Fheija), Cedrela loona (Tairen) and Rhus sinensis/Semialata (Heimang) are the major associated species in the studied area. Among the listed species, Schima wallichii (Usoi) and Cinnamomum zeylanicum (Ushingsha) are the most common and uniformly distributed plant species in the area (Table 4).

Table 109: Population parameters of major trees in Tairenpokpi Tamenglong Protected Forest area

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	Usoi	*Schima wallichii*	167.86	30.13	71.43	15.63
2	Usingsha	Cinnamomum zeylanicum	64.29	11.54	14.29	3.13
3	Tairen	Cedrela loona	14.29	2.56	28.57	6.25
4	Fheija	Wendlandia tinctoria	25.00	4.49	14.29	3.13
5	Nakaything	-	46.43	8.33	14.29	3.13
6	Heimang	Rhus sinensis/Semialata	17.86	3.21	14.29	3.13
7	Jonding	-	21.43	3.85	14.29	3.13
8	Uthum	Bischofia javanica	10.71	1.92	14.29	3.13
9	Uree	Symplocos cochinchinensis	17.86	3.21	14.29	3.13
10	Heikru	Emblica officinalis	7.14	1.28	14.29	3.13
11	Kurao	Erythrina strica Roxb.	3.57	0.64	14.29	3.13
12	Theibong	Artocarpus intergrifolia	3.57	0.64	14.29	3.13

Source: Field survey

30. Gmelina arborea (Wang) and Schima wallichii (Usoi), were dominant tree species of tree species of Kangchup Leimakhong Irang Protected Forest area with the density of 375 and 65

plants per hectare respectively. Cedrela loona (Tairen), Pinus khesia (Uchan) and Khalam are the major associated species in the protected forest area. Among the listed species, Gmelina arborea (Wang) is the most common and uniformly distributed plant species in the area (Table 5).

Table 110: Population parameters of major trees in Kangchup Leimakhong Irang Protected Forest area

SN	Local Name	Scientific Name	Density	Relative Density	Frequency	Relative Frequency
1	Wang	*Gmelina arborea*	375.00	59.32	57.14	13.33
2	Usoi	*Schima wallichii*	64.29	10.17	57.14	13.33
3	Shahee		28.57	4.52	14.29	3.33
4	Tairen	*Cedrela loona*	14.29	2.26	42.86	10.00
5	Uyung	*Quercus lamellosa*	7.14	1.13	28.57	6.67
6	Khalam		25.00	3.95	28.57	6.67
7	Uchan	*Pinus khesia*	17.86	2.82	14.29	3.33
8	Chigonglei		3.57	0.56	14.29	3.33
9	Neem	*Azadirachta indica*	7.14	1.13	14.29	3.33
10	Uthangjing		7.14	1.13	14.29	3.33
11	Thangjee		10.71	1.69	14.29	3.33
12	Urhinga		3.57	0.56	14.29	3.33

Source: Field survey

3. Flora along alignment in Unclass forest of Tamenglong

31. A total of six 20 x 20 m2 sized sample plots were laid along the proposed alignment in the unclass forest area of Tamenglong district. Vegetation along this area consists of Wa (Arundinaria clarkei; Bamboo) as dominant plant in the region.

32. Gmelina arborea (Wang) and Heiret, were dominant tree species of unclass forest area of Tamenglong district with the density of 192 and 42 plants per hectare respectively. Quercus lamellosa (Uyung), Schima wallichii (Usoi) and Parkia timoriana (Yongchak) are the major associated species in the protected forest area. Among the listed species, Gmelina arborea (Wang) is the most common and uniformly distributed plant species in the area (Table 6).

Table 111: Population parameters of major trees in Unclass Forest Tamenglong

SN	Local Name	Scientific Name	Density (tree/Ha)	Relative Density	Frequency	Relative Frequency
1	Wang	*Gmelina arborea*	191.67	57.50	66.67	25.00
2	Heiret		41.67	12.50	50.00	18.75
3	Ushoi	*Schima wallichii*	16.67	5.00	33.33	12.50
4	Uyung	*Quercus lamellosa*	25.00	7.50	33.33	12.50
5	Yongchak	*Parkia timoriana*	16.67	5.00	16.67	6.25
6	Heining	*Sapondius pinnata*	4.17	1.25	16.67	6.25
7	Ubram		12.50	3.75	16.67	6.25
8	Shahee		12.50	3.75	16.67	6.25

Source: Field survey

4. Species Richness along the Proposed Alignment

33. Altogether 50 plant species were recorded during vegetation survey in the different study area along the proposed alignment. Species richness is least recorded in 1st sample plot surveyed in the protected forest with only one species. Species richness in Knagchup RF; in the 2nd & 3rd sample plot taken was recorded with 10 species. The plots in Kangchup RF were taken at the pocket area of Angiosperm conyzoides Linn (Khongjainapi) a shrub dominantly grown in the area. Highest species richness was recorded from 3rd and 9th sample plot along the alignment, with 8 and 9 different types of species (Figure 2).

34. Similarly, highest numbers of plants were recorded from 13th sample plot with 99 plants, followed by 32 plants in the 5th sample plot. Least number (3 nos.) of plants was recorded from the 19th sample plot with only one tree species (Figure 2). It is because of the presence of Wa (Bamboo) in that particular plot.

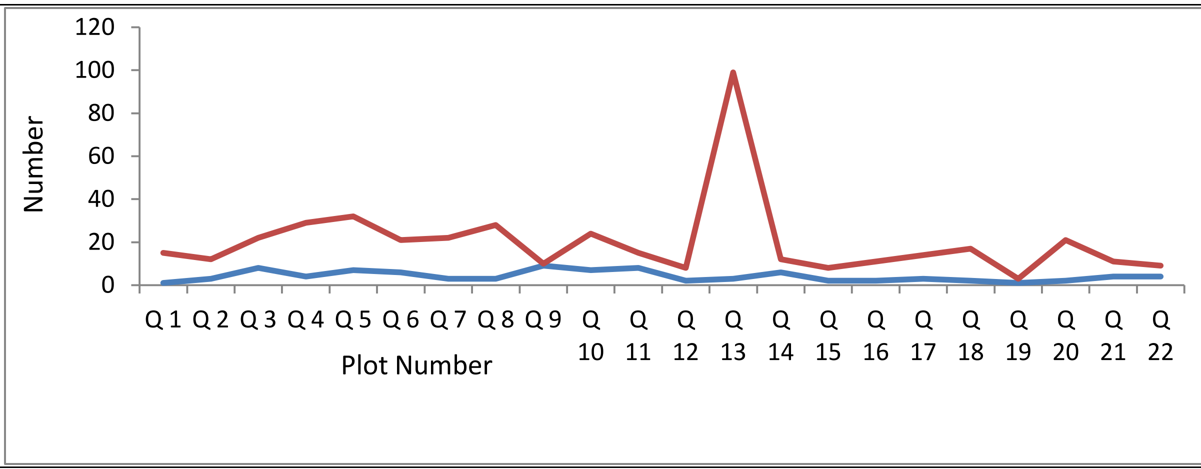

Figure 56: Species richness along the sample plots

C. Volume of Trees in Different Sample Plots

35. Volume of trees was calculated in different sample plots. Maximum tree volume was recorded in plot 13th sample plot at Tairenpokpi Tamenglong Protected Forest area with the value of 1260 cu. m per hectare followed by 8th sample plot at Kangchup Leimakhong Irang Protected Forest with the value of 1255.27 cu. m per hectare. Similarly, least tree volume was recorded in the 20th plot of unclass forest of Tamenglong district which have only 55.12 cu. m per hectare (Table 7).

Table 112: Volume of trees in each sample plot (formula used from FAO Forestry)

Plot No	Vol. per ha Volume in cubic meter per hectare	Ranking of volume in different plots
Q1	184.275	18
Q2	0	21
Q3	259.875	15
Q4	0	22
Q5	308.7	14
Q6	426.825	9
Q7	889.875	4
Q8	1255.275	2
Q9	418.95	10
Q10	1047.375	3
Q11	848.925	5

Q11	848.925	5
Q12	376.425	13
Q13	1260	1
Q14	220.5	17
Q15	385.875	12
Q16	609.525	6
Q17	439.425	8
Q18	559.125	7
Q19	149.625	19
Q20	55.125	20
Q21	242.55	16
Q22	406.35	11

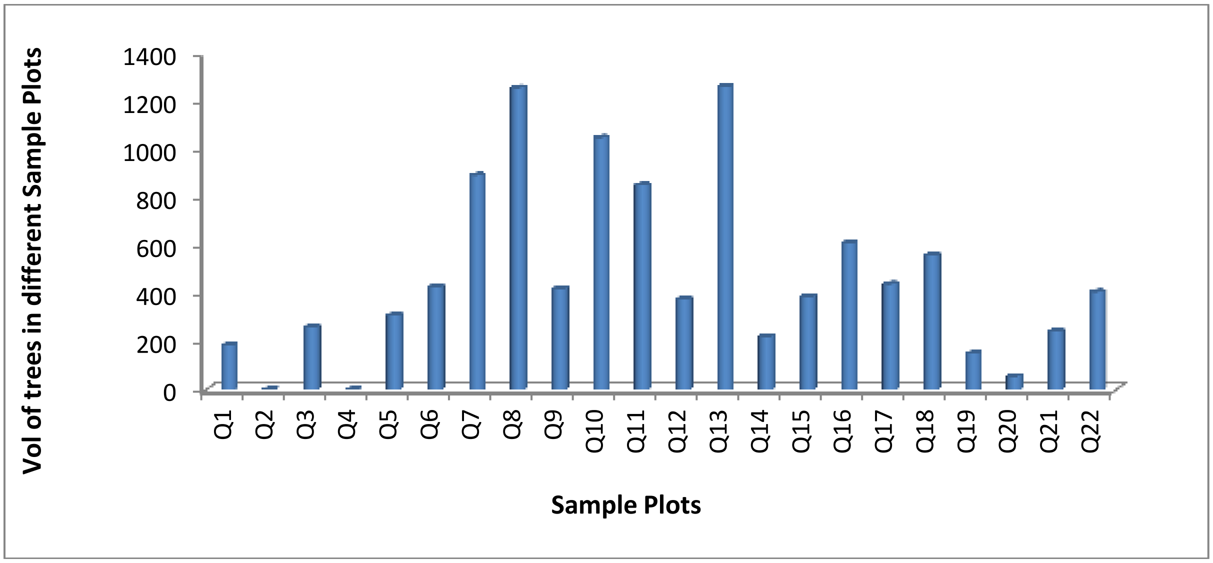

Figure 57: Volume of tress in different sample plots

36. As shown up earlier, a total of 22 sample plots were laid along the alignment in the forest areas. Two sample plots were laid at Kangchup RF area and average tree volume for the reserve forest is 129.93 cu m per hectare. The area has plenty of open grasslands and bushes therefore tree volume is low. A total of 14 sample plots were laid on the Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest region. Number of sample plots taken in this region was higher because the proposed alignment will be mostly through green fields in this region. Average volume in cubic meter per hectare of trees within the 7 sample plots on Tairenpokpi Tamenglong Protected Forest is 497.7. The figure is 678.3 for average volume in cubic meter per hectare of trees in 7 sample plots on Kangchup Leimakhong Irang Protected Forest. Similarly 6 sample plots were laid in unclass forest area of Tamenglong district. Average volume of trees in unclass forest area is 308.7 cu m per hectare.

D. Volume of Individual trees in Survey Areas

1. Volume of Individual trees in Kangchup RF Area

37. Volume of Schima wallichii was in Kangchup RF area with 366.75 cu m per hectare, followed by Parkia timoriana with 50.12 cu m per ha.

Table 113: Volume of major trees in Kanchup RF Area

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Schima wallichii*	2.934	366.75
2	*Quercus lamellosa*	1.722	43.05
3	*Parkia timoriana*	2.005	50.125
4	*Erythrina strica Roxb.*	0.85	21.25

2. Volume of Individual trees in Protected Forest area

38. Volume of Schima wallichii was maximum in Tairenpokpi Tamenglong forest area with 492.5 cu m per ha. Volume of Nakaything and Cedrela loona is 66.85 & 34.53 cu m per ha., respectively. (Table 9).

Table 114: Volume of major trees in Tairenpokpi Tamenglong Protected Forest

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Schima wallichii*	2.934	492.50
2	*Cedrela loona*	2.417	34.53
3	*Wendlandia tinctoria*	0.661	16.53
4	*Nakaything(Local Name)*	1.44	66.85
5	*Jonding (Local Name)*	0.834	17.87
6	*Emblica officinalis*	1.058	2.69
7	*Erythrina strica Roxb.*	0.85	3.03
8	*Artocarpus intergrifolia*	1.26	4.49

39. Volume of Gmelina arborea maximum was in Kangchup Leimakhong Irang Protected Forest area with 690 cu m per hectare, followed by Schima wallichii with 188.62 cu m per ha.

Table 115: Volume of major trees in Kangchup Leimakhong Irang Protected Forest

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Gmelina arborea*	1.84	690
2	*Schima wallichii*	2.934	188.62
3	*Quercus dealbata.Hook*	1.789	51.11
4	*Cedrela loona*	2.417	34.53
5	*Quercus lamellosa*	1.722	12.29
6	*Acacia nilotica*	3.96	14.16
7	*Azadirachta indica*	0.945	6.47

3. Volume of individual trees in Unclass Forest area

40. Volume of Gmelina arborea was maximum in unclass forest area with 352.67 cu m per ha, followed by Schima wallichii & Ficus cunia of 48.8 & 44.08 cu m per hectare, respectively. As anticipated, the volume of trees per hectare was less as in compared to protected forest areas area (Table 11).

Table 116: Volume of major trees in unclass forest area of Tamenglong

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
1	*Gmelina arborea*	1.84	352.67
2	*Ficus cunia*	1.058	44.08

SN	Scientific name	Average volume in cu m (individual tree)	Volume in cu m per ha for individual trees
3	*Schima wallichii*	2.934	48.9
4	*Quercus lamellosa*	1.722	43.05
5	*Parkia timoriana*	2.005	33.42
6	*Ubram (Local Name)*	1.854	23.17
7	*Quercus dealbata.Hook*	1.789	22.36

E. Specific Observations

41. This section describes specific recognizable features along the proposed alignment area. Photographs of the plots were taken where a suitable vantage point was available. The proposed alignment follow existing track made by local community in Protected Forest area of Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protect Forest. An old road known as IB road is also there which will be followed in some the sections of proposed alignmsent. The forest areas in Tamenglong district were inaccessible due to non-availability of motor able except IB road which is not in use any more.

42. The vehicles from Noney to Tamenglong are following the route of Wairnagba- Bhalok-Tamenglong. Because the construction of a new bridge on Irang River has been completed and the conditions of road in between Wairangba –II to Bhalok has been improved. The proposed alignment in this region will follow existing track which will result minimum loss of vegetation in the forest areas.

43. It was observed that the whole forest areas trees are cleared in patches for Jhum cultivation by communities. The large sized trees were mostly on hills with stiff slope where cultivation activities not performed. Most frequent plant species found along the forest area were *Gmelina arborea (Wang), Schima wallichii* (Usoi), *Cinnamomum zeylanicum (Ushingsha), Eucalyptus citriodora Hook (Nasik), Psidium guajava (Pungdon), Wendlandia tinctoria* (Fheija), *Cedrela loona* (Tairen) and *Rhus sinensis/Semialata* (Heimang) and *Ficus cunia (Heiret)* etc.

F. Status of Protected, Endangered and Rare Species

44. List of protected plant species enlisted by different organizations is given in table 7. Altogether six species and two groups (Anacardiaceae and Orchidaceae families) of protected species were recorded from the surveyed area.

Table 117: Protected, Endangered and Rare Species at Different Category

Species	Local Name	IUCN	GoI	CITES	Local Availability	Remarks
Renanthera imschootiana	Red vanda	NA	VI	A I	R	
Vanda coerulea	Blue vanda	NA	VI	A I	R	
Paphiopedilum spicerianum	Ladies slipper orchid	NA	VI	A I	R	
Cycas pectinata	Cycad	V	VI	A II	R	
Taxus wallichiana Zucc	Common yew or Birmi leaves	NA		A II	C	
Heimang	Rhus sinensis/ Semialata	NA			R	VUN

Abbreviations:
IUCN: T = Threatened, R = Rare, V = Vulnerable, LC = Least Concern

GoI: (Government of India, THE WILDLIFE (PROTECTION) ACT, 1972): Schedule VI = specified plants: Willfully pick, uproot, damage destroy, acquire or collect any specified plant from any forest land and area specified,
CITES: A I & II = Appendix I & II =species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled)
Local Availability: (Observation by vegetation survey team): A = abundant, C = common, R = rare

45. The orchid species listed as threatened on the International Union for Conservation of Nature (IUCN) Red List than species from any other plant family found in Manipur state. North East region of India is also considered as one of the mega biodiversity spot in terms of richness of flora and fauna diversity. In this region it is estimated about 876 orchid species in 151 genera are available.

46. The population of orchids is declining due to ruthless commercial exploitation, by the Convention on International Trade in Endangered Species (CITES) of wild flora and fauna, it is observed that habitat destruction is the major factor involved. Orchids prefer to grow in undisturbed forests area either in tree trunks i.e. epiphytes, or on the forests floor i.e. terrestrial or semi terrestrial, a large number of orchid species, which were once abundant in the forests, are now at the verge of extinction. Some of them have become so rare that it has become impossible to trace them in their natural habitat.

IV. CONCLUSION AND RECOMMENDATION

A. Conclusion

47. For the construction of proposed road alignment in forest area, vegetation was surveyed along the Kangchup RF, Tairenpokpi Tamenglong and Kangchup Leimakhong Irang protected forest and unclass forest of Tamenglong district as a part of Environmental Impact Assessment. A total of 22 sample plots were laid in the forest areas. Out of 22 plots, 2 were laid in Kangchup RF area, 7 each was laid in Tairenpokpi Tamenglong and Kangchup Leimakhong Irang protected forest area and 6 sample plots were laid in unclass forest area in Bhalok region of Tamenglong district. Square sample plot of the size of 400 sq. m was used during the survey.

48. The different forest types were recorded in the survey areas. Kangchup RF area is mixed representation Tropical moist deciduous, Northern sub tropical broad leaved hill forests and Northern Montane wet temperate forests, Tairenpokpi Tamenglong and Kangchup Leimakhong Irang protected forest area is typically represented East Himalayan Moist Mixed Deciduous Forest (3C/C3b) and Cachar Tropical Semi Evergreen Forest mixed with Assam Sub-Tropical Pine Forest. A total of 53 different tree species are represented in 22 sample plots, showing the homogeneity of forest.
49. In Kangchup RF area Schima wallichii (Usoi), Eucalyptus citriodora Hook (Nasik) and Psidium guajava (Pungdon) were dominant tree species of with the density of 125, 88 and 75 plants per hectare respectively. Angiosperm conyzoides Linn (Khongjainapi) is most common shrub in this area.

50. Schima wallichii (Usoi), Cinnamomum zeylanicum (Ushingsha) and Nakaything were dominant tree species of Tairenpokpi Tamenglong Protected Forest area with the density of 168, 65 and 47 plants per hectare respectively. Wendlandia tinctoria (Fheija), Cedrela loona (Tairen) and Rhus sinensis/Semialata (Heimang) are the major associated species in the studied area.

51. Gmelina arborea (Wang) and Schima wallichii (Usoi), were dominant tree species of Kangchup Leimakhong Irang Protected Forest area with the density of 375 and 65 plants per hectare respectively.

52. Gmelina arborea (Wang) and Ficus cunia (Heiret) were dominant tree species of unclass forest area of Tamenglong district with the density of 192 and 42 plants per hectare respectively.

53. Among the listed species, Gmelina arborea (Wang) is the most common and uniformly distributed plant species in the forest areas of Tamenglong district. Arundinaria clarkei (Wa/Bamboo) is abundant plant species and in between banana cultivation is done by community in the protected forest area.

54. Out of all the forest of survey area Kangchup RF (Senapati District) is in secondary successive stage and most of tree has been cut or cleared by community of the area, trees having diameter less than 10 cm at breast height and bushes are grown dominantly. The forest in Tamenglong district is in mixed stage i.e. primary/virgin and secondary stage. It shows that the forest was heavily destroyed by cutting and felling of trees earlier.

55. The volume of tress per hectare is recorded maximum of Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest region, attributed to large trees and higher number of trees per hectare. The volume of tress per hectare in Kangchup RF & unclass forest area is less compared to protected forest areas. This is due to Jhum cultivation activities by community along proposed alignment in Kangchup RF area. There is growth of bamboos and other bushes in unclass forest area of Tamneglong restricting large tree species growth in the area.

56. Altogether six species, two groups (Anacardiaceae and Orchidaceae) were recorded that falls under different conservation categories. Four species were protected by Government of India, one species by IUCN, and five species by CITES. Among the protected species, Cycas pectinata was kept under conservation category by all three i.e. GoI, IUCN and CITES.

B. Recommendations

57. Following recommendations were proposed for future intervention:

- Forests along the proposed road alignment are mostly at secondary succession stage with primary stage in between in accessible areas.
- Proposed road alignment will transect through some of agriculture fields and human settlement at five locations. The affect on human settlement and movement is negligible as in most of locations are on non-metallic road.
- Protected Forest areas in Tamenglong district are the area of high ecological value due to the habitat of certain medicinal plants, birds and mammals. Therefore, restriction on animal hunting and tree cutting during construction stage needs to implement.
- Compensatory plantation is mandatory for major species, which will be cleared due to project. Similarly, compensatory plantation is needed for those species, which have high ecological value and for the protected species.
- Forest clearances to be taken prior to commencement of construction activities for both reserve forest areas as well as for protected forest areas.

Appendix A: General Information of sample plots

Quadrant no. & Date	Coordinates	Elevation (m)	Location			Dominant species	Number of Trees	Forest Type
			Chainage (approx. km)	Aspect (Side)	Village Boundary			
Tairenpokpi Tamenglong Protected Forest								
1(28/12/14)	24°51'43.787" N 93°47'20.171" E		17+600	North-East (RHS)	Khanchup Chiru	Schima wallichii	15	Cachar Tropical Semi Evergreen Forest
Kangchup RF								
2(28/12/14)	24°52'2.052" N 93°47'2.343" E		19+700	East (RHS)	Khanchup Bangla	Eucalyptus citriodora Hook	12	East Himalayan moist deciduous forests
3(28/12/14)	24°52'29.646" N 93°46'49.316" E		21+400	North (RHS)	Khanchup Bangla	Schima wallichii	22	
Tairenpokpi Tamenglong Protected Forest								
4(28/12/14)	24°51'47.630" N 93°46'23.832" E		23+800	East (LHS)	Khanchup Bangla	Cinnamomum zeylanicum	28	Cachar Tropical Semi Evergreen Forest and Assam Sub-Tropical Pine Forest
5(29/12/14)	24°51'48.856" N 93°45'54.612" E		25+600	North (RHS)	Shonglung	Schima wallichii	32	
6(29/12/14)	24°51'45.344" N 93°45'26.306" E		26+700	North (RHS)	Shonglung	Schima wallichii and Jonding	21	
7(29/12/14)	24°51'57.684" N 93°44'26.982" E		28+300	East (RHS)	Shonglung	Nakaything & Symplocos cochinchinensis	22	
8(29/12/14)	24°52'27.488" N 93°44'1.230" E		30+500	North (RHS)	Shonglung	Schima wallichii & Cedrela loona	28	
9(30/12/14)	24°53'29.362" N 93°42'44.502" E		33+600	East (RHS)	Waphong	Cedrela loona & Erythrina strica Roxb.	10	
Kangchup Leimakhong Irang Protected Forest								
10(31/12/14)	24°54'22.930" N 93°41'54.587" E		39+200	West (LHS)	Ijeirong	Quercus dealbata.Hook & Schima wallichii	24	Cachar Tropical Semi Evergreen Forest, Moist Mixed Deciduous forest and Assam Sub-Tropical Pine Forest
11(31/12/14)	24°55'6.279" N 93°41'27.712" E		42+500	North (RHS)	Oktan	Pinus khesia & Azadirachta indica	15	
12(02/01/15)	24°54'56.058" N 93°40'18.564" E		46+600	East (RHS)	Oktan	Gmelina arborea & Schima wallichii	8	
13(02/01/15)	24°55'34.101" N 93°39'34.906" E		50+100	West (LHS)	Bakua	Gmelina arborea	99	
14(02/01/15)	24°55'31.055" N 93°38'53.856" E		52+500	West (RHS)	Nagaching	Ficus auriculata & Ficus cunia	12	
15(03/01/15)	24°53'47.523" N		61+100	West (LHS)	Lukhami	Gmelina arborea &	8	

Quadrant no. & Date	Coordinates	Elevation (m)	Location			Dominant species	Number of Trees	Forest Type
			Chainage (approx. km)	Aspect (Side)	Village Boundary			
	93°35'52.694" E					Schima wallichii		
16(03/01/15)	24°54'16.312" N 93°35'5.204" E		65+500	South (LHS)	Irang River	Gmelina arborea & Schima wallichii	11	
Unclass Forest, Tamenglong								
17(03/01/15)	24°54'22.280" N 93°34'23.732" E		69+600	South (LHS)	Wairangba-II	Ficus cunia & Quercus lamellosa	14	Cachar Tropical Semi Evergreen Forest and Assam Sub-Tropical Pine Forest
18(04/01/15)	24°55'23.952" N 93°32'41.434" E		72+500	East (RHS)	Khebuching	Gmelina arborea	17	
19(04/01/15)	24°55'35.629" N 93°32'23.797" E		73+000	West (LHS)	Khebuching	Ubram & Wa	3	
20(04/01/15)	24°56'33.325" N 93°32'6.359" E		74+800	East (RHS)	Bhalok	Gmelina arborea & Quercus lamellose	36	
21(04/01/15)	24°58'1.487" N 93°33'7.369" E		80+500	East (LHS)	Bhalok	Gmelina arborea & Schima wallichii	11	
22(04/01/15)	24°58'52.262" N 93°33'0.989" E		86+700	East (RHS)	Bhalok	Parkia timoriana, Gmelina arborea & Schima wallichii	9	

Appendix B: Plant site survey form for tree, shrubs and herbs

Data for sample plots (20m x 20m) at points 100mts on the left and right side of road

Date: Name of data collector:

Name of road section/point: Quad. #:

Slope: Aspect: Altitude:

Vegetative data (If species name is not known take photo and write photo #)

1.	**Canopy layer**	
No.	**Species/Common Name**	**No. of trees/Approximate percentage coverage**
2.	**Undergrowth**	

Data for Volume of Trees (Measure only trees with dbh > 10 cm)

No.	Tree species	Dbh	Height

Appendix C: List of Plants recorded along the Survey Areas

S.No.	Local Name	Scientific Name	Availability	Status (Endemic/Exotic)	IUCN Status
1	Chigonglei	*Acacia nilotica*	LC	Endemic	NA
2	Chumbrei	*Prunus cerasoides*	LC	Endemic	NA
3	Fheija	*Wendlandia tinctoria*	C	Endemic	NA
4	Heiba	*Ficus auriculata*	LC	Endemic	
5	Heikha	*Prunus domestica*	LC	Endemic	NA
6	Heikreng	*Celtis australis*	LC	Endemic	NA
7	Heikru	*Emblica officinalis*	C	Endemic	NA
8	Heimang	*Rhus sinensis/Semialata*	R	Endemic	VUN
9	Heining	*Sapondius pinnata*	LC	Endemic	NA
10	Heiret	*Ficus cunia*	LC	Endemic	
11	Ingo		R	Endemic	
12	Jonding		R	Endemic	
13	Khalam		LC	Endemic	
14	Khock	*Albizzia stipulata*	LC	Endemic	
15	Kurao	*Erythrina strica Roxb.*	C	Endemic	NA
16	Lamuk		LC	Endemic	
17	Manbi	*Allophylus cobbe*	R	Endemic	NA
18	Mirhi		R	Endemic	
19	Nakaything		R	Endemic	
20	Nasik	*Eucalyptus citriodora Hook*	C	Endemic	NA
21	Neem	*Azadirachta indica*	LC	Endemic	NA
22	Nobap	*Citrus maxima.*	LC	Endemic	NA
23	Nong-Ganghei		R	Endemic	
24	Nonthing		R	Endemic	
25	Oag		R	Endemic	
26	Pareng	*Alnus nepalesis*	LC	Endemic	NA
27	Pungdon	*Psidium guajava*	C	Endemic	
28	Saijik		LC	Endemic	
29	Shahee	*Quercus dealbata.Hook*		Endemic	
30	Sileima	*Eugenia pracox*	R	Endemic	NA
31	Shizou		R	Endemic	
32	Tairen	*Cedrela loona*	C	Endemic	NA
33	Tamuk			Endemic	
34	Thangjee			Endemic	
35	Theibong	*Artocarpus intergrifolia*	C	Endemic	NA
36	Thik			Endemic	
37	Thing			Endemic	
38	Uchan	*Pinus khesia*	C	Endemic	NA

S.No.	Local Name	Scientific Name	Availability	Status (Endemic/Exotic)	IUCN Status
39	Ujin			Endemic	
40	Uree	*Symplocos cochinchinensis*	LC	Endemic	NA
41	Urhinga			Endemic	
42	Usingsha	*Cinnamomum zeylanicum*	A	Endemic	NA
43	Usoi	*Schima wallichii*	A	Endemic	NA
44	Uthangjing	*Euryale ferox*		Endemic	
45	Uthum	*Bischofia javanica*		Endemic	NA
46	Uyung	*Quercus lamellosa*	A	Endemic	NA
47	Wang	*Gmelina arborea*	A	Endemic	NA
48	Wano			Endemic	
49	Yongchak	*Parkia timoriana*	A	Endemic	NA
50	Wa	*Arundinaria clarkei*	A	Endemic	NA
51	Khongjainapi	*Angiosperm conyzoides Linn.*	A	Endemic	NA
52	Banana				
53	Komla	*Citrus sinensis*	A	Endemic	NA

ANNEX 15: REPORT ON WILDLIFE ASSESSMENT STUDY

I. INTRODUCTION

A. Background

1. This report summarizes the findings and results of the wildlife assessment surveys carried out along the proposed alignment of Imphal-Kanchup-Tamenglong Road (subproject) section. This is a non-sample subproject covered under Tranche 1 of Asian Development Bank's (ADB's) SASEC Regional Road Connectivity Investment Program in India. The subproject road is located in Manipur State of India.

2. The project road starts at Imphal City and ends at Tamenglong covering a total length of 111.055 kms. The alignment passes through districts of West Imphal, Senapati, and Tamenglong connecting major settlements Imphal, Kangchup, Haochong, Bhalok and Tamenglong. The initial 15 km of project road alignment from Imphal to Kangchup is an existing road in plain terrain, whereas alignment between Kangchup to Tamenglong (about 96 km) is new green-field alignment mostly located in mountainous terrain. The present road section is proposed for improvement and upgradation to four lane (in plain areas) and two lane (in hilly terrain) configurations with shoulders and side drains.

B. Study Background

3. About 96 km length of the proposed alignment is new green-field passing through hilly terrain mostly with patches of vegetation and forest areas. It is reported that the proposed alignment passes through protected forest /reserve forests of Senapati Forest Division and Western Forest Division (Tamenglong) of Manipur. About 1.9 km length passing through Kanchup Reserve Forest and remaining section passing through protected (unclassed) forests of Tamenglong Forest division.

4. This wildlife study has been carried out as an integral part of the environmental impact assessment (EIA) study [20] of the subproject road. This study intends to document the mammalian species, type of fishes and the diversity of birds as well as the habitats of the wildlife present found in the forest area which will be impacted by the construction of proposed alignment of Imphal-Tamenglong road. This study also recommends the mitigating measures to the probable adverse impact to the habitat destruction and casualties to the wildlife.

C. Objectives

5. The specific objectives of the undertaking were to:

- Document the wildlife (mammalian, reptiles, birds & fishes species) present in the project area
- Identify the valuable ecological habitat of the species and wild animal movement tracks corridor across the proposed alignment
- Identify the possible impacts that the implementation (construction and operation) of the proposed project will bring about on the forest fauna and their habitat

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[20] The Environmental Impact Assessment (EIA) for the proposed subproject has been carried out as part of project preparation and in compliance with Environmental Assessment and Review Framework (EARF) for the Project.

- Recommend pragmatic measures to mitigate the impact of the proposed project on wildlife and their habitat

D. Methodology

6. Several methods including literature review, direct field sightings by transact walk, discussions with local communities, consultations with local (field level) forest officials etc. were used to collect data of presence of wildlife in the project areas. These methods are described below.

E. Literature Review

7. List of forest fauna (species of mammals, reptiles, birds & fishes) recorded from Northern Forest Division, Kangpokpi and Senapati Forest Division and Western Forest Division, Tamenglong were collected using the secondary source. In addition to this; stake holder consultation undertaken with government agencies responsible for forest resources of the area.

F. Direct Sightings

8. Wildlife sighted directly was recorded and their locations (GPS Coordinates and Elevations) were recorded with topographic maps. Additionally, the habitat attributes of the area of the sightings were also recorded. Habitat attributes included the vegetation types and coverage, proximity from water bodies, aspects, etc. Altogether 22 random line transects of varying lengths were set up in and along the project alignment area in order to document any direct wildlife observations encountered.

9. Out of 22 line transects, three were laid in Kangchup Reserve Forest area, six were drawn in Tairenpokpi Tamenglong Protected Forest area, seven were set up in the area of Kangchup Leimakhong Irang Protect Forest and six sample plots were taken in un-class forest area of Tamenlong district. Each line transect was located in such a way that it either within the proposed RoW of the alignment or near to right of way of the alignment. Synopsis of all studied transect line is given in Appendix 1.

G. Study Site

10. Kangchup Reserve Forest and Kangchup Leimakhong Irang Protected Forest area were in Senapati district and comes under jurisdiction of Northern Forest Division, Kangpokpi. The protected forest areas of Tairenpokpi Tamenglong and unclassed forest area in Tamenglong district under jurisdictions of Western Forest Division, Tamenglong.

1. Transect Details

11. Altogether 22 transects were taken along the proposed alignment during the survey. The beginning and end point of GPS coordinates, elevation, aspect and forest area was taken. Location of transects and the name of village boundary were also recorded while setting up the transect line (Table 1).

2. Sign Survey

12. Another important method applied during the study was identification of animal signs. Such signs included footprints, faeces (pellets/scats/droppings), diggings, scents, etc. Animal

signs occurring along the 5m left and right along the transect trails were identified and wild mammals were documented. GPS location and habitat attributes as mentioned earlier were noted for those signs too.

3. Interview and Discussion

13. It is a fact that people living at human wildlife interface are better acquainted with the wildlife diversity in their neighborhoods and their core habitats. So, informal interviews and discussions mainly concerning on the wildlife were conducted at various places with different people specially aged people and community chiefs.

14. Local inhabitants were also interviewed to gain more insight into the pattern of the wildlife movement within and across the project area.

Table 118: Details of each transect line set up wild life survey

Transect no. & Date	Starting Point	Ending Point	Elevation (m)	Location			Observed Wildlife (Actual animal or sign of animal – footprint, droppings etc.)	Forest Area
				Chainage (approx. km)	Aspect (Side)	Village Boundary		
1(28/12/14)	24o51'29.72" N 93o47'44.2" E	24o51'33.12" N 93o47'47.80" E	962	18+800	North (RHS)	Khanchup Chiru	-	Tairenpokpi Tamenglong Protected Forest
2(28/12/14)	24o52'5.209" N 93o46'59.227" E	24o52'8.181" N 93o47'3.670" E	1038	19+800	North-East (RHS)	Khanchup Bangla	-	Kangchup RF
3(28/12/14)				21+600	West-South (RHS)	Khanchup Bangla	-	
4(28/12/14)	24o52'31.157" N 93o46'44.289" E	24o52'34.975" N 93o46'45.823" E	1339	23+800	North-East (RHS)	Khanchup Bangla	Bird-Nightingale (Khoining), Batek	
5(29/12/14)	24o51'55.311" N 93o46'22.086" E	24o51'58.807" N 93o46'24.623" E		26+900	North-west (RHS)	Shonglung	Animals-Barking deer (Saji), Wild Cat (Keijenglang), Bird-Nightingale (Khoining), Wild Pigeon (Lam Khunou), Woodpecker(Utubi)	Tairenpokpi Tamenglong Protected Forest
6(29/12/14)	24o51'39.198" N 93o45'27.960" E	24o51'43.630" N 93o45'29.497" E		28+700	In RoW	Shonglung	Animals-Barking deer (Saji), Bird-Nightingale (Khoining), Batek	
7(29/12/14)	24o51'44.921" N 93o44'45.882" E	24o51'44.640" N 93o44'40.847" E		29+300	North (RHS)	Shonglung	Animals-Clouded Leopard, Bird-Nightingale (Khoining), Wild Pigeon (Lam Khunou),	
8(30/12/14)	24o52'8.100" N 93o44'32.766" E	24o52'5.476" N 93o44'37.113" E		32+500	North-west (RHS)	Waphong	Bird-Nightingale (Khoining), Wild Pigeon (Lam Khunou), Batek	
9(31/12/14)	24o53'19.771" N 93o42'50.417" E	24o53'21.807" N 93o42'56.464" E		39+100	North-east (RHS)	Ijeirong	Bird-Nightingale (Khoining), Wild Pigeon (Lam Khunou), Batek	
10(31/12/14)				41+600	East (RHS)	Oktan	Animals-Wild Pig (Wild Boar), Bird-Eagle	Kangchup Leimakhong Irang Protect Forest
11(02/01/15)	24o55'3.922" N 93o41'22.729" E	24o55'4.122" N 93o41'16.693" E		46+500	North (RHS)	Oktan	Bird-Nightingale (Khoining), Eagle, Wood pecker, Batek, Kingfisher, Charoi	
12(02/01/15)	24o55'38.547" N 93o39'41.496" E	24o55'48.533" N 93o39'48.138" E		52+500	North East (RHS)	Nagaching	Bird-Nightingale (Khoining), Batek, Eabao	
13(02/01/15)	24o55'33.250" N 93o39'2.6018" E	24o55'36.234" N 93o39'8.165" E		54+100	East (LHS)	Nagaching	Bird-Nightingale (Khoining), Wild Pigeon, Eabao	

Transect no. & Date	Starting Point	Ending Point	Elevation (m)	Location			Observed Wildlife (Actual animal or sign of animal – footprint, droppings etc.)	Forest Area
				Chainage (approx. km)	Aspect (Side)	Village Boundary		
14(03/01/15)	24o54'54.675" N 93o38'31.161" E	24o54'50.178" N 93o38'26.893" E		61+100	East (LHS)	Lukhami	Bird-Nightingale (Khoining), Batek, Eabao	
15(03/01/15)	24o53'51.267" N 93o35'48.384" E	24o53'55.566" N 93o35'48.876" E		66+100	North (RHS)	Irang River	-	
16(03/01/15)	24o54'11.932" N 93o34'48.593" E	24o54'8.940" N 93o34'43.864" E		69+500	West-South (LHS)	Wairangba -II	Bird-Nightingale (Khoining), Batek,	
17(04/01/15)				72+500	South -LHS	Khebuchin g	Animals-Snake, Slow Loris, Bird-Nightingale (Khoining), Wild Pigeon (Lam Khunou),	Unclass Forest Tamenglong
18(04/01/15)	24o55'36.752" N 93o32'30.321" E	24o55'41.689" N 93o32'32.701" E		73+500	North-East (RHS)	Khebuchin g	Bird-Nightingale (Khoining), Batek	
19(04/01/15)	24o56'43.389" N 93o32'2.291" E	24o56'2.291" N 93o31'58.063" E		75+500	North (LHS)	Khebuchin g	Bird-Nightingale (Khoining), Orngkothon, Batek	
20(04/01/15)	24o58'2.015" N 93o33'0.115" E	24o57'56.582" N 93o33'4.054" E		78+800	South (RHS)	Bhalok	-	
21(04/01/15)	24o58'55.449" N 93o32'55.823" E	24o59'0.370" N 93o32'51.031" E		81+100	North-West (RHS)	Bhalok	Bird-Nightingale (Khoining), Batek	
22(04/01/15)	24o58'51.161" N 93o32'28.907" E	24o58'56.308" N 93o32'32.610" E		85+700	South (LHS)	Bhalok	Animals-Squirrel (Kheiroi), Bird-Nightingale (Khoining), Eagle,	

II. FINDINGS

A. Forest Fauna in project areas

15. The state is famous for its biodiversity in terms of rare fauna and flora. Manipur, in fact is in the junction of two ecological hotspots, the North Eastern India Hotspot and Malayan

16. Hotspot, and due to transitional effect, most of the species of wildlife typical of Himalayan Region and Malayan region are found in the state.

17. Due to presence of Hills, plains, and swamps and other wetlands, resulting diversity in climatic and floristic conditions provide habitat to multifarious types of fauna. So much of faunal diversity is available here that the state is regarded as a treasure box of rare wildlife. The analysis of faunal diversity reveal nearly 2601 species belonging to various categories in 1261 genera of 368 families. According to ZSI (2005), among these faunal groups, insects dominate the number with 1220 species followed by birds with 586 species, fishes with 141 species and molluscs 127 species. Mammals are of 75 species, Amphibians of 14 species and reptiles of 9 species.

18. Based on secondary sources, there are 33 species of mammals, 100 species of birds, 55 species of raptiles, 13 species of amphibians & 82 species of fishes has been recorded in the forest areas under project alignment.Wildlife in the studied forest areas is gven in Table 119.

Table 119: Details of Wildlife found in project affected forest areas

Sl.No.	Common Name	Scientific Name
Mammals		
1	Clouded leopard	Neofelis nebulosa
2	Fishing cat	Felis viverrina
3	Golden cat	Felis temmincki
4	Hog badger	Arctonyx colaris
5	Hoolock gibbon	Hylobates hoolock
6	Leopard or Panther	Panthera pardus
7	Leopard cat	Felis bengalensis
8	Tiger	Panthera tigris
9	Pangolin	Manis crassicaudata
10	Serow	Capricornis sumatraensis
11	Slow loris	Nycticebus coucang
12	Spotted linsang	Prionodon pardicolor
13	Assamese macaque	Macaca assamensis
14	Bonnet macaque	Macaca radiata
15	Ferret badgers	Melogale moschata M. personata
16	Rhesus macaque	Macaca mulatta
17	Stump-tailed macaque	Macaca speciosa
18	Wild dog or, Dhole	Cuon alpinus
19	Large Indian Civet	Viverra zibetha
20	Flying squirrel	Hylopetes alboniger
21	Himalayan black bear	Selenarctos thibetanus
22	Jungle cat	Felis chaus
23	Yellow throated Marten	Martes flavigula
24	Common otter	Lutra lutra
25	Barking deer or, Munjac	Muntiacus muntjak
26	Goral	Nemorhaedus goral

Sl.No.	Common Name	Scientific Name
27	Sambar	Cervus unicolor
28	Wild pig	Sus scrofa
29	Hedge hog	Hemiechinus auritus
30	Indian porcupine	Hystrix indica
31	Small Indian Civet	Viverricula indica
32	Toddy cat	Paradoxurus hermaphroditus
33	Bay bamboo rat	Cannomys badius
Birds		
1	Assam bamboo partridge	Bambusicola fytchii
2	Great Indian hornbill	Buceros bicornis
3	Humes bar-backed pheasant	Syrmaticus humiae humiae
4	Indian pied hornbill	Anthracoceros malabaricus
5	Tragopan pheasant	Tragopan blythii
6	Darter or, Snake bird	Anhinga rufa
7	Purple heron	Ardea alba
8	Night heron	Nycticorax nycticorax
9	Paddybird or, Pond heron	Ardeola grayii
10	Cattle egret	Bubulcus ibis
11	Little bittern	Ixobrychus minutus
12	Bittern	Botaurus stellaris
13	Lesser whistling teal/Tree duck	Dendrocygna javanica
14	Pintail duck	Anas acuta
15	Common teal	Anas poecilorhyncha haringtoni
16	Common pochard	Aythya ferina
17	White-eyed pochard	Aythya nyroca
18	Sparrow-hawk	Accipiter nisus
19	Tawny eagle	Aquila vindhiana
20	Crested serpent eagle	Spilornis cheela
21	Pied harrier	Circus melanoleucos
22	Red-legged or, Amur falcon	Falco amurensis
23	Common or, Grey quail	Coturnix coturnix
24	Little bustard-quail	Turnix sylvatica
25	Black partridge	Francolinus pictus
26	Red junglefowl	Gallus gallus
27	White-breasted waterhen	Amaurornis phoenicurus
28	Indian moorhen	Gallinula chloropus
29	Purple moorhen	Porphyrio porphyrio
30	Coot	Fulica atra
31	Large Indian pratincole or, Collared swallow plover	Glareola pratincola
32	Little tern	Sterna albifrons
33	Purple wood pigeon	Columba punicea
34	Spotted dove	Streptopelia chinensis
35	Little brown dove	Streptopelia senegalensis
36	Indian red-breasted parakeet	Psittacula alexandri
37	Lorikeet	Loriculus vernalis
38	Cuckoo	Cuculus canorus
39	Red-winged crested cuckoo	Clamator coromadus
40	Indian drongo cuckoo	Surniculus lugubris
41	Koel	Eudynamys scolopacea
42	Lesser coucal	Centropus toulou
43	Barn or, screech owl	Tylo alba
44	Grass owl	Tylo capensis

Sl.No.	Common Name	Scientific Name
45	Forest eagle owl	Bubo nipalensis
46	Brown wood owl	Strix leptogrammica
47	Bay owl	Phodilus badius
48	Blue-eared kingfisher	Alcedo meninting
49	White-breasted kingfisher	Halcyon smyrnensis
50	Chestnut-headed bee-eater	Merops leschenaulti
51	Blue-bearded bee-eater	Nyctyornis athertoni
52	Hoopoe	Upupa epops
53	Indian golden-backed three-toed woodpecker	Dinopium javanense
54	Blue-throated barbet	Megalaima asiatica
55	Himalayan great barbet	Megalaima virens
56	Long-tailed broadbill	Psarisomus dalhousiae
57	Sand lark	Calandrella raytal
58	House martin	Delichon urbica
59	Black drongo or, King-crow	Dicrurus adsimilis
60	Racket-tailed drongo	Dicrurus paradiseus
61	Crow-billed drongo	Dicrurus annectans
62	Indian Myna	Acridotheres tristis
63	Jungle Myna	Acridotheres fuscus
64	Pied Myna	Sturnus contra
65	Green magpie	Cissa chinensis
66	Yellow-billed blue magpie	Cissa flavirostris
67	Himalayan tree pie	Dendrocitta formosae
68	Jungle crow	Corvus macrorhynchos
69	Pied flycatcher-shrike	Hemipus picatus
70	Large cuckoo-shrike	Coracina novaehollandiae
71	Long-tailed minivet	Pericrocotus flammeus
72	Black-headed bulbul	Pycnonotus atriceps
73	Black-headed yellow bulbul	Pycnonotus melanicterus
74	Red-vented bulbul	Pycnonotus cafer
75	Spotted babbler	Pellorneum ruficeps
76	Red-capped babbler	Timalia pileata
77	Yellow-breasted babbler	Macronous gularis
78	Quaker babbler	Alcippe poioicephala
79	White-headed shrike-babbler	Gampsorhynchus rufulus
80	Red-billed leiothrix	Liothrix lutea
81	Neck-laced laughing thrush	Garrulax moniligerus
82	Black-gorgeted laughing thrush	Garrulax pectoralis
83	Brook’s flycatcher	Muscicapa poliogenys
84	White-browed fantail flycatcher	Rhipidura aureola
85	Streaked wren-warbler	Prinia gracilis
85	Thick-billed warbler	Acrocephalus aedon
87	Dull green leaf warbler	Phylloscopus trochiloides
88	Large-billed leaf warbler	Phylloscopus mangirostris
89	Rubythroat	Erithacus pectoralis
90	Blue chat	Erithacus brunneus
91	Magpie robin	Copsychus saularis
92	Jerdon’s bush chat	Saxicola jerdoni
93	Fire-breasted flowerpecker	Dicaeum ignipectus
94	Forest wagtail	Motacilla indica
95	White wagtail	Motacilla alba
96	Yellow-backed sunbird	Aethopyga siparaja

Sl.No.	Common Name	Scientific Name
97	Little spider hunter	Arachnothera longirostris
98	Black-breasted weaver bird	Ploceus benghalensis
99	Streaked weaver bird	Ploceus manyar
100	Black-headed Munia	Lonchura malacca
Reptiles		
1	Diard's blind snake	Typhina diardi diardi, Schlegel
2	Indian rock python	Python molurus molurus, Linn
3	Laurentis earth snake	Cylindrophis rufus burmanus, Smith
4	Dhaman (Rat Snake	Ptyas mucosus, Linn
5	Indo-Chinese rat snake	Ptyas korrs, Schlegel
6	Manipur green snake	Opheodrys doriae, Boulenger
7	White-striped kukri snake	Oligodon albocinctus, Cantor
8	Common kukri snake	Oligodon arnensis, Shaw
9	Spot-tailed kukri snake	Oligodon dorsalis, Gray
10	Wolf snake	Lycodon jara, Shaw
11	Collared black-headed snake	Sibynophis collaris, Grey
12	Green rat snake	Zaocys nigromarginatus, Blyth
13	Himalayan keelback	Natrix himalayana, Gunther
14	Checkered keelback	Xenochrophis piscator
15	Common keelback	Natrix punctulata
16	Red-necked keelback	Rhabdophis subminiata, Schlegel
17	Tawny cat snake	Boiga ochracea, Gunther
18	Indian gamma	Boiga trigonata, Schneider
19	Large spotted cat snake	Boiga multimaculata, Boie
20	Eastern gamma	Boiga gokool, Gray
21	Whip snake	Ahaetula prasinus, Boie
22	Bronze-backed snake	Ahaetula subcularis, Poulenger
23	Mock viper	Psammodynastes pulverulentus, Boie
24	Iridescent snake	Blythia recticulata, Blyth
25	Striped-neck snake	Liopeltis frenatus, Gunther
26	Trinket snake (Copperhead)	Elaphe radiata, Schlegel
27	Banded krait	Bungarus fasiatus, Schneider
28	Blue krait	Bungarus caeruleus, Schneider
29	King cobra (Monocellate)	Naja naja kauthia, Linn
30	Hamadryad (King cobra)	Ophiophagus hannah, Cantor
31	Russell's viper	Vipera russelli, Shaw
32	Blotched pit viper	Trimeresurus monicola, Gunther
33	Bamboo pit viper	Trimeresurus gramineus, Shaw
34	Green pit viper	Trimeresurus albolabris, Gray
35	Spot-tailed pit viper	Trimeresurus erythrurus, Cantor
36	House lizard	Gekko gecko, Linnaeus
37	House lizard	Hemidactylus bowringi, Gray
38	House lizard	Hemidactylus garnoti, Dumeril & Bibon
39	House lizard	Cosymbotus platyurus, Schneider
40	Flying lizard	Draco norvilli, Aloock
41	Garden lizard	Calotes versicolor
42	Garden lizard	C. mystaceus, Dumeril & Bibon
43	Garden lizard	C.jerdoni, Gray
44	Garden lizard	C. microlepis, Boulenger
45	Scin lizard	Mabuya multifaciata, Schneider
46	Scin lizard	M. macularia, Dumeril & Bobin
47	Scin lizard	M. novemcarinata, Anderson

Sl.No.	Common Name	Scientific Name
48	Scin lizard	M. quadricarinata, Boulenger
49	Scin lizard	Dasia olivacea, Gray
50	Scin lizard	Lygosoma maculatum, Blyth
51	Monitor lizard	Varanus bengalensis, Daudin
52	Monitor lizard	Varanus salvador, Laurenti
53	Water turtle	Cyclemys dentata, Gray
54	Box turtle	Cuora amboinensis, Daudin
55	Roofed turtle	Kachunga tentoria, Gray
Amphibians		
1	Common toad	Bufo melanostictus, Schneider
2	Toad Yazdani & Chanda	Bufoides species,
3	Indian Bulfrog	Rana tigrina, Doudin
4	Indian cricket frog	Rana limnocharis, Boie
5	Indian burrowing frog	Rana breviceps, Schneider
6		Amolops afganus, Gunther
7		Micrixalus borealis, Annandale
8	Tree frog	Hyla annectan, Jerdon
9	Narrow mouthed frog	Microhyla ornata, Dumeril & Bibon
10	Narrow mouthed frog	Kaloula pulchra, Gray
11	Tree frog or, Banana frog	Polypedates leucomystax, Gravenhorst
12		Ichthyophis species
13	Salamander or Himalayan Newts	Tylototriton verrucosus, Anderson
Fishes		
1	Nganap	Acantophthalmus pangia
2	Nganap	Acantophthalmus longpinnis
3	Ngaril Laina	Anguilla bengalensis
4	Ngachou	Aorichthys aor
5		Aspidoparia morar
6		Aspidoparia ukhrulensis
7	Ngarel	Bagarius bagarius
8	Ngarel	Bagarius yarrelli
9		Balitora brucei
10	Khabak	Bangana dero
11	Ngawa	Barilius barila
12	Ngawa	Barilius barna
13	Ngawa	Barilius bendelisis
14	Ngawa	Barilius chatriensis
15	Ngawa Phuri Thungbi	Barilius dogarsinghi
16	Ngawa	Barilius ngawa
17	Ngawa	Barilius tileo
18	Ngarang	Batasio tengana
19	Sareng Khoibi	Botia berdomorei
20	Sareng Khoibi	Botia dario
21	Sareng Khoibi	Botia histrionica
22	Nung-nga	Brachydanio acuticephala
23	Katla, Bao	Catla catla
24	Thang-gol Pubi	Chagunius chagunio
25	Ngarang	Chagunius nicholsi
26		Chela laubuca
27	Mrigal	Cirrhinus mrigala
28	Khabak	Cirrhinus reba
29	Ngakra	Clarias batrachus

Sl.No.	Common Name	Scientific Name
30	Ngaroi	Crossocheilus burmanicus
31	Grass Carp (Napi Chabi)	Ctenopharyngodon idellus
32	Puklaobi	Cyprinus carpio
33	Nung-nga	Danio aequipinnatus
34		Danio devario
35		Danio naganensis
36		Danio yuensis
37	Ngasang, Belunpaibi	Esomus danricus
38	Ngahei	Eutropichthys vacha
39		Exostoma stuarti
40	Ngarang, Ngayek	Gagata cenia
41	Silver carp	Hypopthalmichthys molitrix
42	Ngaton. Khabak	Labeo bata
43	Ngathi	Labeo calbasu
44	Ngathi	Labeo fimbriatus
45	Kuri	Labeo gonius
46	Ngatin	Labeo pangusia
47	Rou	Labeo rohita
48	Ngakrijou	Lepidocephalus berdmorei
49	Nganap Nakuppi	Lepidocephalus irrorata
50	Ngasep	Mystus cavasius
51	Nganan	Mystus microphthalmus
52		Mystus pulcher
53	Nganan	Nangra viridiscens
54	Ngara	Neolissochilus hexagonolepis
55	Ngara	Neolissochilus stracheyi
56	Ngatin	Ompok bimaculatus
57	Pengba, Tharak	Osteobrama belangrei
58	Ngaseksha	Osteobrama cunma
59	Nung-nga	Poropuntius burtoni
60	Nung-nga	Poropuntius clavatus
61		Pseudechenis sulcatus
62		Psilorhynchus balitora
63		Psilorhynchus microphthalmus
64	Phabou Nga	Puntius chola
65	Phabou Nga	Puntius conchonius
66	Japan Puthi	Puntius javanicus
67	Heikak Nga	Puntius jayarami
68	Ngakha Meingaangbi	Puntius manipurensis
69	Nganoi, Ngahou	Puntius sarana orphoides
70	Nganoi, Ngahou	Puntius sarana sarana
71	Phabou Nga	Puntius sophore
72	Phabou Nga	Puntius stoliczkanus
73	Ngakha Meingaangbi	Puntius ticto ticto
74	Ngawa	Raiamas bola
75	Ngawa Thangong	Raiamas guttatus
76	Nung-nga	Rasbora rasbora
77		Salmostoma sladoni
78	Sana-nga	Schizothorax richardsonii
79	Ngakoi	Semiplotus manipurensis
80	Ngara	Tor putitora
81	Ngara, Ngakreng	Tor tor

Sl.No.	Common Name	Scientific Name
82	Sareng	Wallago attu

Source: Working plan for Western Forest Division Tamenglong and Bishnupur, Central & Thoubal Forest Divisions and Working Plan of Senapati District

19. On account of decimation of the game animals and birds carried out through the ages due to hunting for meat and trophy and intolerance of the people to wildlife and the progressive destruction of habitat, several species like Clouded Leopard (Neofelis nebulosa), Barking Deer (Muntiacus muntjak), Sabeng etc. once abundant have now become extinct from forest area under these divisions. These Divisions has been the habitat, from times immemorial, of large variety of mammals, birds, reptiles and fishes. Besides monkeys, gibbons, wild-cats, goats, pigs, porcupines, pangolins, foxes and wild dogs, these forests were noted for its black bears which were found in the hills adjoining the valley. The Malayan species such as Slow Loris (Nycticebus coucang) and a variety of pheasants were also found. The bears, leopards, civet cats are no longer seen in these forests. In Table 120 species listed in schedules of The Wildlife (Protection) Act, 1972 from the project affect forest areas.

Table 120: List of species listed in schedules of The Wildlife (Protection) Act, 1972

S. No.	Common Name	Scientific Name	Local Name	Family
Schedule I				
Mammals				
1	Clouded Leopard	Neofelis nebulosa		Felidae
2	Leopard cat	Felis bengalensis	Keisal	Felidae
3	Golden Cat	Felis timminki	Tokpa	Felidae
4	Hoolock	Hylobates hoolock		
5	Pangolin	Manis crasiscaudata	Saphu	Manidae
6	Slow loris	Nycticebus coucang		
Birds				
1	Great Indian hornbill	Buceros bicornis	Langmeidong	Bucerotidae (Hornbills)
Schedule II				
Special Game				
1	Bison	Bos gaurus		
2	Hog badger	Arctonyx collaris		Mustelidae
3	Python	Python molurus vivitatus	Lairen	
4	Serow	Capricornis sumatraensis	Sabeng	Bovidae
5	Stump tailed macaque	Macaca speciosa	Yong Meikakpi	Cereopithecidae
Schedule III				
Big Game				
1	Barking deer	Muntiacus muntjak	Shaji	Cervidas
2	Himalayan black bear	Selenartos thebetanus	Sawom Amuba	Ursidae
3	Sambar	Cervus unicolor	Saajal	Bovidae
4	Wild pig	Sus scrofa	Lamok	Suidae
Schedule IV				
Small Game				
1	Otter	Lutra lutra	Sanamba	Mustelidae
2	Mrs. Hume's bar backed pheasant	Syrmaticus humiae humaie	Nogyin	Phasinidae
3	Burmese ring dove	Strepto peia decaocto		
4	Indian moorhen	Gallinula chlorophus	Pat uren	Raffidcae
5	the Bar tailed dove	Macropygis unchail tusalia		Columbidae

S. No.	Common Name	Scientific Name	Local Name	Family
6	Pheasant tailed Jacana	Hydro phasia nuschirargus		Jacanidae

Source: Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Division

B. Results of Field Surveys

1. Avifauna (Birds Species)

20. Altogether 11 species of birds were observed during the wildlife survey in forest areas along the alignment. Black-headed bulbul (Pycnonotus atriceps), Black-headed yellow bulbul (Pycnonotus melanicterus), Purple wood pigeon (Columba punicea) and Batek were most common observed avifauna in the all forest areas. The species of Blue-eared kingfisher (Alcedo meninting) and White-breasted kingfisher (Halcyon smyrnensis) were seen in forest areas adjoining to Ijei and Irang rivers. Besides these birds, Purple wood pigeon (Columba punicea), Forest eagle owl (Bubo nipalensis), Tawny eagle (Aquila vindhiana), Indian golden-backed three-toed woodpecker (Dinopium javanense) were also observed. The birds observed in transect line are given in below Table 121.

Table 121: Birds species observed in transect line studies

S. No.	Common Name	Scientific Name	Location	Remarks
			Transect Line	
1	Black-headed bulbul	Pycnonotus atriceps	TL-4,5,6,7,8,9,11,12,13,14,16, 17, 18,19,21, 22	
2	Black-headed yellow bulbul	Pycnonotus melanicterus	TL-6,7,8,9,13,14, 16,17,18	
3	Forest eagle owl	Bubo nipalensis	TL-10	
4	Tawny eagle	Aquila vindhiana	TL-22	
5	Indian golden-backed three-toed woodpecker	Dinopium javanense	TL-5, 11	
6	Blue-eared kingfisher	Alcedo meninting	TL-11	
7	White-breasted kingfisher	Halcyon smyrnensis	TL-11	
8	Batek	-	TL-4,6,8,9,11,12,14,16,18, 19, 21	

S. No.	Common Name	Scientific Name	Location	Remarks
			Transect Line	
9	Orngkothon	-	TL-19	
10	Eabao	-	TL-12,14	
11	Charoi	-	TL-11	

Source: Wildlife Field survey along proposed alignment

21. Altogether 11 species of birds were recorded from fifteen transects line (TL-4,5,6,7,8,9,11,12,13,14,16,17, 18,19,21, 22) set up at different locations in forest areas.

22. Transects line 1,2 & 3 were set up at Kangchup Reserve Forest area within walking distance of settlement areas named Kangchup Chiru and Kangchup Bangla village. Cultivation activities were performed in the area along the proposed alignment. The areas are under human and livestock pressure with movement of human beings. Goat, Cow and Buffalo dung and grazing goats & buffaloes were commonly observed in this Kangchup RF. The sign of forest fire were observed during the survey. Similar to Kangchup Reserve Forest area conditions were noted in the unclass forest area of Tamenglong with signs of hunting were also found. The human movement pressure is comparatively low in protected forest areas of Tairenpokpi Tamenglong Protected Forest and Kangchup Leimakhong Irang Protected Forest.

2. Threatened Birds Species

23. Based on the secondary source the proposed alignment affected forest areas are possible habitat for one globally threatened species (Great Indian hornbill) and five nationally vulnerable (Mrs. Hume's bar backed pheasant, Burmese ring dove, Indian moorhen, the Bar tailed dove, Pheasant tailed Jacana) birds species. (Table 122).

Table 122: Birds species in Project affected the Forest Area listed in IUCN red list & Wildlife Protection (Act) 1972

S. No.	Common Name	Scientific Name	Family	Category	
				Schedule	IUCN Status
1	Great Indian hornbill	Buceros bicornis	Bucerotidae (Hornbills)	I	Near Threatened
2	Mrs. Hume's bar backed pheasant	Syrmaticus humiae humaie	Phasinidae	IV	NA
3	Burmese ring dove	Strepto peia decaocto	Columbidae	IV	NA
4	Indian moorhen	Gallinula chlorophus	Raffidcae	IV	NA
5	the Bar tailed dove	Macropygis unchail	Columbidae	IV	

S. No.	Common Name	Scientific Name	Family	Category	
				Schedule	IUCN Status
		tusalia			
6	Pheasant tailed Jacana	Hydro phasia nuschirargus	Jacanidae	IV	NA

Source: Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Division

24. As per local community discussion during wildlife survey one globally near threatened species of bird (Great Indian hornbill) was recorded from the forest areas in the project areas.

3. Wild Animals

25. The transect no. 2, 3 & 4 were laid along the proposed alignment in Kangchup Reserve Forest area to survey the signs of wild animals. None was recorded along in these transects.

26. Total six transect line (TL no. 1, 5,6,7,8 & 9) were set up in Tairenpokpi Tamenglong Protected Forest. In this area signs of animal (footprints & fresh droppings) at transect line no. 5 & 6) of barking deer (Munitacus muntjak) and droppings of Jungle/Wild Cat (Felis chaus) at transect line no. 5 were observed. The animal sign (droppings) of Clouded leopard (Neofelis nebulosa) was found in transect line no. 7, which was near to existing IB road observed with the help of local community. Flying squirrel (Hylopetes alboniger) was slighted in the transect line no. 8.

27. In Kangchup Leimakhong Irang Protected Forest area seven transect line (TL no. 10, 11, 12, 13, 14, 15 & 16) were studied. The animal sign (footprints & digging) of wild pig (Sus scrofa) were noted in transect no. 10.

28. The remaining six transects were set up in unclassed forest area of Tamenglong in between the chainage km 72+500 to end point of alignment. Slow Loris (Nycticebus coucang) and black Squirrel (S. carolinensis) was directly sighted in transect line no. 17 & 22, respectively. The details of wild animals observed are presented in Table 123.

Table 123: Details of wild animals observed during survey

S. No.	Common Name (Local Name)	Scientific Name	Family	Identification	Location
1	Barking Deer (Saji)	Munitacus muntjak	Cervidae	P &F	TL-5 & 6
2	Jungle/Wild Cat (Keijenglang)	Felis chaus	Felidae	P	TL-5
3	Clouded Leopard	Neofelis nebulosa	Felidae	P	TL-7
4	Slow Loris	Nycticebus coucang	Lorisidae	V & F	TL-17
5	Squirrel (Kheiroi)	S. carolinensis	Scuridae	V & F	TL- 22
6	Flying Squirrel	Hylopetes alboniger	Scuridae	V	TL- 8 & 22
7	Wild Pig(Wild Boar)	Sus scrofa	Suidae	F & D	TL-10
8	Snake	-	-	F	TL-17

Note: Identification: V=Direct Sighting, P=Pellet, F=Footprint, S=Scat, Sc=Scent, D=Digging;

29. Altogether 7 mammalian species were recorded in and around the project alignment area through direct sighting and sign survey technique. The 7 species belonged to 5 families. Of these two species, Slow Loris (Nycticebus coucang) and Flying Squirrel (Hylopetes alboniger) were recorded by direct sighting in protected forest area of Kangchup Leimakhong Irang. Signs (droppings & footprints) of Barking Deer (Munitacus muntjak) were found in the protected forest area of Tairenpokpi Tamenglong and signs of hunting of Barking Deer were also observed near to transect line no. 5 at chainage km 26+800 to 27+000 (approx.). Clouded Leopard (Neofelis nebulosa), Jungle/Wild Cat (Felis chaus) & wild pig (Sus scrofa) were recorded on the basis of animal signs (droppings) located in transect line no 5 & 7 during field survey.

4. Animal Movement tracks

30. In between chainage km 26+000 to 29+800 of proposed alignment there was possible movement of wild animals (barking deer, wild pig & sabeng) across proposed alignment as animals track from hill towards local stream (water source) was found with less slope area of the forest. In this region of Tairenpokpi Tamenglong protected forest area was with minimum human movement due to no track in this region.

31. As per local community observations there was movement of barking deer and wild pig in between chainage km 40+000 to 42+000.

32. In Kangchup Leimakhong Irang protected forest area at km 62+000 to 65+000 of proposed alignment there was possible barking deer movement track across the road section. This region has Irang River to serve as water source for wild animal on the hills.

33. In Bhalok village boundary under unclassed forest area of Tamenglong possible route of wild animal movement from hills to fields across alignment at chainage km 79+000 to 80+000. As per local community from Bhalok settlement there was a movement track for wild animals (tiger, leopard, barking deer & wild pig) crossing proposed alignment at chainage km 90+700 to 91+000.

Table 124: Locations of possible animal movement tracks crossing proposed alignment

Animal tracks from km 26+000 to 29+800 possibly for Barking Deer, Wild Pig & Sabeng

Animal movement track at km 28+700

Route movement for wildboar (pig) between chainage at Km 41-42 km

Possible animal movement route from hill to agriculture fields cross the alignment at chainage km 79 to 80

5. Threatened Wild Animals

34. The working plans of forest divisions recorded that the area along proposed alignment provides shelter to 16 species of wild animals listed in Schedule of Wildlife Protection (Act) 1972. Of these the Hoolock (Hylobates hoolock) is endangered, Hog badger (Arctonyx collaris) and Otter (Lutra lutra) are threatened. Clouded leopard (Neofelis nebulosa), Slow loris (Nycticebus coucang), Serow (Capricornis sumatraensis), Sambar (Cervus unicolor) are considered vulnerable. Least concerns animals list includes Barking deer (Muntiacus muntjak) and Wild pig (Sus scrofa). Table 8 shows wild Animals in the project affected forest area listed in IUCN red list & Wildlife Protection (Act) 1972 (GoI).

Table 125: Wild Animals in the project affected forest area listed in IUCN red list & Wildlife Protection (Act) 1972

S. No.	Common Name	Scientific Name	Family	Category	
				Schedule	IUCN Status
1	Clouded Leopard	Neofelis nebulosa	Felidae	I	Vulnerable
2	Leopard cat	Felis bengalensis	Felidae	I	NA
3	Golden Cat	Felis timminki	Felidae	I	
4	Hoolock	Hylobates hoolock	Hylobatidae (Gibbons)	I	Endangered
5	Pangolin	Manis crasiscaudata	Manidae	I	NA
6	Slow loris	Nycticebus coucang	Lorisidae	I	Vulnerable
7	Bison	Bos gaurus	Bovidae	II	Vulnerable
8	Hog badger	Arctonyx collaris	Mustelidae	II	Threatened
9	Serow	Capricornis sumatraensis	Bovidae	II	Vulnerable
10	Stump tailed macaque	Macaca speciosa	Cereopitheci dae	II	NA
11	Barking deer	Muntiacus muntjak	Cervidas	III	Least Concern
12	Himalayan black bear	Selenartos thebetanus	Ursidae	III	NA
13	Sambar	Cervus unicolor	Bovidae	III	Vulnerable
14	Wild pig	Sus scrofa	Suidae	III	Least Concern
15	Otter	Lutra lutra	Mustelidae	IV	Threatened
16	Python	Python molurus bvivitatus	Pythonidae	II	NA

Source: Working plan for Western Forest Division Tamenglong and Working Plan of Senapati & Northern Forest Division

35. Of these species of wild animals Clouded leopard (Neofelis nebulosa), Slow loris (Nycticebus coucang), Barking deer (Muntiacus muntjak) and Wild pig (Sus scrofa) are recorded during site survey in the forest areas.

6. Fishes

36. There are three main river and their tributaries will be crossed by proposed alignment. Iring, ijei and Irnag are annual following rivers which are habitat of various species of fishes. The information on fish's names & availability was collected from local community in these rivers. The details are given below in Table 126.

Table 126: Details of fishes in Iring, Ijei and Irang Rivers

S. No	Local Name	Scientific Name	Availability
Iring River			
1	Ngajen		
2	Ngaleng		
3	Lung-nga		
4	Ngolin		
5	Ngani		Rainy Season
6	Ngabrron		Rainy Season
7	Ngarui		
Ijei River			
1	Nga-leag		
2	Ngajen		
3	Ngabrun		
4	Kaleinga		
5	Nga-zaak		
6	Ngakha		
7	Takwang		
8	Thiyamga		
9	Ngari		
10	Ngalin		
11	Ngachang		
12	Ngashan		
13	Ngana		
14	Ngakhakolung		
15	Ngashaang		
16	Ngakrichou		
17	Nganaptowngcha		
18	Tortoise		
19	Aimu		
Irang River			
1	Ngara	Neolissochilus hexagonolepis, Neolissochilus stracheyi	
2	Ngachou		
3	Ngatia		
4	Ngathei		
5	Ngarin		

C. Community Discussion

37. Discussion with local community chiefs and peoples were undertaken about sighting of wildlife in the forest around their settlement. The wildlife listed in the categories of IUCN and schedules of Wildlife Protection (Act), 1972 were specifically targeted in discussion and information was collected about location of sighting, possible movement tracks, habitats and season of sighting. Barking deer, leaopard, junle cat, Sabeng, wildpig and sajaan are animals frequently sighted in the forest. Community informed that the frequency of sighting of animals (Hoolock Gibbon, Clouded Leopard, Leopard Cat, Golden Cat, Bear, Great Indian hornbill) is decreasing in the region. The details of community discussion are provided in Table 127. The sample questionnaire is provided as Appendix 3.

Table 127: Details of information collected from interviews/discussions of local community from settlement in project areas

S. No.	Settlement Name	Participants	Medicinal plants in use	Dominant Tree	Main Wildlife			Hoolock Gibbon	Clouded leopard	Leopard cat	Golden Cat	Bear	Great India Hornbill	Remarks
					Name	Period	Location							
1	Kangchup Bangla	Mr. Khulam, Mr. Lamminthang, Mr. Hehao, Mr. Hejang	Lam Thani, Shamba, Twitochak, Kelchangmai & Ngancha	Uingthaou and Wang	Barking Deer	Oct to Dec (Night)	Twikailongni	√	√	√		√	√	
					Wild Boar	May to Sept. (Night)	Kanchup IB							
					Porcupine	Jun to August (throughout)	Farms							
2	Wapong	Mr. Agui Remroi, Mr. Ramson Khumba, Mr. Glory Reanroi	Tapulou, Kazai, Phudet, Aonbageikra	Wang	Barking Deer	Oct-Feb (Night)	Jungle		√	√		√	√	
					Bear	April-June (Night)	Around Village							
					Saajan (Deer)	May-June (Night)	Jungle							
					Leopard	June-Sept (Day & Night)	Jungle							
3	Ijeeirong	Mr. B. Pouri, Mr. B T Shinrei, Mr. I K Kuthui	Tamthakpui	Wang & Leihao	Barking Deer	Throughtout year (Night)	Jungle	√	√	√				200 yrs old Kapante
					Leopard	July-Sept (Night)	Jungle							
					Wild Boar	July-Sept (Night)	Jungle							
4	Bakua	Mr. B T Luther, Mr. BP Keishangsheiba, Mr. Kharei	Anting, Antrai, Inbaijen, Keathana	Wang	Wild Boar	Aug-Sept (Night)	Farms		√	√				
					Barking Deer	Nov-Jan (Night)	Lownhnon							
					Topa	Nov-Jan (Night)	Paddy Fields							
5	Oktan	Mr. Achoo, Mr. Keishilung, Mr. Keidon, Mr. Tanu	Emsh karsnlou, Shangjalou,	Wang	Wild Boar	Sept-Oct (Night)	Dringreichen							
					Barking Deer	April-July (Night)	Kanakwa							
					Shayaan	Sept-Oct (Night)	Twirujon							
6	Nagaching	Ms. Luniyang, Mr. Pingzoun,	Thang (Tairen),	Usoi	Saajan	April-June (Day)	Chwapangth wak					√	√	

S. No.	Settlement Name	Participants	Medicinal plants in use	Dominant Tree	Main Wildlife			Hoolock Gibbon	Clouded leopard	Leopard cat	Golden Cat	Bear	Great India Hornbill	Remarks
					Name	Period	Location							
		Mr. Kthwon, Mr. Dimrei	Ureirom, Pukthan,		Sapeng	Throughtour yr (Night)	Takwa							
					Wild Boar	Throughtour yr (Night)	Around Village							
7	Wairangba-II	Mr. Keishan Shamungou, Mr. A.G. Pamei, Mr. Athur Kanei		Wang	Barking Deer	Aug-Oct (Night)	Langkhon						√	
					Saajan	April-Sept. (Night)	Langkhon							
					Fox	Feb-May (Night)	Langkhon							
8	Wairangba-III	Mr. Tajonang	Ureirom, Talang	Wa & Wang	Wild Boar	May-Sept (Night)	Ngangkhun						√	
					Barking Deer	April-Aug (Night)	Taopolong							
9	Bhalok-III	Mr. Lunghilak, Mr. Rahrem, Mr. Achanpou	Usoi	Wa, Wang & Usoi	Barking Deer	Throughtout yr (Night)	Atihok		√	√		√	√	
					Wild Boar	June-Sept (Night0	Digathwa							
					Sabeng	Aug-Feb (Night)	Atihok							

III. ANALYSIS AND CONCLUSIONS

A. Discussions

38. Altogether 11 species of birds from 5 families and 7 mammalian species from 5 families were observed during the wildlife survey through direct sighting and sign survey technique in forest areas along the alignment. The commonly found birds include Black-headed bulbul (Pycnonotus atriceps), Black-headed yellow bulbul (Pycnonotus melanicterus), Purple wood pigeon (Columba punicea) and Batek in project affected forest areas.

39. One globally threatened species (Great Indian hornbill) and five nationally vulnerable (Mrs. Hume’s bar backed pheasant, Burmese ring dove, Indian moorhen, the Bar tailed dove, Pheasant tailed Jacana) birds species recorded in these forest areas as per secondry sources. Based on community discussion one globally near threatened species of bird (Great Indian hornbill) was recorded from the forest areas in the project areas.

40. The working plans of forest divisions recorded that the area along proposed alignment provides shelter to 16 species of wild animals listed as Threatened. Of these the Hoolock (Hylobates hoolock) is endangered, Hog badger (Arctonyx collaris) and Otter (Lutra lutra) are threatened. Clouded leopard (Neofelis nebulosa), Slow loris (Nycticebus coucang), Serow (Capricornis sumatraensis), Sambar (Cervus unicolor) are considered vulnerable. Least concerns animals list includes Barking deer (Muntiacus muntjak) and Wild pig (Sus scrofa).

41. Barking Deer (Munitacus muntjak), Clouded Leopard (Neofelis nebulosa), Jungle/Wild Cat (Felis chaus) & wild pig (Sus scrofa) are wild animals recorded in the forest area during survey.

B. Specific Impacts on Widlife due to Road Construction

42. Development activities obviously have the Environmental Impact which directly affects the wildlife and birds. This study was carried out to innumerate the possible impacts (adverse and beneficial) on birds due to road construction along proposed alignment with recommendations to promote the beneficial impacts while mitigating the adverse impacts.

1. Beneficial Impacts

43. The construction of bridges might increase the habitat of certain water birds. Different species of birds (for example White-breasted Waterhen) will inhabit near the reservoir making high diversity. The impact will be permanent in duration.

2. Adverse Impacts

44. **Construction phase**. Disturbance to the Birds: Logging off of large trees, drilling, collection and deposition of building materials and the high movement of labor force on the construction sites will disturb the habitat of birds. Large fruiting trees are the major nest building sites of most species of birds. Logging them off might destroy the nests of birds and young chicks. Drilling will disturb the feeding birds nearby and pollution due to deposition of construction materials may chase away the birds from their usual habitat. High movement of labor force might involve in hunting activities of birds. Blasting activities and rock fragments may injure the birds. Inundation of current water habitat will disturb the feeding and reproductive grounds of water birds mainly from the areas close to water bodies.

45. **Operation phase**. Habitat Fragmentation: The micro topography of the construction site areas changes after the construction of road, which will fragment the habitat of birds like White-breasted Water Hen. Construction of road will collect large amount of water from small rivulets which will decrease the habitat of birds like Forktails and Dipper which prefer to forage near fast flowing rivulets.

C. Conclusions

46. The forest area along proposed alignment holds high diversity of birds (100 species of birds from secondary source and 33 species of mammals. As proposed alignment will follow existing track except in some sactions so the negative effect on the habitat and diversity of birds will be negeligible. At some locations animal movement tracks observed during field survey need to taken during construction and operational stage of the road. Casualties to the wildlife due to construction activities, probable hunting and poaching activities will have deleterious effect to the diversity and number. So, appropriate practical measures will be necessary to mitigate such impacts on forest fauna and their habitat.

Appendix 1: Synopsis of all studied transect line

Date: 28-12-2014			Name of data collector:	Ksh. Royan	
Name of road section/point: 18+800				Transect No.:	1
Slope:		Aspect:	North	Altitude:	1038
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
NIL					

Date: 28-12-2014			Name of data collector:	Ksh. Royan	
Name of road section/point: 19+800				Transect No.:	2
Slope:		Aspect:	East	Altitude:	
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
NIL					

Date: 28-12-2014			Name of data collector:	Ksh. Royan	
Name of road section/point: 21+600				Transect No.:	3
Slope:		Aspect:	North-West	Altitude:	1326
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
	NIL				

Date: 28-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 23+800 Transect No.: 4

Slope: Aspect: North Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Kangchup Bangla	Nightingale (Khoining)	Actual Bird	3	10m
		Batek	Actual Bird	2	10m

Date: 29-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 26+900 Transect No.: 5

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Shonglung	Barking deer (Saji)	Sign -footprints & droppings (Photo - 23)	1	NA
		Wild Cat (Keijenglang)	Sign- Droppings	1	NA
		Monkey	Local Community Feedback	NA	NA
		Wild Pigeon (Lam Khunou)	Bird-Call	1	
		Nightingale (Khoining)	Actual Bird	4	8-10m
		Woodpecker(Utubi)	Bird-Call	1	NA

Note - Possible animal movement corridor for 1. Barking Deer, 2. Wild Pig Photo No. 26, due to water body in south of our alignment and less slope

Date: 29-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 28+700 Transect No.: 6

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Songlung	Barking deer (Saji)	Sign -droppings (Photo - 35)	1	NA
		Batek	Actual Bird	2	8-10m
		Nightingale (Khoining)	Actual Bird	3	do

Note - Animal movement corridor for 1. Sabeng, 2. Barking Deer, 3. Wild Pig Photo No. 36

Date: 29-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: Approx. 29+300 Transect No.: 7

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Shonglung	Clouded Leopard	Sign -droppings (Photo - 43)	1	NA
		Nightingale (Khoining)	Actual Bird	6	8-10m
		Wild Pigeon (Lam Khunou)	Actual Bird	3	do

Date: 30-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 32+500 Transect No.: 8

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Waphong	Nightingale (Khoining)	Actual Bird	3	6-10m
		Batek	Bird-Call	1	NA
		Wild Pigeon (Lam Khunou)	Actual Bird	2	8-10m

Date: 31-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 39+100 Transect No.: 9

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Ijeirong	Animal -NIL			
		Nightingale (Khoining)	Bird-Call	1	NA
		Wild Pigeon (Lam Khunou)	Actual Bird & Call	2	8-10m
		Batek	Bird-Call	3	6-10m

Note- Barking deer movement corridor as per local community at Km 40-41

Date: 31-12-2014 Name of data collector: Ksh. Royan

Name of road section/point: 41+600 Transect No.: 10

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Oktan	Wild Pig (Wild Boar)	Sign- footprint (Photo-66,67)	4	10-20m
		Eagle	Actual Bird	1	NA

Note- Possible route movement for corridor wildboar (pig) between chainage at Km 41-42 km

Date: 02-01-2015			Name of data collector:	Ksh. Royan	
Name of road section/point: 46+500-46+700				Transect No.:	11
Slope:		Aspect:		Altitude:	
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Oktan	Nightingale (Khoining)	Bird Actual & Call	5	6-10m
		Eagle	Actual Bird	1	NA
		Wood pecker (Utubi)	Bird-Call	1	NA
		Batek	Bird-Call	1	NA
		Kingfisher (Nsiarakpi)	Actual Bird	1	NA
		Charoi	Actual Bird	1	NA

Date: 02-01-2015			Name of data collector:	Ksh. Royan	
Name of road section/point: 52+500-53+000				Transect No.:	12
Slope:		Aspect:		Altitude:	
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Nagaching	Nightingale (Khoining)	Bird Actual & Call	4	6-10m
		Batek	Bird-Actual	2	6-10m
		Eabao (Photo 99)	Bird-Actual	2	6-10m

Date: 02-01-2015			Name of data collector:	Ksh. Royan	
Name of road section/point: 54+100-55+000				Transect No.:	13
Slope:		Aspect:		Altitude:	

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Nagaching	Nightingale (Khoining)	Bird Actual & Call	3	6-10m
		Wild Pigeon(Lam-Khunu)	Bird-Actual	2	6-10m
		Eabao (Photo 101)	Bird-Actual	2	10-15m

Date: 03-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 61+100-62+000 Transect No.: 14

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Lukhambi	Nightingale (Khoining)	Bird Actual	4	6-10m
		Batek	Bird Actual & Call	3	6-10m
		Eabao	Bird-Actual	2	8-15m

Note- Possible animal route movement of barking deer & wildpig in between km 62 to 65

Date: 03-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 66+100 - 67+500 Transect No.: 15

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Irang River	Nil			

Date: 03-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 69+500-70+000 Transect No.: 16

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Wairangba-2	Nightingale (Khoining)	Bird Actual & Call	3	5-10m
		Batek	Bird Call	1	NA

Date: 04-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 72+500-73+000 Transect No.: 17

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Khebuching	Snake	Sign-Footprint (Photo 108, 109)	1	5-10m
		Slow Loris	Actual- Slighting	1	NA
		Nightingale (Khoining)	Bird Actual & Call	3	6-12m
		Wild Pigeon(Lam-Khunu)	Bird-Actual	2	5-10m

Date: 04-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 73+500-74+000 Transect No.: 18

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Khebuching	Nightingale (Khoining)	Bird Actual & Call	1	NA
		Batek	Bird-Actual	2	5-10m

Date: 04-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 75+500-76+000 Transect No.: 19

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Khebuching	Nightingale (Khoining)	Bird Actual & Call	4	6-12m
		Batek	Bird-Actual	2	8-10m
		Orngkothon	Bird-Actual	1	NA

Date: 04-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 78+800-79+000 Transect No.: 20

Slope: Aspect: Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Bhalok	NIL			

Note- Possible animal movement route from hill to agriculture fields cross the alignment at chainage km 78 to 80

Date: 04-01-2015 Name of data collector: Ksh. Royan

Name of road section/point: 81+100-81+300 Transect No.: 21

Slope: Aspect: East Altitude:

No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Bhalok	Batek	Actual	2	6-10m
		Nightingale (Khoining)	Bird Actual & Call	4	6-15m

Date:	04-01-2015		Name of data collector:	Ksh. Royan	
Name of road section/point: 85+700-85+800				Transect No.:	22
Slope:		Aspect:	South	Altitude:	
No.	Exact location/Plot number and local name of area	Name of wildlife species/common name	Sighting (Actual animal or sign of animal – footprint, droppings etc.)	Frequency of sighting	Approximate distance between two sightings
1	Bhalok	Squirrel (Kheiroi)	Actual (Photo 115, 116)	1	NA
		Eagle	Bird Actual (Photo 114)	1	NA
		Nightingale (Khoining)	Bird Actual & Call	3	6-10m

Appendix 2. Glimpses from the field

Footprints of Barking Deer at Transect Line no. 5 (km 26+900)

Droppings of Junle Cat at Transect Line no. 5 (km 26+900)

Droppings of Barking deer at Transect Line no. 6 (km 28+700)

Droppings of Leopard at Transect Line no. 7 (km 29+300)

Footprints of Wild pig at Transect Line no. 10 (km 41+600)

Movement track of Wild pig at Transect Line no. 10 (km 41+600)

Footprints of Wild pig at Transect Line no. 10 (km 42+100)

Honey bee at transect line no. 19 (km 75+500)

Snake tracks at Transect Line no. 17 (km

Footprints of squirrel at Transect Line no. 22 (km

72+500) location where slow loris sighted directly

85+700)

Domestic buffalos in Waterbody at km 75+700)

Fields along road alignment from km 69+600 to 75+5000

Appendix 3: Sample Questionnaire for Focus Group Discussions
Questionnaire for Focus Group Discussions/Community

Date: Interviewer:

Name of road section/chainage:

Sl. No.	Village	Geography	Names of participants

Physical Environmental Features:

From where do you source your drinking water?

Are there any issues with water in your community? If yes, what is the issue and what do you think is causing it?

What do you think will solve the water problem?

Do you have any problems with noise? If so what is causing it?

Do you have any problems with soil (erosion, low fertility etc.)? If yes what do you think is causing it? For how long has the problem been existing?

What do you think would help solve the soil problem?

Is there any past history of natural calamities such as flood, drought, hailstones, earthquake etc. in your village? If so describe and mention when it happened?

Vegetation:

Do you consume any trees or plants from the forest next to your village? If yes what is the local name of the plants and what do you use them for? (edible plants, medicinal plants etc.)

Sl. No.	Local name of plant	Use

Which plant or tree is most abundantly found in the forest next to your village? How would you measure the abundance? (number of trees per decimal/acre or other measurements)

Wildlife:

What are the wild animals (including birds) found in the forest next to or village?

Sl. No.	Animal name (Mention actual sighting or signs of animal)	Timing of seeing (month and time of day)	Frequency of sighting animal/ animal sign	Location of sighting

Hoolock Gibbon

How many Hoolock Gibbon’s did you see this year?

Do you notice any changes in the numbers of Hoolock Gibbon’s that you see today in comparison to the past? How long ago would be “the past”?

What is the change? What do you think is causing the change?

Have there been any Hoolock Gibbon accidents with vehicles this year? If so, how many? Have there been any accidents over the past few years? Is this a common occurrence?

According to your observation do you notice any changes in the behavior of the Hoolock Gibbon’s? (more friendly to humans? More shy? Anything else etc.)

Clouded Leopard/Leopard Cat/Golden Cat

How many Clouded Leopard/Leopard Cat/Golden Cat’s did you see this year?

Do you notice any changes in the numbers of Leopard’s that you see today in comparison to the past? How long ago would be “the past”?

What is the change? What do you think is causing the change?

Have there been any Leopard accidents with vehicles this year? If so, how many? Have there been any accidents over the past few years? Is this a common occurrence?

According to your observation do you notice any changes in the behavior of the Leopard’s? (more friendly to humans? More shy? Anything else etc.)

Bear

In which area and what kind of conditions do you usually notice the Bear or signs?
Do you notice a reduction or increase in the incidences of sighting the Bear or signs of the Bear?

If so what do you think is causing it and what do you feel about it?

<u>Great Indian hornbill/Rufous necked Hornbill</u>

Where specifically do you see/hear the hornbills usually? (on trees, flying overhead?)

Do you notice any reduction/increase in the number of sightings of the bird? What do you think is causing the reduction/increase? What could prevent a decrease of the bird number?

<u>Others wild animal/bird/reptile</u>

In which area and what kind of conditions do you usually notice the …………………. or signs?

Do you notice a reduction or increase in the incidences of sighting the above mentioned or signs of the same?

If so what do you think is causing it and what do you feel about it?

<u>Religious/Cultural sites</u>

Are there any religious/cultural/historical sites monuments around your village? If so name them and give a slight background on them.

Where is the site/monument located?

Additional

Would you have any suggestions/ideas to improve the natural environment of your area?

Are you happy that your village is close to the highway? Why?

(Note down any other relevant information that you may get from the people)

Appendix 4: Community Consultation


At Settlement Kangchup Bangla


At Settlement Shunglung Nepali


At Settlement Ijeirong


With Oktan chief


At Settlement Bakua


At Settlement Nagaching


At settlement Wairanba-II


At settlement Bhalok-III

Appendix 5: Discussion/Consultation with Forest Department

S.No	Date & Place	Name	Designation	Mobile No.	Remarks
1	27/12/14, Sanjenthong, Imphal	Mr. Robert	Divisional Forest Officer, Kangpokpi Senapati	9436021947	Discussion on wildlife in the forest areas along proposed alignment
		Mr. Md. Abdul Hyeshah	Range Officer, Motoung	9862762983	Status of wildlife in the forest under project areas
		Mr. L. Kumar	Beat Officer, Kangchup	897422085	
2	27 & 28/12/14, Imphal & Kangchup RF	Mr. Sunil Kumar	Forest Guard, Kangchup Reserve Forest	8974005010	Help in field survey in Kangchup RF area
3	30/12/14, Imphal	Mr. D. K. Vinod	Divisional Forest Officer, Central Division	8974162128	Discussion on wildlife in the forest areas along proposed alignment
		Mr. Sukham Rattan Kumar	Deputy Range Officer, Sardar West Range Office	9863058977	Status of wildlife in the forest under project areas, second home for Sangai deer in Irosima RF is adjacent to existing Imphal-Kangchup Road, need fencing towards raod
4	30/12/14, Imphal	Mr. Huri Golmei	Divisional Forest Officer, Westren Division, Tamenglong	8974419024	Discussion on wildlife in the forest areas along proposed alignment
		Mr. Hitler Singh	Range Officer, Tamenglong	8413804277	Status of wildlife in the forest under project, Tiger killed by villagers at Bhalok in yr. 2005, in august 2013 clouded leopard claw was catched, Falcon birds visit Tamenglong region in month of Nov.-December.

ANNEX 16: DISTRIBUTION AND HABITAT REQUIREMENTS OF ENDANGERED AND INDIA SCHEDULE 1 WIDLIFE, BIRDS, AND PLANTS

INDIA: SASEC Road Connectivity Investment Program (Imphal-Kanchup-Tamenglong Road)

1. This Critical Habitat Assessment has been performed as an important part of the environmental impact assessment process for the Imphal-Kanchup-Tamenglong Road Project (non-sample subproject of ADB's SRCIP[21] for India). Although there are legally protected areas or biological corridor (the ADB SPS notes that critical habitats include legally protected areas such as the national parks, wildlife sanctuaries, biological corridors) along the proposed alignment of the project road, part of the project road is located in reserve /unclassed forests of Senapati and Tamenglong Forest Divisions of Manipur state in northeastern India. India supports a number of threatened (protected/endangered) species of plants and animals, including those in the northeastern India and other protected areas that are connected together by the biological corridors. It is therefore necessary to determine if the project area itself (the project footprints and immediately adjacent areas) is critical for the survival of these threatened species.

2. This assessment is based on the latest IUCN data and maps for the key species of concern, as well as recent research reports and surveys for specific animals. It has also been supported by habitat and wildlife surveys in the proposed project footprint areas; working plans of forest divisions in the project areas; opinions of wildlife and species experts (including officials from wildlife division of Manipur forest department and field staff of respective forest divisions in the project area; discussion with WWF India in the early phase of the EIA and again as this critical habitat assessment was developed), as well as review of wildlife staff and local community scientific and anecdotal information on wildlife in the project area. All the information in this critical habitat assessment has been reviewed species basis together with information provided in the working plans of the forest divisions (obtained from Manipur Forest Department, Imphal), and found to be up-to date and accurate. Independent expert opinions regarding several protected species in the northeast India and their range and habitat requirements were also sought, to corroborate the project conclusions regarding critical habitat. The detailed analysis and species-specific data are noted below.

A. Criteria that the analysis responds to:

3. The objective of this critical habitat assessment is to: (i) determine if critical habitat is present in the project area; and, (ii) determine if there will be any measurable adverse impacts, following the definitions and requirements within ADB's Safeguard Policy Statement (SPS, 2009).

4. Specifically, the SPS defines critical habitat as "critical habitat is an area that has high biodiversity value". It includes (ADB Sourcebook, 2012):

- habitat required for the survival of critically endangered or endangered species;
- areas having special significance for endemic or restricted-range species;
- sites that are critical for the survival of migratory species;
- areas supporting globally significant concentrations or numbers of individuals of congregatory species;
- areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and
- areas having biodiversity of significant social, economic, or cultural importance to local communities.

[21] India: South Asia Subregional Economic Cooperation (SASEC) Road Connectivity Investment Program, an ADB MFF to India.

5. Furthermore, Appendix 1, para 28 of the SPS sets out specific requirements for projects that may affect critical habitat, such that, no project activity will be implemented in areas of critical habitat unless the following requirements have been met:

- There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.
- The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.

6. In order to identify if the project area is critical for the survival of threatened species, quantitative thresholds for critical habitat determination described in the International Finance Corporation (IFC) Performance Standard 6, Guidance Note 2012 have also been used as guidance (see below). Specifically, the IFC describes critical habitat in two tiers.

1. Tier one states:

- Habitat required to sustain >10 percent of the global population of a CR or EN species/subspecies where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species.
- Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.

2. Tier two states:

- Habitat that supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally-important concentrations of a Red listed EN species where that habitat could be considered a discrete management unit for that species/subspecies.
- Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species.
- As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.

7. Relevant aspects of the IFC Guidance Note 6 - Biodiversity Conservation and Sustainable Management of Living Nature Resources (January 2012) are highlighted below:

High Conservation Value Types and Performance Standard 6

HCV Type	Performance Standards
HCV 1: Areas containing globally, regionally or nationally significant concentrations of biodiversity values	Critical habitat in most cases. See paragraphs GN55–GN112 for further guidance.
HCV 1.1: Protected areas	
HCV 1.2: Rare, threatened or endangered species	
HCV 1.3: Endemic species	
HCV 1.4: Seasonal concentrations of species	
HCV 2: Globally, regionally or nationally significant large landscape-level areas where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.	Natural habitat, and may be critical habitat if areas contain high biodiversity values as identified in paragraph 16 of Performance Standard 6.
HCV 3: Areas that are in or contain rare threatened or endangered ecosystems	Critical habitat
HCV 4: Areas that provide basic ecosystem services in critical situations	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6. See paragraphs GN126–GN142 for further guidance.
HCV 4.1: Areas critical to water catchments	
HCV 4.2: Areas critical to erosion control	
HCV 4.3: Areas providing critical barriers to destructive fire	
HCV 5: Areas fundamental to meeting basic needs of local communities	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6. Client requirements defined in Performance Standard 5 are also applicable. See paragraphs GN126–GN142 for further guidance.
HCV 6: Areas critical to local communities' traditional cultural identify (areas of cultural, ecological, economic	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6. Client requirements

GN65. For Criteria 1 through 3, the project should determine a sensible boundary (ecological or political) which defines the area of habitat to be considered for the Critical Habitat Assessment. This is called the "discrete management unit," an area with a definable boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas (adapted from the definition of discreteness by the Alliance for Zero Extinction). A discrete management unit may or may not have an actual management boundary (e.g., legally protected areas, World Heritage sites, KBAs, IBAs, community reserves) but could also be defined by some other sensible ecologically definable boundary (e.g., watershed, interfluvial zone, intact forest patch within patchy modified habitat, seagrass habitat, coral reef, concentrated upwelling area, etc.). The delineation of the management unit will depend on the species (and, at times, subspecies) of concern.

B. Identification of the DMU:

8. Critical habitat assessment requires the definition of a discrete management unit (DMU) that can guide the analysis of whether or not the project area will impinge on critical habitat for endangered or India protected species. A DMU is an area with a clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas. While different species may have different habitat requirements and ranges, which would dictate different discrete management units, in reality, for northeastern India, there are legally declared protected area including in Manipur State (Figure 1) which has already recognized that habitat requirements and ranges of the important and endangered species that occurs in the State.

9. Although there are no legally protected areas along the project road but proposed alignment is passing through reserved forest and open unclassed forest of Senapati and Tamenglong Forest Divisions. About 2.1 km length of the proposed project alignment passes through Kanchup Reserved

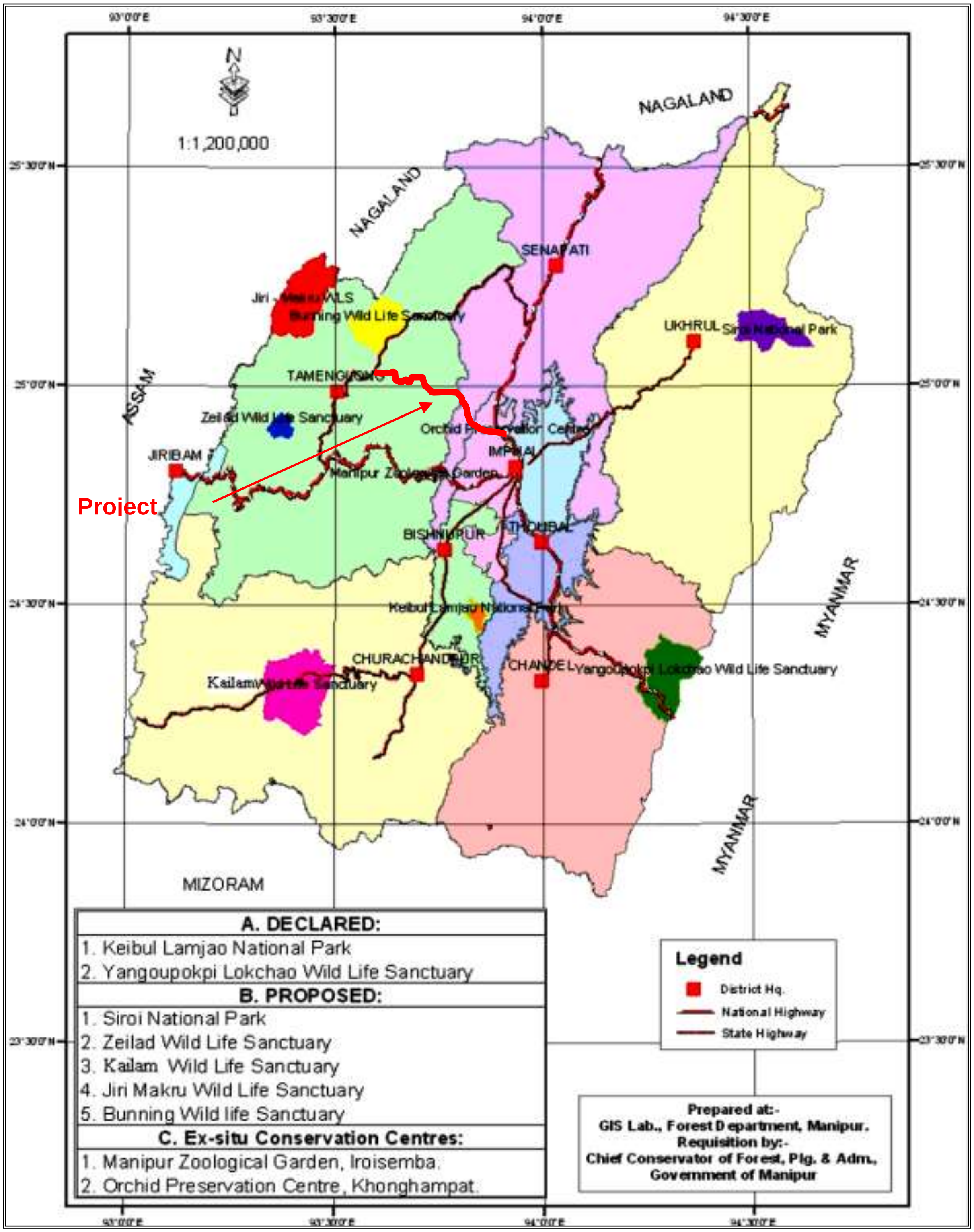
Forest under northern forest division Kangpokpi in Senapati District of Manipur. The forests of Kanchup Reserve division consists of forests types viz. Tropical moist deciduous, Northern sub tropical broad leaved hill forests and Northern Montane wet temperate forests. Sub-tropical broad-leaved forests are confined to the altitude from 1000-1800 m. and rainfall from 2000 – 4800mm. Boundaries of Kanchup Reserve Forests are clearly demarcated (Figure 3) and it also facilitates the management of the important habitats species for number of species. The Kanchup Reserved Forest is situated between 24052'N to 24054' N Latitude and 93046'E to 93049'E Longitude and it has a total area - 9.60 Sq.Km. The Kangchup Reserved Forest is hill which runs north to south cut up at places by streams flowing from upper reaches. The highest elevation is 1907m above MSL and is situated on the Imphal-Kangchup Road. The Kangchup Reserved Forest falls within Sadar Hills West Sub- Division under the control of the Northern Forest Division and under the jurisdiction of the Kanglatongbi Range.

10. Therefore, for the purpose of the critical habitat assessment for the proposed Imphal-Kanchup-Tamenlong Road project, the discrete management unit is defined as the Kanchup Reserve Forest (see figure 3), as well as the areas of 10 km radius along the alignment of proposed road (see figure 2). The project footprints (these include carriageway, quarry and borrow areas, muck dumping sites, construction camps) and immediate zone of influence (within 10 km of the project footprints). The habitat type in the project area is characterized mostly by degraded forest (previously harvested in places and re-growing, and patches now used for cattle grazing), barren areas, hills with agricultural and shifting cultivation, and various houses (mostly scattered along the right of way of the project and in adjacent areas). More specifically, the project interaction with the project area will be as follows:

- About 30 m strip of forest land for about 90 km length which is cause diversion of forest land for non-forest purposes
- Only about 6.1 ha of reserve forest will be diverted since only 2.1 km length of the proposed alignment passing through reserve forest
- Rest of the Kanchup Reserve Forest will remain completely undisturbed and still accessible to wildlife.
- Muck disposal sites, quarries and borrow areas are located away from the dense forested areas so that there wont be any loss of habitats.

C. Species assessed:

11. For the critical habitat assessment, the range and habitat requirements of each of the protected/endangered animals in Northeast India (and in Manipur state) were addressed. Those species which have been observed in and near Kanchup Reserve Forest (in the DMU) and in forests along the proposed alignment of project road were considered in more detail on a species-specific basis. These details are provided below. For each species, a conclusion regarding whether or not Tier 1 and 2 criteria (under the IFC Guidance Note 6) are triggered by the project road (i.e., whether or not the project area is habitat critical to the survival of endangered species) is provided.



Source: Wildlife Wing, Forest Department, Government of Manipur

Figure 58: Protected Area Map of Manipur State showing Project Road

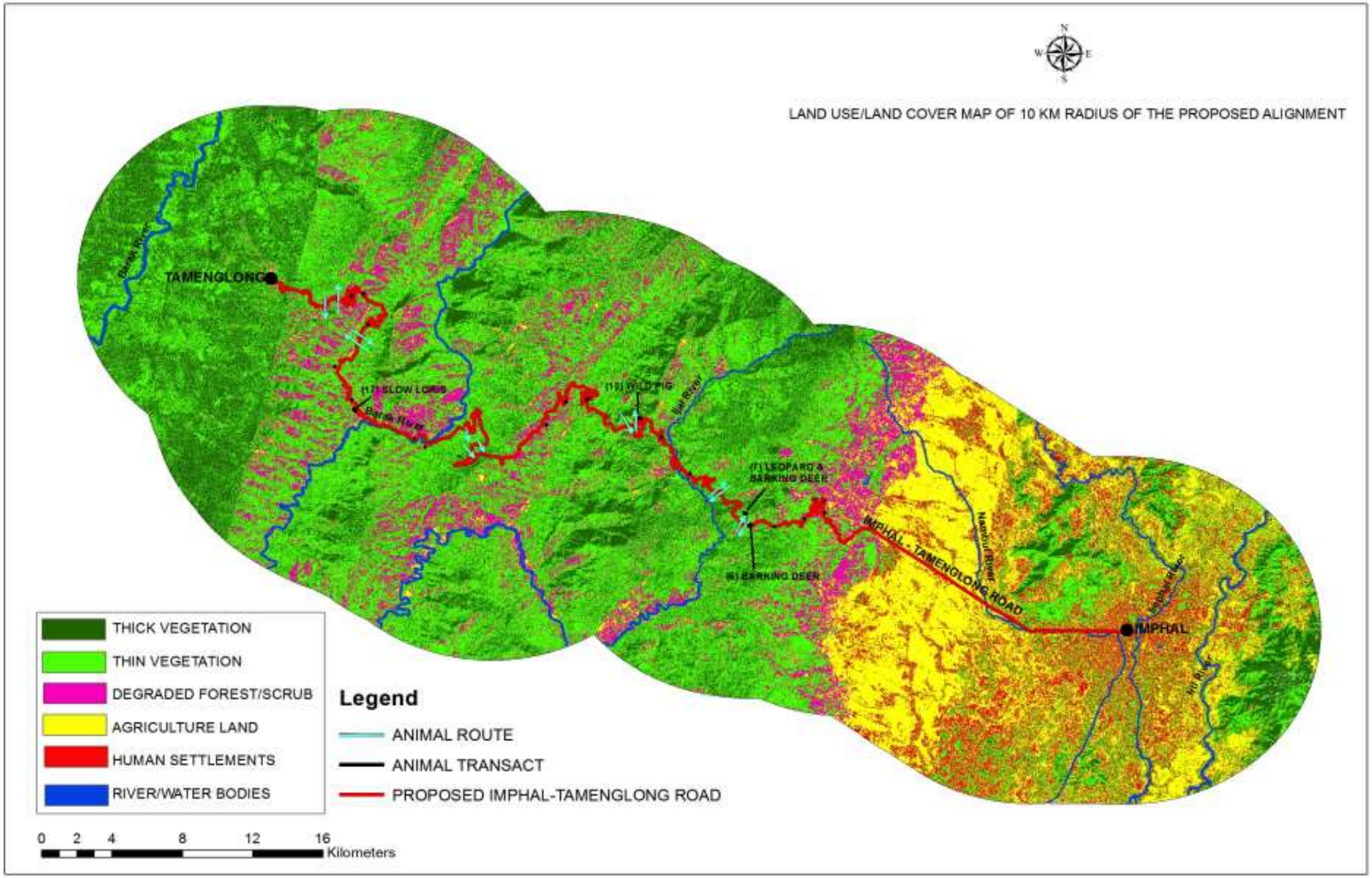


Figure 59: Habitat Map of the Project 10 km Radius along Project Road Alignment

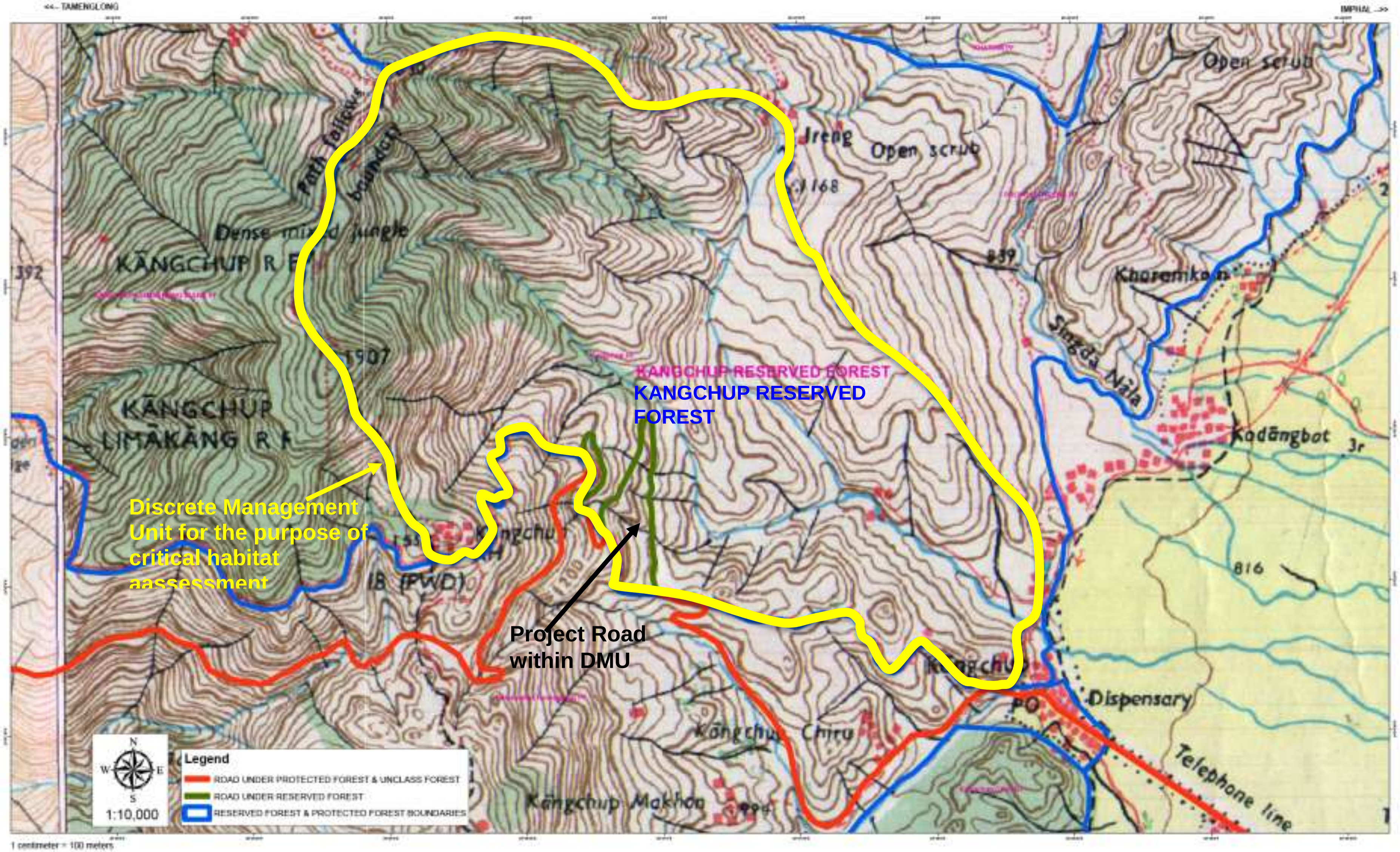


Figure 60: Discrete Management Unit for Critial Habitat Assessment

Table 1: Wildlife (noted endangered species in North-eastern part of India)

Common Name	Scientific Name	IUCN and National Threat Category	Present in Project Area
Plants			
Cycad	*Cycas pectinata*	Vulnerable Schedule VI	Not recorded during survey along alignment, but mentioned in Working plan of forest division
Wild life (Birds)			
Great Indian hornbill	*Buceros bicornis*	Near Threatened Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff
Wild life (Animals)			
Asian Elephant	Elephasmaximus	Endangered Schedule I	No
Tiger	Pantheratigris	Endangered Schedule I	No
Asiatic Black Bear	Ursusthibetanus	Vulnerable Schedule I	No
Clouded Leopard	*Neofelis nebulosa*	Vulnerable Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff
Hoolock	*Hylobates hoolock*	Endangered Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff
Slow loris	*Nycticebus coucang*	Vulnerable Schedule I	Sighted during survey along alignment
Bison	*Bos gaurus*	Vulnerable Schedule II	Not sighted during survey along alignment, but reported by locals and forest staff
Hog badger	*Arctonyx collaris*	Threatened Schedule II	Not sighted during survey along alignment, but reported by locals and forest staff
Serow	*Capricornis sumatraensis*	Near Threatened Schedule II	Not sighted during survey along alignment, reported by locals and forest staff
Barking deer	*Muntiacus muntjak*	Least Concern Schedule III	Foot marks sighted during survey along alignment
Sambar	*Cervus unicolor*	Vulnerable Schedule III	Not sighted, but reported by locals and forest staff
Wild pig	*Sus scrofa*	Least Concern Schedule III	Foot marks sighted during survey along alignment

Schedule I* means that the species is included in the Schedule I of the Wildlife Protection Act of India.

** The project area is taken to mean within about 10 km radius of the project road alignment, including the Kanchup Reserve Forest, even though the project will only encroach about 20-30 meters strip for 2.1 kms length in the Kanchup Reserve Forest). See below for detailed explanations of species distributions (whether in the project area or not).

Table 2: Species-specific distribution and habitat requirement data
(from the IUCN database, Schedule 1 of India's Wildlife (Protection) Act, India wildlife research papers, and survey data along the project road).

Legend: ***Indicates the Project Area location***

Common Name	Scientific Name	IUCN and National Threat Category	Present in Project Area
Plants			
Cycad	*Cycas pectinata*	Vulnerable Schedule VI	Not recorded during survey along alignment, but mentioned in Working plan of forest division

IUCN Status: Listed as Vulnerable due to an estimated decline in habitat of >30% over the past 90 years (three generations = 120 years). This species is also listed on Appendix II of the CITES Appendices and Schedule VI of India protected list.

Range: *C. pectinata* is abundant in the hill forests of northeastern India, and has also been collected from Nepal, Bhutan and Bangladesh. It extends into northern Burma (Myanmar) and Yunnan Province in southern China, and south and east into northern Thailand, Lao PDR, Viet Nam and northeastern Cambodia. Recorded from 600 to 1,300 m asl.

Native to: Bangladesh; Bhutan; Cambodia; China (Yunnan); India (Uttar Pradesh); Lao People's Democratic Republic; Myanmar (Myanmar (mainland)); Nepal; Thailand; Viet Nam. There is no Red List distribution information available for this species. This is a common and widespread species. Population trend is decresing.

This species occurs in medium to tall closed forest on deep, often clay-rich and more fertile soils, usually as part of the general shrub understorey in moderate to deep shade. *C. pectinata* is a plant of medium to higher elevations and moist conditions. It is recorded from a variety of substrates, but most frequently occurs on clay soils over limestone. Climate is tropical with wet, humid summers and milder, drier winters. Although often found on limestone substrates, it is by no means restricted to these, and it also occurs on granites and meta-sediments. The Hill tribes in Assam and northeastern India, eat the seeds and emergent leaves are used as a vegetable. The fleshy stem is pounded and used as a hair wash. Although its habitat is continually being reduced, large populations remain, and it is not under any immediate threat of extinction.

Source of data above: Nguyen, H.T. 2010. *Cycas pectinata*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

Working Plan of Northern Forest Division, Forest Department, Government of Manipur

Khuraijam Jibankumar Singh & Rita Singh. 2012. Cycad conservation and its challenges in India. In Bhattacharya and Garg (eds) News challenges: New opportunities in environment. McMillan: New Delhi

IFC Criteria: No Tier 1 criteria are triggered, since the *C.pectinata* is not CR and EN. Also, since the *C.pectinata* is widespread species and large population remains and the species is not under any immedciate threat of extention, Tier 2 criteria are not triggered (the project area is not supporting nationally or regionally important concentrations of *C.pectinata*). The species is not recorded during the surveys along the project road alignment. Also it is widespread species and large population remains and the species is not under any immediate threat of extinction. It is native species of Assam and Myanmar (mainland). In the project areas it is not recorded in abundance. Review of the data indicate that species occurs in medium to tall closed forests in deep which is not common in the project areas. The habitat in project area is disturbed and open. As such project area does not support regionally important concentrations of *C.pectinata*

Conclusion Regarding Project Interections with Critical Habitat: The species is not observed in the project area as it is limited to tall closed forests in deep. Therefore there are no concerns for *C.pectinata.* However in case during the project execution if this plant species is found within the proposed alignment of the project road, neessary measures including transplantation will be carried out in coordination with conservator of forests of Northern, Senapati, and Tamengong Forests Divisions of Manipur.

Wild life (Birds)			
Great Indian hornbill	*Buceros bicornis*	Near Threatened Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff

IUCN Status: Classified as Near Threatened (NT) on the IUCN Red List and listed on Appendix I of CITES.

Range: Although this species has a large range, it occurs at low densities and is patchily distributed. It may have a moderately small population and is likely to be declining moderately rapidly throughout its range; it is therefore listed as Near Threatened.

Buceros bicornis has a wide distribution, occurring in **China** (rare resident in west and south-west Yunnan and south-east Tibet), **India** (locally fairly common, but declining), **Nepal** (local and uncommon, largely in protected areas), **Bhutan** (fairly common), Bangladesh (vagrant), **Myanmar** (scarce to locally common resident throughout), **Thailand** (widespread, generally scarce but locally common), **Laos** (formerly common; currently widespread but scarce and a major decline has clearly occurred), **Vietnam** (rare and declining resident), **Cambodia** (rare), peninsular **Malaysia** (uncommon to more or less common) and **Indonesia**: the species is now uncommon on Sumatra where it has shown a significant decline following recent devastation of the island's lowland forest (K. D. Bishop *in litt.* 2012).

Native to: Found in East Asia and South & Southeast Asia. It is native to Bhutan; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Thailand; Viet Nam

The population has been estimated to number 3,500 individuals in west India. This only constitutes 5-24% of the species’ range, so a very preliminary estimate of the total population is 10,000-70,000 individuals. It is probably best placed in the band 20,000-49,999 individuals.

It is forest habitat (Subtropical / Tropical Moist Lowland and Subtropical / Tropical Moist Montane). This species frequents wet evergreen and mixed deciduous forests, ranging out into open deciduous areas to visit fruit trees and ascending slopes to at least 1,560 m (Mudappa and Raman 2009). The abundance of this species tends to be correlated with the density of large trees, and it is therefore most common in unlogged forest; indeed, recent work has shown a significant nesting preference for larger trees, usually in old-growth forest (James and Kannan 2009).

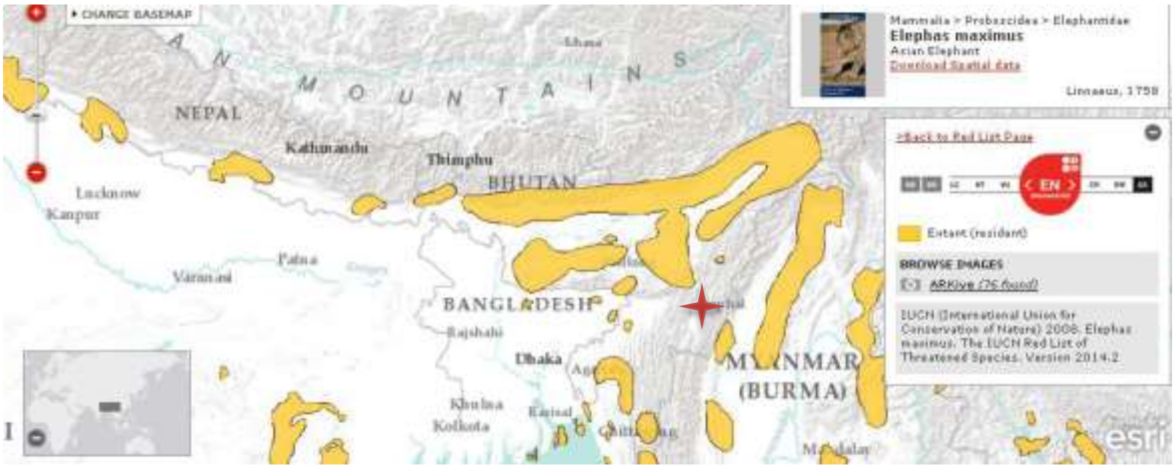
Logging is likely to have impacted on this species throughout its range, particularly as it shows a preference for forest areas with large trees that may be targeted by loggers. Forest clearance for agriculture is also likely to have contributed to declines. It is particularly susceptible to hunting pressure as it is large and visits predictable feeding sites (such as fruiting trees), and its casques are kept or sold as trophies. It is also probably impacted by the pet trade (Eames 2008).

Source of data above: BirdLife International 2013. *Buceros bicornis*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: No Tier 1 criteria are triggered, since the Great Indian hornbill is not CR and EN. Also, since the hornbill occurs throughout other parts of India and Asia, Tier 2 criteria are not triggered (the project area is not supporting nationally or regionally important concentrations of hornbills).

Conclusion Regarding Project Interactions with Critical Habitat: While the Great Indian hornbill are reported in the project area (no direct sighting along the project road alignment), the species is found in mature, dense, evergreen and broadleaved forest, mainly in the hills up to altitudes of 1,800 m, which is much lower than the project area (85% of the road alignment, all in the northern section, is higher than 1,800 m asl). There are few areas of pristine forest with the large trees required for hornbill in the project area. It is concluded that the project area is not critical to the survival of this species. In any case, there will be minimal clearing of trees along the road alignment. It is considered that the project impacts on the habitat and population of this species will be negligible.

Wild life (Animals)			
Asian Elephant	Elephas maximus	Endangered Schedule I	No



IUCN Status. Endangered. Also this species is listed on CITES Appendix I.

Listed as Endangered (EN) because of a population size reduction inferred to be at least 50% over the last three generations, based on a reduction in its area of occupancy and the quality of its habitat. Although there are few accurate data on historical population size, from what is known about trends in habitat loss/degradation and other threats including poaching, an overall population decline of at least 50% over the last three generations (estimated to be 60–75 years, based on a generation time estimated to be 20–25 years) seems realistic.

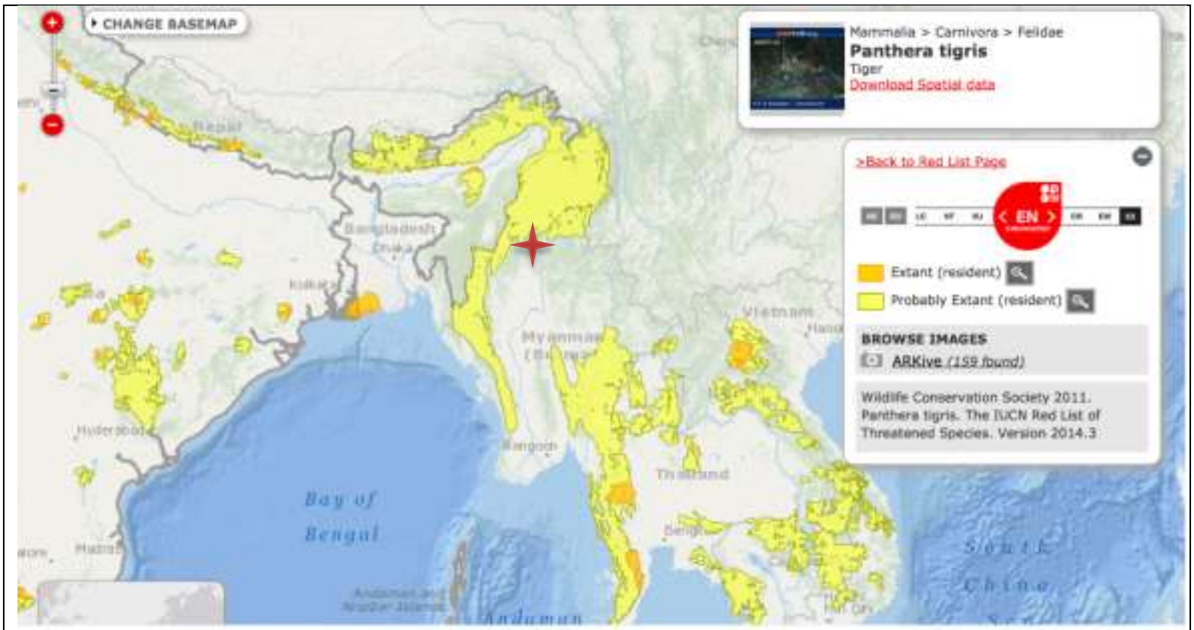
Asian elephants formerly ranged from West Asia along the Iranian coast into the Indian subcontinent, eastwards into South-east Asia. The species occurs in Bangladesh, Bhutan, India, Nepal, and Sri Lanka in South Asia and Cambodia, China, Indonesia (Kalimantan and Sumatra) Lao PDR, Malaysia (Peninsular Malaysia and Sabah), Myanmar, Thailand, and Viet Nam in South-east Asia. Feral populations occur on some of the Andaman Islands (India).

Once widespread in India, the species is now restricted to four general areas: northeastern India, central India, northwestern India, and southern India. In northeastern India, the elephant range extends from the eastern border of Nepal in northern West Bengal through western Assam along the Himalaya foothills as far as the Mishmi Hills. From here it extends into eastern Arunachal Pradesh, the plains of upper Assam, and the foothills of Nagaland. Further west, it extends to the Garo Hills of Meghalaya through the Khasi Hills, to parts of the lower Brahmaputra plains and Karbi Plateau. Elsewhere in the south in Tripura, Mizoram, Manipur, and the Barak valley districts of Assam, isolated herds occur (Choudhury, 1999).

The Asian elephant has a wide, but highly fragmented, distribution in Myanmar. The five main areas of elephant abundance are: the Northern Hill Ranges, the Western Hill Ranges, Pegu Yoma (central Myanmar), Tenasserim Yoma (in the south, bordering Thailand), and Shan State or eastern Yoma. In Manipur Asian Elephants are reported in the Yangoupokpi Lokchao Wildlife Sanctuary (bordering Myanmar at Moreh) and movement is generally reported across Myanmar border.

Native to: Bangladesh; Bhutan; Cambodia; China; India; Indonesia (Kalimantan, Sumatera); Lao People's Democratic Republic; Malaysia (Peninsular Malaysia, Sabah); Myanmar; Nepal; Sri Lanka; Thailand; Viet Nam

A recent estimate for the global population size of the Asian elephant was 41,410–52,345 animals Sukumar (2003) The estimated population size in India is about 26,390–30,770. Based on data it appears almost certain that over 50% of the remaining wild Asian elephants occur in India. The overall population trend of the Asian elephant has been downwards, probably for centuries. This remains the case in most parts of its range, but especially in most of the countries of South-east Asia. Within India, there is evidence that the large population in the Western Ghats in south of the country has been increasing in recent years due to improved conservation effectiveness. Asian elephants are generalists and they occur in grassland, tropical evergreen forest, semi-evergreen forest, moist deciduous forest, dry deciduous forested and dry thorn forest, in addition to cultivated and secondary forests and scrublands. Over this range of habitat types elephants are seen from sea level to over 3,000 m asl. In the Eastern Himalaya in northeast India, they regularly move up above 3,000 m asl in summer at a few sites (Choudhury, 1999). The Asian elephant is one of the last few mega-herbivores (i.e. plant-eating mammals that reach an adult body weight in excess of 1,000 kg) still extant on earth (Owen-Smith, 1988). Given their physiology and energy requirements, elephants need to consume large quantities of food per day. They are generalists and browse and graze on a variety of plants. The proportions of the different plant types in their diet vary depending upon the habitat and season. This species is listed on CITES Appendix I. The most important conservation priorities for the Asian elephant are: 1) conservation of the elephant's habitat and maintaining habitat connectivity by securing corridors; 2) the management of human–elephant conflicts as part of an integrated land-use policy that recognizes elephants as economic assets from which local people need to benefit or at least no suffer; 3) better protection to the species through improved legislation and law enforcement, improved and enhanced field patrolling, and regulating/curbing trade in ivory and other elephant products. Monitoring of conservation interventions is also needed to assess the success or failure of the interventions so that adjustments can be made as necessary (i.e. adaptive management). Reliable estimation of population size and trends will be needed as part of this monitoring and adaptive management approach. Source of data above: Choudhury, A., Lahiri Choudhury, D.K., Desai, A., Duckworth, J.W., Easa, P.S., Johnsingh, A.J.T., Fernando, P., Hedges, S., Gunawardena, M., Kurt, F., Karanth, U., Lister, A., Menon, V., Riddle, H., Rübel, A. & Wikramanayake, E. (IUCN SSC Asian Elephant Specialist Group) 2008. *Elephas maximus*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**. **IFC Criteria:** The Asian elephant occurs only in small herds at southern part of Manipur (in YLWLD bordering Myanmar) and southern India, and in other countries in West Asia along the Iranian coast into the Indian subcontinent, eastwards into South-east Asia, as indicated by the IUCN database (see map). It has never been seen in the Kangchup Reserve Forest and along the project road alignment. The project area has no habitat importance for Asian elephants, so does not trigger Tier 1 or 2 criteria. **Conclusion Regarding Project Interactions with Critical Habitat:** There is no concern for elephants, as they do not occur in the project area (restricted to YLWLS bordering Myanmar, and other parts of India and elsewhere).			
Tiger	Panthera tigris	Endangered Schedule I	No



IUCN Status: Listed as endangered, as a precautionary approach finds that the population of breeding adult Tigers is likely fewer than 2,500 mature individuals (in 42 protected source sites, there is evidence of a breeding total of 2,154 Tigers). Also included in Schedule 1 of India list. Tiger range appears to have declined by over 50% over the last three generations (21–27 years) (Dinerstein *et al.* 2007, Walston *et al*. 2010b). Comparing present Tiger population estimates (approximately 3,000) to those in the 1990s (5,000–7,000), despite the imprecision of the earlier estimate, also suggests a decline of at least 50% over this time period.

The Tiger once ranged widely across Asia, from Turkey in the west to the eastern coast of Russia (Nowell and Jackson 1996). Over the past 100 years Tigers have disappeared from southwest and central Asia, from two Indonesian islands (Java and Bali) and from large areas of Southeast and Eastern Asia. Tigers have lost over 93% of their historic range (Sanderson *et al*. 2006, Walston *et al.* 2010b). Tigers are currently found in thirteen Asian range states: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russia, Thailand and Viet Nam. They may still persist in North Korea, although there has been no recent confirmed evidence.

In India, landscapes with Tigers found to be much smaller and more fragmented than in the original assessment (Sanderson *et al.* 2006: 63 and Figure). India holds over half the world's tiger population. According to the latest tiger census report released on March 28, 2011 by the National Tiger Conservation Authority, the current tiger population estimated is 1,706 (i.e. ranging between a minimum of 1,571 to a maximum of 1,875). The results include figures from 17 Indian states with a tiger population. In 2008 the tiger population figure stood at 1,411. The Tiger Census 2008 report had classified the tiger occupied forests in India into 6 landscape complexes; namely (a) Shivalik-Gangetic Plains, (b) Central Indian Landscape Complex (c) Eastern Ghats, (d) Western Ghats, (e) North-Eastern Hills and Bhramaputra Plains, and (f) Sunderbans. Northeastern hills and Bhramaputra plains reported tiger occupancy in 4230 km^2 of forests. Many of the tiger populations, particularly those outside protected reserves, are fragmented, suffer from intense poaching pressure, a dwindling prey base and over-used habitat.

Native to: Bangladesh; Bhutan; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia (Peninsular Malaysia); Myanmar; Nepal; Russian Federation; Thailand; Viet Nam

Tigers are found mainly in the forests of tropical Asia, although they historically occurred more widely in drier and colder climes. One subspecies, the Amur Tiger *P.t. altaica*, persists in the Russian Far East. Photos of Tigers up to 4,500 m have been obtained in Bhutan (Wang 2008). The future of Tiger range depends upon the Asian governments creating effective Tiger landscapes by conserving large areas of suitable habitat. Within these landscapes, the most urgent need is to first secure the source sites—protected areas with viable Tiger populations—where most of the global Tiger population is now clustered, and many of which are currently too threatened to deliver their potential as the wellspring of species recovery (Walston *et al*. 2010b).

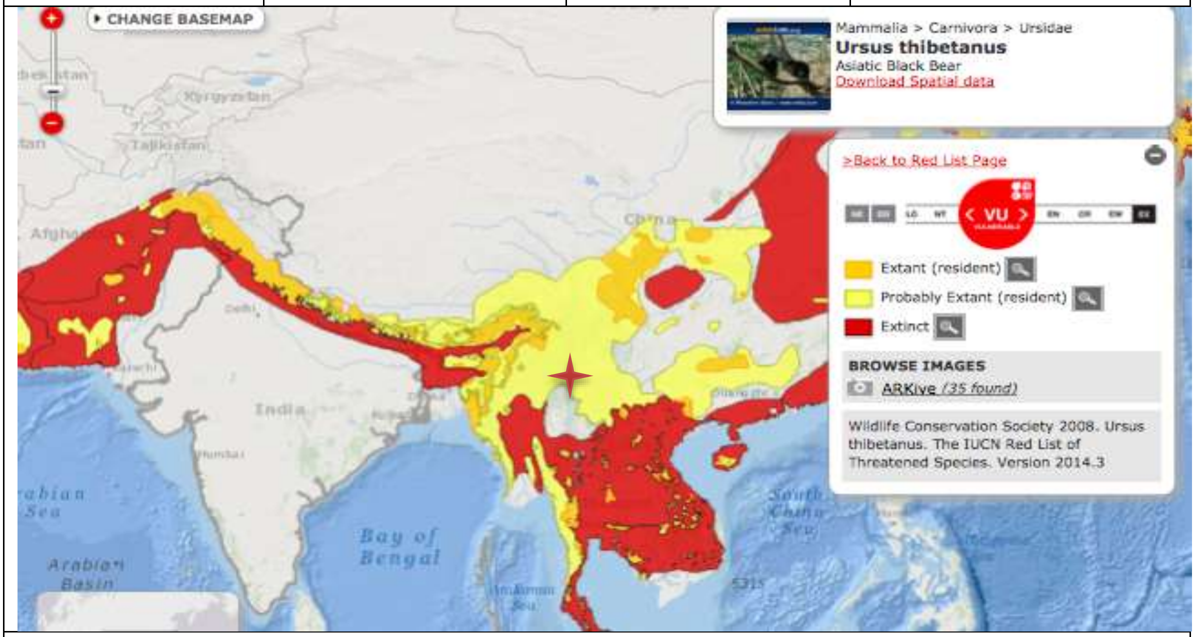
Source for data above: Chundawat, R.S., Habib, B., Karanth, U., Kawanishi, K., Ahmad Khan, J., Lynam, T., Miquelle, D., Nyhus, P., Sunarto, S., Tilson, R. & Sonam Wang 2011. *Panthera tigris*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

Wildlife Protection Society of India (current status of Tigers in India)

IFC Criteria: There are no tigers spotted neither reported in the project area. It has never been seen in the Kangchup Reserve Forest and along the project road alignment. There are at least 42 protected sites globally that support tiger populations. The project area has no habitat importance for Tigers, so does not trigger Tier 1 or 2 criteria.

Conclusion Regarding Project Interactions with Critical Habitat: There is no concern for tigers, as they do not occur in the project area (restricted to protected areas in Assam (Kaziranga), West Bengal (Manas National Park), and in Arunachal Pradesh.

Asiatic Black Bear	Ursus thibetanus	Vulnerable Schedule I	No



IUCN Status: Vulnerable. It has been included on CITES Appendix I. Although actual data on population sizes or trends are lacking, it seems likely, given the rate of habitat loss and uncontrolled exploitation that the world population has declined by 30–49% over the past 30 years (3 bear generations).

Range: (red areas in the map above indicate locations where the Asiatic Black Bear no longer occurs) Fossil remains of the Asiatic black bear have been found as far west as Germany and France, but in historic times the species has been limited to Asia. This species occupies a narrow band from southeastern Iran (Gutleb and Ziaie 1999) eastward through Afghanistan and Pakistan, across the foothills of the Himalayas, to Myanmar. It occupies all countries in mainland Southeast Asia except Malaysia. It has a patchy distribution in southern China, and is absent in much of east-central China. Another population cluster exists in northeastern China, the southern Russian Far East, and into North Korea. A small remnant population exists in South Korea. They also live on the southern islands of Japan (Honshu and Shikoku) and on Taiwan and Hainan. Sport hunting of Asiatic black bears is legal in Japan and Russia. The species now occurs very patchily through much of its former range, especially in Iran, Afghanistan, Pakistan, mainland southeast Asia and China. Its distribution in parts of China and Myanmar remains very poorly known.

The distribution of the Asiatic black bear roughly coincides with forest distribution in southern and eastern Asia (FAO 2006), except that in central and southern India this species is replaced by the sloth bear (*Melursusursinus*), in southern Thailand and into Malaysia it is replaced by the sun bear (*Helarctosmalayanus*) and north and west of the Russian Far East it is replaced by the brown bear (*Ursusarctos*). However, the Asiatic black bear overlaps the ranges of each of these species, especially the sun bear in a large portion of Southeast Asia.

Native to: Afghanistan; Bangladesh; Bhutan; Cambodia; China; India; Iran, Islamic Republic of; Japan; Korea, Democratic People's Republic of; Korea, Republic of; Lao People's Democratic Republic; Myanmar; Nepal; Pakistan; Russian Federation; Taiwan, Province of China; Thailand; Viet Nam.

Source for data above: Garshelis, D.L. & Steinmetz, R. (IUCN SSC Bear Specialist Group) 2008. *Ursus thibetanus*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: This animal is not IUCN critically endangered or endangered, so does not trigger Tier 1 criteria. Tier 2 criteria are not triggered, since the project area does not support nationally or regionally important concentrations of Asiatic Black Bears (they occur through Central and Southern part of India and other countries to the southeast Asia).

Conclusion Regarding Project Interactions with Critical Habitat: The Asiatic Black Bear prefers contiguous forest habitat. There is no concern for Asiatic Black Bear, as they do not occur in the project area.

Clouded Leopard	*Neofelis nebulosa*	Vulnerable Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff

IUCN Status: Vulnerable.

Range: The clouded leopard is found from the Himalayan foothills in Nepal through mainland Southeast Asia into China (Nowell and Jackson 1996). The clouded leopard historically had a wide distribution in China, south of the Yangtze, but recent records are few, habitat is fast disappearing, illegal hunting of this species has been prolific and its current distribution in China is poorly known (Wozencraft*et al.* 2008). The clouded leopard is extinct on the island of Taiwan (Anon. 1996). It still occurs marginally in Bangladesh: Khan (2004) reported that local people still see clouded leopards in the mixed-evergreen forests of the northeastern and southeastern parts of the country. The map shows range within forest cover (European Commission, Joint Research Centre, 2003) to reflect patchiness caused by deforestation upon recommendation of the assessors (IUCN Cats Red List workshop 2007).

Included on CITES Appendix I and protected by national legislation over most of its range (Nowell and Jackson 1996). Hunting is banned in Bangladesh, Brunei, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Nepal, Taiwan, Thailand, and Viet Nam, and hunting regulations apply in Lao PDR (Nowell and Jackson 1996). It occurs in many protected areas.

Native to: Bangladesh; Bhutan; Cambodia; China; India; Lao People's Democratic Republic; Malaysia (Peninsular Malaysia); Myanmar; Nepal; Thailand; Viet Nam

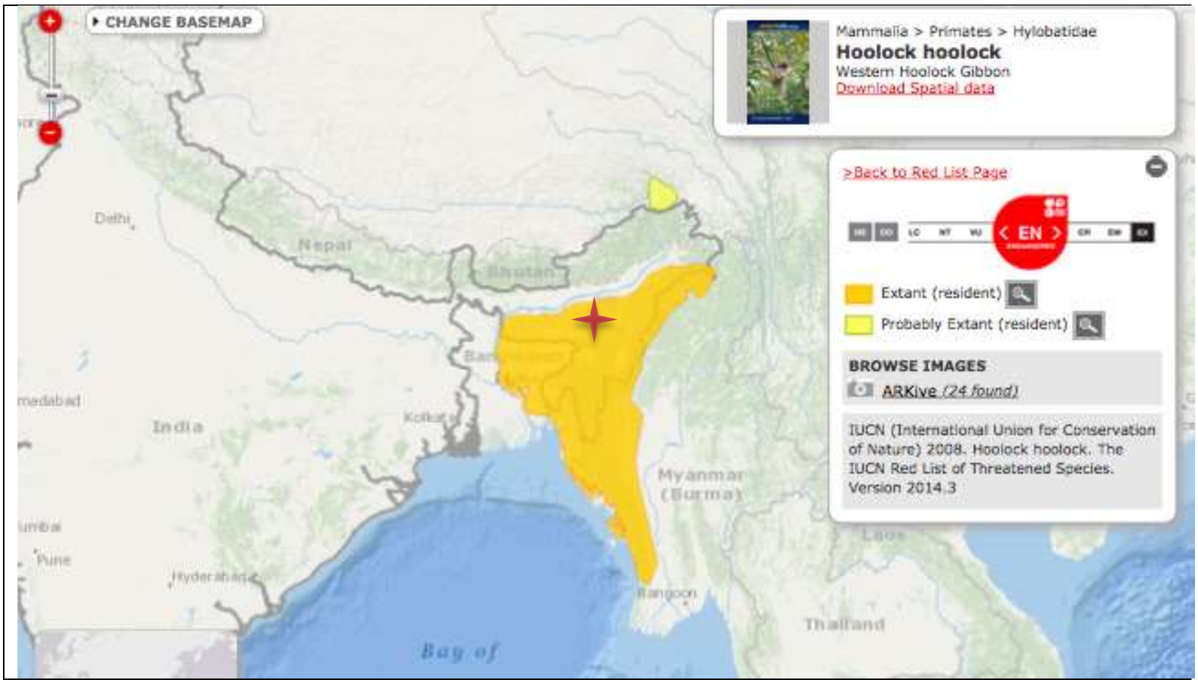
They are strongly associated with forest habitat, particularly primary evergreen tropical rainforest, but there are also records from dry and deciduous forest, as well as secondary and logged forests. They have been recorded in the Himalayas up to 2,500 m and possibly as high as 3,000 m. Less frequently, they have been found in grassland and scrub, dry tropical forests and mangrove swamps (Nowell and Jackson 1996). Clouded leopards prefer closed forest (Grassman *et al.* 2005, Austin *et al.* 2007), and their habitat in Southeast Asia is undergoing the world's fastest deforestation rate (1.2-1.3% a year since 1990: FAO 2007).

Source for data above: Sanderson, J., Khan, J.A., Grassman, L. & Mallon, D.P. 2008. *Neofelis nebulosa*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: Clouded leopards have never been recorded in the project area along the project road and also during wildlife surveys it has not spotted. However forest officials and locals reported presence of clouded leopard in the region. The animal is not IUCN critical or endangered, so does not trigger Tier 1 criteria. Also, because this animal is only IUCN “vulnerable” and Schedule 1, the project area does not trigger Tier 2 criteria, since there are no nationally or regionally important concentrations of clouded leopards in this region of the country.

Conclusion Regarding Project Interactions with Critical Habitat: While clouded leopards may occur in forests of the project area, it is therefore suggested that the project area, as degraded forest habitat adjacent to human settlements, is not important for this animal. Project interactions with the clouded leopard are not expected (even if this animal were to occur there), as they will continue to have undisturbed access to the large forested areas of Kangchup Reserve Forests.

Hoolock	*Hylobates hoolock*	Endangered Schedule I	Not sighted during survey along alignment, but reported by locals and forest staff



IUCN Status: Listed as Endangered as there is reason to believe the species has declined by at least 50% over the past 40 years (approximately three generations) due primarily to hunting and habitat loss. Over the coming 40 years, this decline is likely to reach similar proportions due to continuing habitat loss. This species is listed on CITES Appendix I and on schedule I of the Indian Wildlife (Protection) Act of 1972. Overall, it is found in 30 protected areas in India (Choudhury 2001) and many others throughout its range.

Native to: This species is found in eastern Bangladesh, northeastern India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura), and northwestern Myanmar (west of the Chindwin River). It might possibly occur in China (extreme southeastern Tibet). The distribution in India is restricted to points south of the Brahmaputra and east of the Dibang (Dingba Qu) Rivers (Choudhury 2001). Animals that once were common in the plains of Arunachal Pradesh (northeasternmost India) before that habitat was cultivated for agriculture and tea are not so anymore (Islam and Feeroz 1992).

This species occurs in several of India's northeastern states, but populations there tend to be isolated. It is common in certain areas of occurrence, but rare in others due to intense hunting by local tribes (Choudhury 1991), and is considered rare throughout its range (Choudhury 2001). The species was found in all forested patches in northeastern India about 30 years ago, but they are reduced to a few forest fragments now. The total population in northeastern India was estimated to be about 2,600, of which the majority—about 2,000—occurs in the state of Assam (Molur *et al*. 2005). A population of about 170 gibbons has more recently been identified as *H. leuconedys* (Das *et al*. 2006) and should be subtracted from the population estimate if this identity is proven. Moreover, there are surveys needed in Mehao region, where there is uncertainty as to which species the gibbons there represent (Das *et al.* 2006; Das pers. comm.). Namdapha National Park in the Changlang District of Arunachal Pradesh is a relative stronghold for this species in India, offering the population there its largest contiguous stretch of protected habitat (Chetry *et al.* 2003).

There are no population estimates available for Myanmar. It is possible that the largest and most viable populations of western hoolock are to be found in this country, where at present almost no attention is paid to it (W. Brockelman pers. comm.). There are several thousand square kilometers of unsurveyed forest habitat in the central-west and north-west of this country, with a particular need to survey the western areas west of Chindwin/Ayerawady River. There are reports of gibbons in Rakhine Yoma Elephant Range, but there is no knowledge of the actual population level there (W. Brockelman pers. comm. 2006). The

western part of Hukuang Tiger Reserve with a large area of forest (>1,000 km^2) has not been surveyed, but is likely to have this species. The northern limit is just south of Hkakaraborazi National Park. This species is a forest-dweller that, depending on its locale, inhabits tropical evergreen rainforests, tropical evergreen and semi-evergreen forests, tropical mixed deciduous forests, and subtropical broadleaf hill forests. It has also been noted in bamboo "brakes" and hollock (*Terminalia myriocarpa*) and ajhar (*Largerstroemia flosreginae*) plantations. One gibbon pair in the Borajan Reserved Forest (north-east India) was observed to habitually descend from the trees to move over scrub and short bamboo especially while trying to reach the isolated food trees inside a village. This pair was found sleeping at heights of 0 m or less in bamboo clumps (Kakati 1997). Although gibbons may be moving through, or sleeping in, bamboo forest or plantations, they cannot survive in monocultures (W. Brockleman pers. comm.). Additionally, the species has been observed in two plains forest locations (Choudhury 1991). Its preferred habitat, however, is dense evergreen and semi-evergreen forests (Choudhury 2001). It has been recorded at altitudes of up to 2,500 m in Manipur, northeast India (Choudhury 2001). In some Indian locales, these animals are rare due to large scale hunting for food and because some ethnic groups believe the gibbons have medicinal properties (Gupta 2005; J. Das pers. comm.). Additionally, jhoom cultivation threatens the habitats of Indian populations, some of which are relatively isolated already (Choudhury 1991). Affecting all northeastern Indian primate populations are harvesting of bamboo for paper mills, oil mining and exploration, and coal mining, which deplete habitat and cause pollution and disturbance (Choudhury 2001). Habitat fragmentation and loss are major threats in India (Molur *et al.* 2005). Small and restricted groups may not be viable because of genetic and demographic instabilities and because they are more affected by hunting pressure and habitat loss. Many small forest fragments are reported to have only one or a few gibbon groups. These have limited chances of surviving more than a few generations without translocation. Source of above Data: Rockelman, W., Molur, S. & Geissmann, T. 2008. *Hoolock hoolock*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015** **IFC Criteria:** Although not sighted during the wildlife survey, Hoolock is common in the project areas (as reported by forest officials and locals). It is listed as endangered but population is dispersed over 30 protected areas in India and wide area of northeastern India including Manipur, Arunachal Pradesh and Myanmar (see IUCN distribution map). The total population in northeastern India was estimated to be about 2,600, of which the majority—about 2,000 (about 77%)-occurs in the state of Assam alone (Molur *et al*. 2005). The population of Hoolock is about 1 % (of the global population). Therefore, Tier 1 criteria does not trigger. Also, since there are no nationally or regionally important concentrations of Hoolock in this region of the country, Tier 2 criteria does not trigger. **Conclusion Regarding Project Interactions with Critical Habitat:** Hoolock may occur in the Kangchup Reserve Forest and degraded forests along the proposed alignment. It is suggested that project proponents will coordinate with local wildlife authorities to minimum impacts on Hoolock due to project activities. Project will have resource to implement conservation activities for Hoolock in compliance with conservation activities of working plans of the forest divisions of Northern Division and Senapati division on Manipur. It is also suggested trees (such as fruit bearing trees, which are common attractions for Hoolock) should be grown away from the proposed alignment to sustain Hoolock.			
Slow loris	*Nycticebus coucang*	Vulnerable Schedule I	Sighted during survey along alignment

IUCN Status: Vulnerable as there has probably a more than 30% reduction in population over three generations (approximately 21-24 years) based on harvesting for the pet trade and extensive habitat loss.

This species occurs in Indonesia (Sumatra, Batam and Galang in the Riau Archipelago, and Pulau Tebingtinggi and Bunguran in the North Natuna Islands), Malaysia (on the Peninsula and the island of Pulau Tioman), southern peninsular Thailand (from the Isthmus of Kra southward), and Singapore (Groves 2001; M. Shekelle pers. comm.)

Native to: Indonesia (Sumatera); Malaysia (Peninsular Malaysia); Singapore; Thailand

Surveys in Sumatra have found this species to occur at very low densities. Its presence is patchy through Peninsular Malaysia. Several short-term studies indicated that it usually occurs at low densities: Pasoh Forestry Research Centre, Peninsular Malaysia (0.01-0.02 animals/km); Petalang Jaya, Malaysia (0.40 animals/km); Genting Sempah, Malaysia (3 captures after 30,000 trap nights) (Barret 1981; Rudd and Stevens 1992; Nekaris *et al.* in press). It was described as uncommon in Panang Island, where one was shot after 11 nights (Liat *et al* 1971). But at sites where long-term studies were chosen found forests where they occur at particularly high densities (Sungai Tekam Forestry Concession, Malaysia, 0.3-0.8 animals/km in logged primary forest, 0.5-1.2 animals/km in unlogged primary forest; Manjung District, Perak, Malaysia, 1.6-4.0 animals/km in unlogged primary forest and 0.4-1.0 animals/km in logged swamp forest and secondary savanna). In general, though, slow lorises of all taxa appear to occur at very low densities (Nekaris *et al*. in press).

The species occurs in primary and secondary lowland forest, gardens, and plantations (Timm and Birney 1992). It is seen more often in edge habitat of forest, possibly because the edge has more supports that may increase foraging efficiency (Johns 1986), but this also may be due to sampling bias, as they are more easily seen on forest edges (Nekaris *et al*. in press). It is frugivorous, but will also eat insects, leaves, and bird eggs (Johns 1986). One long-term study has shown that they consume mainly nectar gum and sap, with fruit and arthropods forming small proportion of diet. Nectar from the flowers of the burtram palm (*Eugeissona tristus*) seems to be a key resource (Wiens and Zitzmann 2003).

The species is collected for use as pets, and the animals are sold throughout Southeast Asia (Nekaris and Bearder 2007; Nekaris and Nijman 2007). The teeth are often pulled, resulting in infection and/or death. If animals survive, lack of teeth makes reintroduction impossible. Well-meaning rescue centres haphazardly reintroduce lorises into local forests without knowledge of their taxonomy or social needs. Sumatran populations are particularly impacted by the pet trade. There is little information available on other threats to this species. It is relatively adaptable to anthropogenic habitats, and so it might less affected by forest loss than some other primate species. Nevertheless, forest loss has been so severe in the region that it is likely to have had some negative impacts. Animals are shot as crop pests and for other reasons (Bennett *et al*. 1994).

The species occurs in several protected areas throughout its range.. The species is protected by law in Malaysia, Thailand and Indonesia, and has been recently transfer from Appendix II to Appendix I of CITES (Nekaris and Nijman 2007).

Source of above data: Nekaris, A. & Streicher, U. 2008. *Nycticebus coucang*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: This animal is not IUCN critically endangered or endangered, so does not trigger Tier 1 criteria. Tier 2 criteria are not triggered, since the project area does not support nationally or regionally important concentrations of Slow loris (they occur through Malaysia, Thailand and Indonesia).

Conclusion Regarding Project Interactions with Critical Habitat: The Slow loris prefers primary and secondary lowland forest, gardens, and plantations. The species is spotted at two locations during the wildlife surveys along the project road. Project activities may temporarily affect these species. It is suggested that project authorities will coordinate with wildlife division of Manipur to implement conservation activities for Slow loris in the project areas.

Bison (Gaur)	*Bos gaurus*	Vulnerable Schedule II	Not sighted during survey along alignment, but reported by locals and forest staff

IUCN Status: Vulnerable. Gaur is listed in CITES Appendix I, and is legally protected in all range states. It occurs in many protected areas, although in northeast India, Myanmar, China, Lao PDR, Viet Nam and Malaysia many such areas retain only tiny populations or have already lost the species.

Range: Gaur historically occurred throughout mainland south and southeast Asia and Sri Lanka. It currently occurs in scattered areas in the following range states: Bhutan, Cambodia, China, India, Lao PDR, Malaysia (Peninsular Malaysia only), Myanmar, Nepal, Thailand, and Viet Nam, but is extinct in Sri Lanka and also, as a resident, apparently in Bangladesh (Grubb 2005; MdAnwarul Islam in litt. 2008; Hedges in prep.). The species is now seriously fragmented within its range, and the mapped distribution is generalized, especially in India, Myanmar, China and Malaysia. The domesticated form of Gaur, considered by IUCN a separate species (*Bosfrontalis*; Mythun, Mithan or Gayal), occurs in parts of India, China, and Myanmar as feral, semi-feral, and domestic animals. This animal is excluded from the red-listing considerations for Gaur.

Native to: Bangladesh; Bhutan; Cambodia; China; India; Lao People's Democratic Republic; Malaysia (Peninsular Malaysia); Myanmar; Nepal; Thailand; Viet Nam

The global population is estimated to lie within 13,000–30,000 animals. Field data suggest that the proportion of mature individuals in the population is likely to be 0.4–0.6, indicating a total of 5,200–18,000 mature individuals, with no population known to have over 1,000 individuals (S. Hedges pers. comm. 2000).

In India, three major (Western Ghats, Central India and North-East) and two minor (Bihar and West Bengal) “Gaur conservation areas” have been identified, reflecting the remaining distribution (Sankar *et al*. 2000; Choudhury 2002). The Western Ghats and their outflanking hills in south India constitute one of the most extensive extant strongholds of Gaur, with good numbers in Wynaad – Nagarahole – Mudumalai – Bandipur complex (Ranjitsinh 1997). Recent distributional assessment surveys in the Karnataka part of the Western Ghats showed the presence of Gaur in more than 60% of the 22,000 km² landscape (K.U. Karanth and N.S. Kumar unpublished data). Ranjitsinh (1997) estimated 12,000–22,000 in India, while Choudhury (2002) suggested that there were about 23,000–34,000 Gaur in India, Bhutan, and Bangladesh; but the true number is simply not known, as shown by the wide ranges. Major populations have been reported in Nagarahole National Park (probably over 2,000), Manas Wildlife Sanctuary (not known; may not be large), Bhadra Wildlife Sanctuary (over 800), Melghat Tiger Reserve (perhaps 500), Bandipur National Park (over 2,000), Kanha National Park (probably under 200), Radhanagari Wildlife Sanctuary (not known; may not be large), Tadoba–Andhari Tiger Reserve (over 1,000), Periyar Tiger Reserve and adjoining forest complex (500–1000), Annamalai range complex (Parambikulum, Valparai, and Grass Hills) (500–700), Silent Valley and adjoining forest complex (500–1000), Agastyamalai forest complex (about 500), Biligirirangangswamy Wildlife Sanctuary and Malemahadeswara Hill range (over 1000), Anshi–Dandeli Tiger Reserve and adjoining forest mosaic (perhaps about 400), Kudremukh National Park and Someshwara Wildlife Sanctuary (about 200–400), Brahmagiri–Pushpagiri–Talakaveri Sanctuary, Mukurti National Park, Pench Tiger Reserve, Jaldapara Wildlife Sanctuary (‘a large population’), Chapramari Wildlife Sanctuary (‘a large population’), and Gorumara Wildlife Sanctuary (‘a large population’). Many other areas are known or suspected to hold small populations, but in many sites such small numbers are unlikely to be viable (Choudhury 2002). The foregoing figures were assigned by N.S. Kumar (pers. comm. 2008) and are based on a variety of sources and methods, and from most areas are for guidance only. An increasing rigour is being applied to large mammal population estimation in India and some of the figures here will warrant modification and future changes to the quoted populations should not necessarily be seen as indicating that a real change in numbers has occurred. In recent years Gaur has reportedly been exterminated from three protected areas, Thattekad Wildlife Sanctuary (Kerala), Bhandhavgarh (Madhya Pradesh) and Kanger Valley National Park (Madhya Pradesh) (Pasha *et al*. 2004). Information on population status from the states of Andhra Pradesh, Orissa and North-East is limited (Choudhury 2002); there are demonstrably very few Gaur in Kaziranga (Karanth and Nicholls 2000). Recent population trends appear to have been stable in well protected areas. The following densities have been estimated: Bhadra Tiger Reserve, 1.48 +/- 0.63 (SE) per km² (Jathanna *et al*. 2003); Pench (Madhya Pradesh) dry deciduous forest, 0.7 animals per km² (Karanth and Nichols 2000); Nagarahole moist deciduous forest,

9.6 animals per km², making it the second-most abundant ungulate there (Karanth and Sunquist 1992); Bandipur dry deciduous forest, 7.0 animals per km² (Karanth and Nichols 2000); Tadoba-Andhari dry deciduous forest, 1.8 animals per km² (Karanth and Kumar 2005); Melghat dry deciduous forest, 1.0 animals per km² (Karanth and Kumar 2005); Pench (Maharashtra) dry deciduous forest, 0.8 animals per km² (Karanth and Kumar 2005). No densities could be estimated, despite the use of suitable survey methodology, at Kanha or Namdapha, implying relatively low populations, and none was found during such surveys at Kaziranga or Ranthambore (Karanth and Nichols 2000); only small numbers persist in Kaziranga (N.S. Kumar pers. comm. 2008). The Bhadra density is low, reflecting poaching (using snares, dogs and shotguns) and livestock grazing. However, the Gaur population there is now steadily increasing with successful conservation interventions (K.U. Karanth and N.S. Kumar unpublished data). A study at Nagarahole National Park compared the fauna of an area which was only moderately hunted with a heavily hunted site: this found respective densities of six and two Gaurs per km² (Madhusudan and Karanth 2002). The Gaur occurs from sea level up to at least 2,800 m asl (Wood 1937; Wharton 1968; Choudhury 2002). Despite the many reports that call it an animal of hill-country, low-lying areas seem to comprise optimal habitat (Choudhury 2002): in Conry's (1989) study area, elevations ranged from 46 to 1,079 m asl but the three radio-tracked Gaur only used areas below 381 m. Elevations below 61 m were used most intensively and all three animals selected these low-lying areas; elevations above 61 m were selected against or used in proportion to availability (Conry 1989). Similarly, in the Tenasserim–Dawna mountains, Thailand, signs of Gaur were more abundant in the lowlands than in the hills, noting that this was the opposite of the patterns that would be predicted if hunting (itself concentrated heavily in the lowlands) was the chief determinant of population densities, although solitary animals were found mainly in the hills (Steinmetz *et al*. 2008). Gaur habitat to be "characterized by (1) large, relatively undisturbed forest tracts, (2) hilly terrain below an altitude of 5,000 to 6,000 ft (1,500–1,800 m asl), (3) availability of water, and (4) an abundance of forage in the form of coarse grasses (including bamboo), shrubs, and trees". *Source for data above:* Duckworth, J.W., Steinmetz, R., Timmins, R.J., Pattanavibool, A., Than Zaw, Do Tuoc& Hedges, S. 2008. *Bosgaurus*.The IUCN Red List of Threatened Species.Version 2014.2.<www.iucnredlist.org>. Downloaded on **02 September 2014**. **IFC Criteria:** Gaur have never been recorded in the project area. As such, the project area is not serving as critical habitat for gaur. Gaur are not IUCN critically endangered or endangered, so Tier 1 criteria are not triggered. In any case, it is impossible that more than 10% of the global population (which would be 1,300 to 3,000 animals) occurs in the project vicinity. Also, there are many gaur habitat locations throughout south and southeast Asia. The project area is not considered a Gaur management site. Also, Tier 2 criteria are not triggered, since the project area does not support nationally or regionally important concentrations of gaur. **Conclusion Regarding Project Interactions with Critical Habitat:** The project area is not in the prime habitat and range of the gaur. Most of the gaur population is in the protected areas and in dense forests. It is therefore concluded that the proposed project clearing areas and work sites are not critically important to gaur, as most of the India population occurs further south, and they are not expected to occur at any project work sites.			
Hog badger	*Arctonyx collaris*	Near Threatened Schedule II	Not sighted during survey along alignment, but reported by locals and forest staff

IUCN Status: Near Threatened as it is undergoing a population decline but globally this is not believed to be at a rate sufficient to qualify for A2cd (i.e.<30% over 3 generations) at this time. Even though it is widespread, it is severely threatened in some areas (Lao, Viet Nam, southeastern China and perhaps Myanmar) by exploitation, which occurs at high levels, and field status surveys reveal that the species is now occurring only patchily and overall rather rarely in these countries.

Range: The hog badger occurs in Central to Southeast Asia. It is found in Mongolia, India (Sikkim, Terai, Assam, Arunacha Pradesh), throughout southern China, Indochina (Viet Nam, Lao PDR and Cambodia), Myanmar, in Indonesia (Sumatra), throughout Thailand and possibly in Perak, Malaysia (Lekagul and McNeely 1977; Duckworth 1997; Pocock 1941; Holden 2006; Roberton *et al.* in prep.; Than Zaw *et al*. in press). There is one isolated record in eastern Mongolia (Aimak Dornod) (Stubbe *et al*. 1998). According to Holden (2006) in Sumatra the hog badger appears to occur primarily above 2,000 m with one record at 700 m, and historical records also indicate a montane range (Miller 1942). Corbet and Hill's (1992) map suggest that on Sumatra the species is restricted to the southern part of the island, whereas, in fact, individuals have been found in many mountainous locations in the north as well (van Strien 2001).

Native to: Bhutan; Cambodia; China; India (Assam); Indonesia (Sumatera); Lao People's Democratic Republic; Mongolia; Myanmar; Thailand; Viet Nam

Population trends for the hog badger may vary across its range. In India, this species is fairly common in Terai. The hog badger is historically widespread in Viet Nam, but sightings seem to be declining (Roberton *et al*. in prep.).

The hog badger is active by day, terrestrial, and not very wary of humans (Duckworth *et al.* 1999). This species is often referred to as nocturnal, however, analysis of numerous camera-trap pictures from Myanmar show no peak at either day or night; it can be active at any time (Than Zaw *et al*. in press). It is usually found in forested areas as high as 3,500 m, and it feeds on “tubers, roots, earthworms, insects, and other small living creatures” (Lekagul and McNeely 1977). Wang and Fuller (2003) conducted a study on the food habits of this species in a rural agricultural area of southeastern China (Taohong Village, Jiangxi Province), and found that this species ate more mammals and gastropods than other species studied. Little is known about its breeding habits, though litter size seems to be two to three young, and individuals have lived up to seven years in captivity (Lekagul and McNeely 1977).

In India, this species is fairly common within grassland habitats of Terai, as well as in dense, tropical evergreen and semi-evergreen forests, and tall grassland -woodland mosaic.

Throughout its range, this species is found in a number of protected areas. In Thailand this species is protected by law, and in India this species is protected under the highest level of protection. It is not protected in Viet Nam or Cambodia and is the largest-bodied unprotected mammal, except for Euraisan Wild Hog Sus scrofa, in Myanmar (Than Zaw *et al.* in press). The China Red List has listed the hog badger as Vulnerable under C1 and A2c.

Source to above data: Timmins, R.J., Long, B., Duckworth, J.W., Wang Ying-Xiang & Than Zaw 2008. *Arctonyx collaris*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

FC Criteria: Hog badger is not IUCN critically endangered or endangered, so does not trigger Tier 1 criteria. Tier 2 criteria are also not triggered, since the project area does not support nationally or regionally important concentrations of Hog badger (they occur through Malaysia, Thailand and Indonesia).

Conclusion Regarding Project Interactions with Critical Habitat: In India Hog badger is commonly found in Sikkim, Terai, Assam, and Arunacha Pradesh. The project area do not have preferred habitat for this species. Therefore project interactions with the Hog badger are not expected.

Himalayan Serow	*Capricornis thar*	Near Threatened Schedule II	Not sighted during survey along alignment, reported by locals and forest staff

IUCN Status: Near threatened. Listed as Near Threatened because this species is believed to be in significant decline (but probably at a rate of less than 30% over three generations, taken at 21 years) due to hunting for food and habitat loss, making the species close to qualifying for Vulnerable under criteria A2cd.

Range: This species is known to occur in east and southeast Bangladesh, Himalayas (Bhutan, northern India including Sikkim and Nepal), China (Tibet only), northeast India (provinces east of Bangladesh), and probably into western Myanmar (Grubb, 2005).

Native to: Bangladesh; Bhutan; China; India; Nepal

Accounts from throughout the species' range report that it inhabits rugged steep hills and rocky places, especially limestone regions up to 3,000 m asl, and also in hill and mountain forest areas with gentler terrain.

The Himalayan serow is listed on Appendix I of CITES. In India, it is listed in Schedule I (revised March 1987) of the Wildlife (Protection) Act (1972) and is thus totally protected. This status has been accepted by all states except Nagaland. In China, it is a Class II nationally protected species.

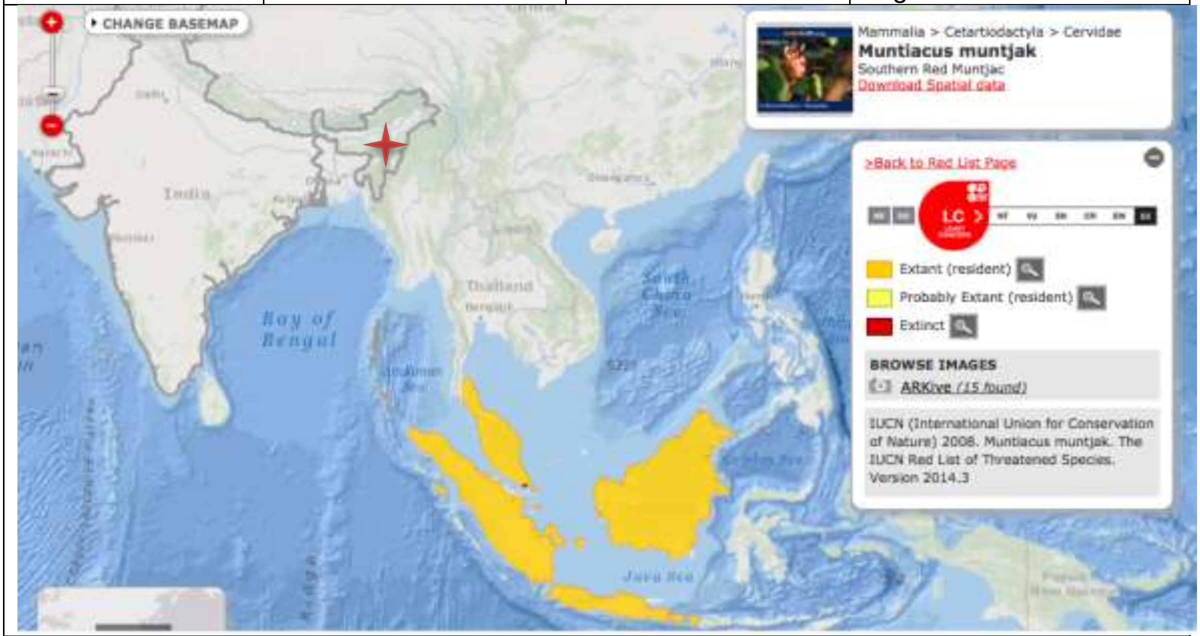
Within India, this species of serow occurs in a number of protected areas in Himachal Pradesh, Uttaranchal, and Sikkim, as well as a few protected areas in Manipur, Meghalaya, and Mizoram (Kathayat and Mathur (2002). In total, it is present in over 50 Indian protected areas, ranging in size from 4 km² to 1,800 km², and totaling about 17,000 km². However, many of these areas include substantial habitat unsuitable for serow and it is has been suggested that only some 6,000 to 8,000 km² of ca. 19,000 km² of good serow habitat in India, lies within protected areas (Johnsingh, 1991; Johnsingh *et al*., in prep. H). Serow occurs in the following protected areas (Fox *et al*., 1986; Green, 1987b; Kumar and Rao, 1985; Lamba, 1987; S. Pandey, 2002; Singh *et al*., 1990): Jammu and Kashmir- Dachigam National Park and Overa-Aru Wildlife Sanctuary; Himachal Pradesh-Great Himalayan National Park and the Daranghati, Gamgul Siya-Behi, Kalatop, Kanawar, Khokhan, Kugti, Manali, Naina Devi, Rupi Bhaba, Sechu Tuan Nala, Tirthan (possibly) and Tundah Wildlife Sanctuaries; Uttar Pradesh -Nanda Devi National Park, Govind Pashu Vihar and Kedarnath Wildlife Sanctuaries; Sikkim - Khangchendzonga National Park; Arunachal Pradesh - Namdapha National Park; and - Megahakrya - Balphakram National Park. However, the species is considered to be locally threatened even within some of these protected areas (e.g. Great Himalayan National Park and Daranghati, Manali, Tirthan and Tundah Wildlife Sanctuaries). Status within country: Indeterminate. Conservation measures proposed for India: 1) Establish the proposed Srikhand National Park, Himachal Pradesh. 2) Develop a management program for maintaining serow habitat and sustaining hunting outside protected areas. Habitat alteration and hunting will continue to negatively affect serow populations throughout northern India, and because serow is apparently dependent on patches of dense vegetation associated with rugged terrain, the alteration or elimination of such vegetation will be highly detrimental to the species. Management to control habitat alteration, prevention of overhunting outside protected areas, and effective protection in parks and sanctuaries, will be required to maintain viable populations in the future.

Source for data above: Duckworth, J.W. & MacKinnon, J. 2008. *Capricornis thar*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: The serow has only IUCN “Near threatened” status, so does not trigger Tier 1 criteria. The serow occurs throughout the protected areas of India where there is undisturbed habitat. The project area does not support nationally or regionally important concentrations of serow, and therefore Tier 2 criteria are not triggered.

Conclusion Regarding Project Interactions with Critical Habitat: While serow have been reported in the project area, the project area is a very small part of a much wider range in India which covers most of the protected areas. Furthermore, the project area is characterized by degraded forest, and steep, slippery slopes adjacent are not conducive to animal movements. All these features present obstacles to serow and make the project area unsuitable habitat for serow. It is considered that the project impacts on the habitat and population of serow will be negligible.

Barking deer	*Muntiacus muntjak*	Least Concern Schedule III	Foot marks sighted during survey along alignment



IUCN Status: Least Concern because it remains common throughout most of its range, is resilient to hunting and increases in numbers with logging and presumably other forms of forest disruption, and survives even almost complete conversion of forest to at least some crop plantations.

Range: Southern Red Muntjac, as defined here, occupies part of the Thai–Malay peninsula and occurs on the main islands of the Greater Sundas (Borneo, Java, Bali and Sumatra) and on various small islands (Chasen 1940; Groves 2003; Meijaard 2003). On Sumatra, it is not geographically limited to southern and eastern parts of the island despite various statements that it is (R.J. Timmins pers. comm. 2008). Taking the northern limit on the peninsula as the Isthmus of Kra (see Taxonomy), *M. muntjak* (as here defined) is assumed to inhabit southern Thailand and might be found to occur in southernmost Myanmar. It is now extinct in Singapore (Baker and Lim 2008).

Native to: Brunei Darussalam; Indonesia; Malaysia; Thailand

Recent camera-trap studies on all main occupied landmasses show this to be a common species.

Southern Red Muntjac are associated with forest, but occur widely even in heavily degraded forest and, in areas adjacent to forest, in plantations of coffee, rubber, sugarcane, cassava, coconut, and teak (Oka 1998; Laidlaw 2000; Azlan 2006; G. Semiadi pers. comm. 2008).

This muntjac has a wide altitudinal range. In Java, S. Hedges (pers. comm. 2008) has seen them over 0–800 m. In Sumatra, it occurs widely in the lowlands and the second species there, *M. montanus*, seems to be montane; whether *M. muntjak* ascends to the highest forests is yet unclear (R.J. Timmins pers. comm. 2008, based on examination of specimens). On Borneo, Red Muntjac lives up to at least 1,000 m asl on the Usun Apau plateau (Payne *et al*. 1985), who stated that "available data suggests that [*M. atherodes*] predominates over the Red Muntjac in low hill ranges and coastal regions", but Meijaard and Sheil (2008) pointed out that still "no robust quantitative data exist to support this [pattern]". Red Muntjac is scarcer than *M. atherodes* in Sungai Wain forest, Kalimantan, which spans 30–150 m asl (G.M. Fredriksson pers. comm. 2008), in the Sarawak Planted Forests, Bintulu Division, a mix of acacia plantation and natural forest (Belden *et al*. 2007; Belden Giman pers. comm.

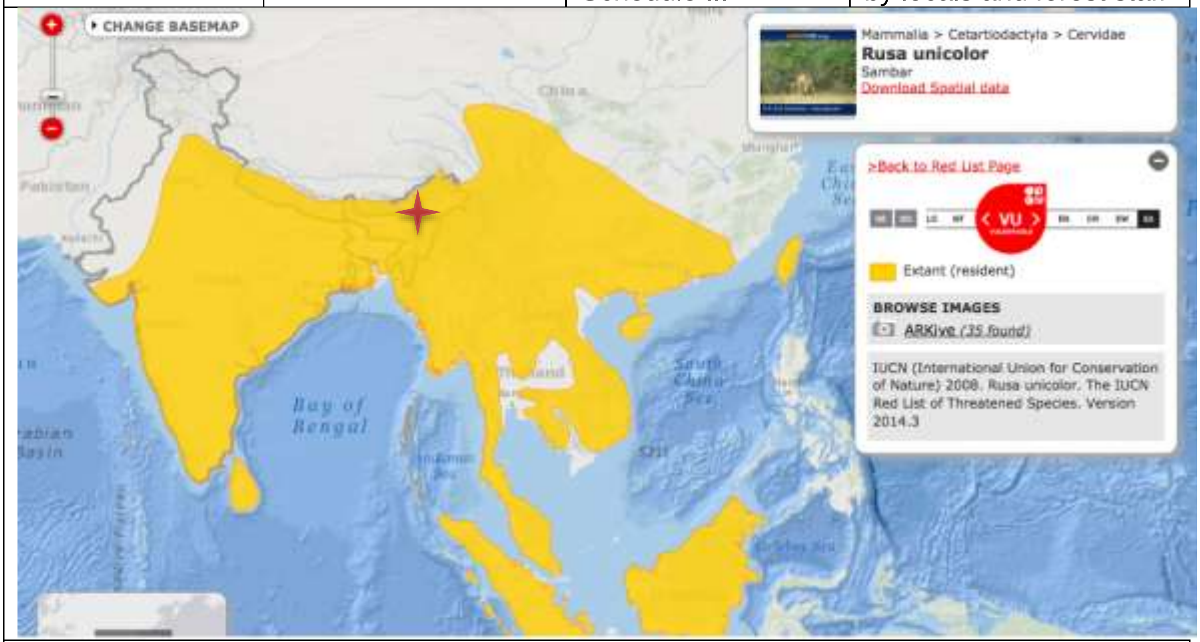
2008), and (slightly so) in the Ulu Segama area of Danum Valley Conservation Area, Sabah, which lies mostly at about 300 m asl (Siew Te Wong pers. comm. 2008). In Borneo, muntjacs were frequently seen, suspected to comprise roughly equal numbers of Red and Yellow, in the Batang Ai National Park, Sarawak, which lies mostly at 100–760 m asl (Meredith 1995). The diet is mostly fruits, buds, tender leaves, flowers, herbs and young grass (Kitchener *et al*. 1990; Oka 1998).

Source of above data: Timmins, R.J., Duckworth, J.W., Hedges, S., Pattanavibool, A., Steinmetz, R., Semiadi, G., Tyson, M. & Boeadi 2008. *Muntiacus muntjak*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: The Barking deer is least concern IUCN status, so does not trigger Tier 1 criteria. It mostly found in Brunei Darussalam; Indonesia; Malaysia; Thailand. Therefore project area does not support nationally or regionally important concentrations of Barking deer, and therefore Tier 2 criteria are not triggered.

Conclusion Regarding Project Interactions with Critical Habitat: Although signs of barking deer are spotted in the project area, it is not a critical habitat for project area since concentration is very low. Therefore it is considered that the project impacts on the habitat and population of barking deer will be negligible.

Sambar	*Cervus unicolor*	Vulnerable Schedule III	Not sighted, but reported by locals and forest staff



IUCN Status: Vulnerable through sustained declines across its range. These vary in severity between regions, and in some areas considerably exceed the threshold for VU.

Range: The Sambar extends from India and Sri Lanka east along the southern Himalayas (including Nepal and Bhutan) through much of south China (including Hainan Island) to Taiwan (where it occurs in the central and eastern parts; Lin, C.-Y. and Lee, L.-L. pers. comm. 2008). Further south it occurs in Bangladesh, throughout mainland South-east Asia (Myanmar, Thailand, Lao PDR, Cambodia, Viet Nam, West Malaysia) and many of the main islands of the Greater Sundas (excepting Java): Sumatra, Siberut, Sipora, Pagi and Nias islands (all Indonesia), and Borneo (Malaysia, Indonesia, and Brunei) (Grubb 2005). The current distribution is now highly fragmented in much of this range (see Population). Payne *et al*. (1985) also listed the Philippines, but the Sambar does not occur there. A record from Ujung Kulon, Java, in van Schaik and Griffiths (1996: 107) is presumably an error for Javan

Rusa *R. timorensis*. The Sambar has been introduced widely outside its native range, e.g.: San Luis Obispo Country, California; the Gulf Prairies and Edwards Plateau regions of Texas (Ables and Ramsey 1974); the St. Vincent Islands, Franklin Country, Florida (Lewis *et al*. 1990); Australia (Slee 1984; Freeland 1990); New Zealand (Kelton and Skipworth 1987); and Western Cape Province, South Africa (Lever 1985). These introduced populations are not included in the distribution map.

Native to: Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China (Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan, Yunnan); India; Indonesia (Sumatera); Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Sri Lanka; Taiwan, Province of China; Thailand; Viet Nam

In India, although the Sambar occurs widely and in many habitat types, and large populations occur in well-secured protected areas, nowhere is it now regionally abundant (Sankar and Acharya 2004). It has been recorded in 208 protected areas (National Wildlife Database, Wildlife Institute of India, cited in Sankar and Acharya 2004); its distribution outside protected areas is now highly scattered. The reported ecological densities of Sambar in India mostly fall within 1–10 animals per km² within the protected area network, and depending on the varying levels of protection efficacy: Bhadra Tiger Reserve, 0.89 +/- 0.23 (SE) per km² (Jathanna *et al*. 2003); Madhya Pradesh Pench National Park dry deciduous forest, 9.6 animals per km² (Karanth and Nichols 2000); Kanha moist deciduous forest, 1.5 animals per km² (Karanth and Nichols 2000); Nagarahole moist deciduous forest, 5.5 animals per km² (Karanth and Sunquist 1992); Bandipur dry deciduous forest, 5.6 animals per km² (Karanth and Nichols 2000); Tadoba-Andhari dry deciduous forest, 3.3 animals per km² (Karanth and Kumar 2005); Melghat dry deciduous forest, 2.7 animals per km² (Karanth and Kumar 2005); Maharashtra Pench dry deciduous forest, 5.9 animals per km² (Karanth and Kumar 2005); Ranthambore semi-arid dry deciduous forest, 10.7 animals per km² (Kumar 2000); and Gir semi-arid dry deciduous forest, two animals per km² (Khan *et al*. 1996). Similar surveys at Kaziranga found too few Sambar to estimate populations there (Karanth and Nichols 2000), this presumably representing habitat characters rather than defective protection, given the buoyant populations of other deer at that site (Hog Deer *Axis porcinus* and Barasingha *Rucervus duvaucelii*). Outside protected areas, Sambar is present mostly in very low numbers, although larger numbers can still be found where its habitat is almost inaccessible to people. The recorded Bhadra density is low, reflecting poaching and forest-resource extraction (Jathanna *et al*. 2003), and the population density is steadily increasing following removal of these pressures in 2003 (K.U. Karanth and N.S. Kumar unpublished data).

No large Indian ungulate has adapted itself to a wider variety of forest types and environmental conditions than has Sambar (Schaller 1967). Within India, Sambar occurs in the thorn and arid forests of Gujarat and Rajasthan, in the moist and dry deciduous forests throughout peninsular India, in the pine and oak forests at the Himalayan foothills, and in the evergreen and semi-evergreen forests of northeastern India and the Western Ghats (Sankar and Acharya 2004; N.S. Kumar pers. comm. 2008). Although the highest densities of Sambar so far recorded were in the semi-arid forests of Ranthambore (Kumar 2000), across most of its Indian range Sambar seems to thrive best in well-watered, moist deciduous hilly terrain (N.S. Kumar pers. comm. 2008).

More widely in India, there does seem to be a marked preference for undulating terrain (N.S. Kumar pers. comm. 2008). Kushwaha *et al*. (2004) found that in Kumaon Himalaya (India), Sambar usage was greater of the higher than the lower altitude area. However, it makes wide use of plains areas elsewhere, where these have not been destroyed, e.g. the Hukaung Valley in Myanmar (J.W. Duckworth pers. comm. 2008).In Borneo, while Payne *et al*. (1985) considered Sambar “most common in secondary forests of gently-sloping terrain” they also knew of occurrence in “tall dipterocarp forests on steep terrain and in swamp forests”. In Thung Yai, Thailand, Sambar signs were twice as abundant in lowland forest as in montane forest, although this difference was not statistically significant (Steinmetz *et al*. 2008).

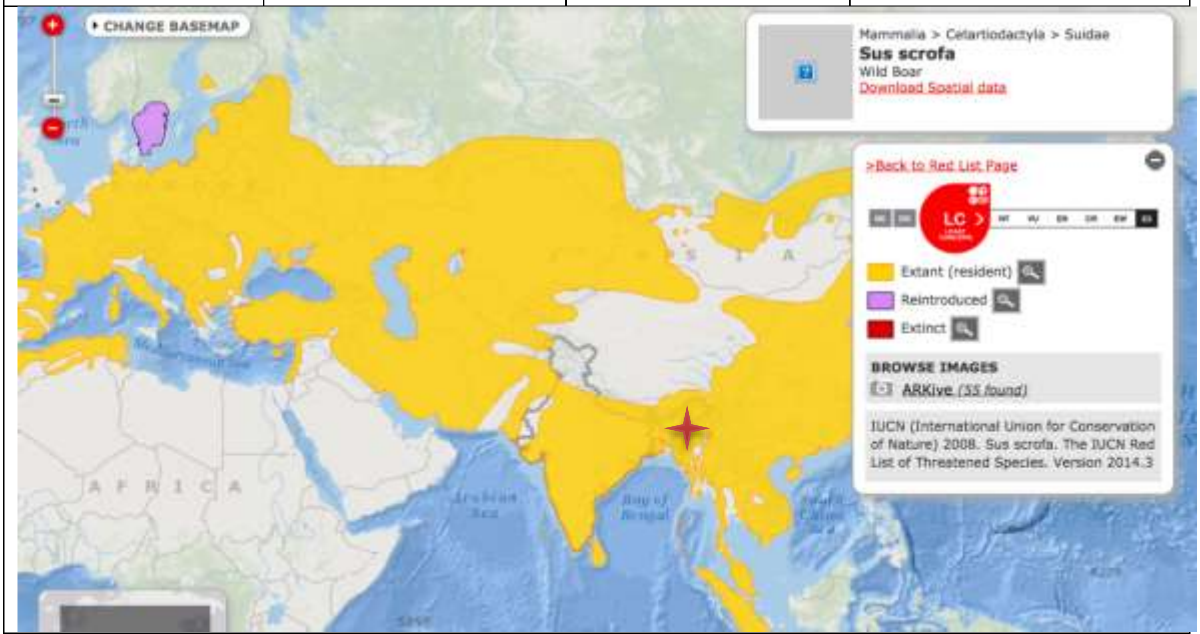
The Sambar is found in many protected areas throughout its range, although in most of these areas this legal status has not stemmed declines and local extinctions from hunting. Similarly, although it is protected from hunting by legislation, even outside protected areas, in most or all range states, these laws are challenging to enforce, given the trade demand for meat and antlers (GMA Indonesia Workshop). Currently the law has a strong protective effect in Taiwan (Lin, C.-Y. and Lee, L.-L. pers. comm. 2008) and in various protected areas of India (N.S. Kumar pers. comm. 2008).

Source of above data: Timmins, R.J., Steinmetz, R., Sagar Baral, H., Samba Kumar, N., Duckworth, J.W., Anwarul Islam, Md., Giman, B., Hedges, S., Lynam, A.J., Fellowes, J., Chan, B.P.L. & Evans, T. 2008. *Rusa unicolor*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: No Tier 1 criteria are triggered, since the Sambar is not CR and EN. Also, since the samber occurs throughout other parts of India and Asia, Tier 2 criteria are not triggered (the project area is not supporting nationally or regionally important concentrations of sambar).

Conclusion Regarding Project Interactions with Critical Habitat: Although Sambar is reported in the project areas, it is not a critical habitat for Samber. They are common to the protected areas. It is considered that the project impacts on the habitat and population of Sambar will be negligible.

Wild pig	*Sus scrofa*	Least Concern Schedule III	Foot marks sighted during survey along alignment



IUCN status: Listed as Least Concern due to its wide range, abundance, tolerance to habitat disturbance, and presence in many protected areas.

Range: The wild pig has one of the widest geographic distributions of all terrestrial mammals, and this range has been greatly expanded by human agency. The species now occurs in pure wild or barely modified feral form on all continents excepting Antarctica, and on many oceanic islands. It is the ancestor of most (but not all) ancient and modern domestic pig breeds, and there is evidence to suggest that it was independently domesticated in several different parts of its range, including Southeast Asia, the Far East and Asia Minor. As a wild form, it has constituted a primary resource of subsistence hunters since the earliest times, and it is one of the most important targets for recreational hunting wherever it remains sufficiently abundant. Over-hunting and changes in land use have resulted in the fragmentation of its range and its extermination throughout the British Isles, Scandinavia, parts of North Africa, and relatively extensive parts of its range in the former Soviet Union. and northern Japan. Nevertheless, the species remains widely distributed and is often locally abundant. As a result of its depredations on crops it is regarded as a pest in many countries, where it remains unprotected outside designated wildlife reserves or is managed as a game animal.

S. scrofa has by far the largest range of all pigs. It occurs throughout the steppe and broadleaved forest regions of the Palaearctic, from western Europe to the Russian Far East, extending southwards as far North Africa, the Mediterranean Basin and the Middle East, through India, Indo-China, Japan (including the Ryukyu Chain), Taiwan and the Greater Sunda Islands of South-east Asia. Populations east of Bali are probably all introduced. It has been extinct in the British Isles since sometime in the 17th century, despite attempted introductions of new stock from Europe (Harting, 1880) (though see below for more recent information). It is also extinct in southern Scandinavia (but see below), over extensive portions of its recent range in west-central and eastern parts of the former Soviet Union (Heptner *et al*., 1961), and in northern Japan (Chiba, 1964, 1975). The species was last reported in Libya in the 1880s, and it became extinct in Egypt in about 1902 (Hufnagl, 1972).

Groves and Grubb (1993) distinguished four 'subspecies groupings', based on both geographic and morphological criteria, as follows:

1. 'Western races' of Europe (*scrofa* and *meridionalis*), North Africa (*algira*) and the Middle East (*lybicus*), extending at least as far east as Soviet Central Asia (*attila and nigripes*);

2. 'Indian races' of the sub-Himalayan region from Iran in the west (*davidi*) to north India and adjacent countries as far east as Myanmar and west Thailand (*cristatus*), and south India and Sri Lanka (*affinis* and subsp. nov.);

3. 'Eastern races' of Mongolia and the Soviet Far East (*sibiricus* and *ussuricus*), Japan (*leucomystax* and *riukiuanus*), Taiwan (*taivanus*), to south-east China and Viet Nam (*moupinensis*); and

4. 'Indonesian race' (or banded pig) from the Malay Peninsular, Sumatra, Java, Bali and certain offshore islands (*vittatus*).

Native to: Afghanistan; Albania; Algeria; Andorra; Armenia (Armenia); Austria; Azerbaijan; Bangladesh; Belarus; Belgium; Bhutan; Bosnia and Herzegovina; Bulgaria; Cambodia; China; Croatia; Cyprus; Czech Republic; Estonia; Finland; France (Corsica); Georgia; Germany; Greece; Hong Kong; Hungary; India; Indonesia (Bali, Jawa, Lesser Sunda Is., Papua, Sumatera); Iran, Islamic Republic of; Iraq; Israel; Italy (Sardegna, Sicilia - Introduced); Japan; Jordan; Kazakhstan; Korea, Democratic People's Republic of; Korea, Republic of; Kyrgyzstan; Lao People's Democratic Republic; Latvia; Lebanon; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Malaysia; Moldova; Monaco; Mongolia; Montenegro; Morocco; Myanmar; Nepal; Netherlands; Pakistan; Palestinian Territory, Occupied; Poland; Portugal; Romania; Russian Federation; San Marino; Serbia (Serbia); Slovakia; Slovenia; Spain; Sri Lanka; Switzerland; Syrian Arab Republic; Taiwan, Province of China; Tajikistan; Thailand; Tunisia; Turkey; Turkmenistan; Ukraine; Uzbekistan; Viet Nam

Source of above data: Oliver, W. & Leus, K. 2008. *Sus scrofa*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on **18 May 2015**.

IFC Criteria: No Tier 1 criteria are triggered, since wild pig is listed as least concern species in IUCN red list. Also, since the wild pigs occur throughout other parts of India and Asia, Tier 2 criteria are not triggered (the project area is not supporting nationally or regionally important concentrations of wildpigs).

Conclusion Regarding Project Interactions with Critical Habitat: Although wild pigs are spotted in the project areas because of its wide range, abundance, tolerance to habitat disturbance, and presence in many protected areas, the project area is not a critical habitat for wild pigs. It is considered that the project impacts on the habitat and population of wild pigs will be negligible.

Schedule I* means that the species is included in the Schedule I of the Wildlife Protection Act of India.

12. **Overall Conclusions Regarding the Project and Critical Habitat:** The conclusion of the forest and wildlife office review and species expert opinions in this critical habitat assessment is that the project will not present any concerns with regard to habitat functionality and species persistence. The forests and the species experts have indicated that the project area does not fall in the critical habitat of the species assessed, and that it is not expected that there will be any measurable adverse impacts on the species populations and habitat values.

13. Regarding the six definitions of critical habitat (ADB SPS) and the IFC Tier 1 and 2 definitions, none of these definitions has been found to apply to the project area. Since there are no legally defined critical habitats (the ADB SPS notes that critical habitats include legally protected areas such as the national parks, wildlife sanctuaries, biological corridors), the project area does not impinge on any specific areas that is critically important to the populations of threatened species in India. Regardless of this conclusion, the project is still taking a precautionary approach and will be implementing a biodiversity conservation plan that includes monitoring and development of a wildlife database, as well as field conservation measures to protect wildlife. Furthermore, at night time, all construction activities will be disallowed, to avoid disrupting wildlife movements particularly in sections of project road with forest areas.