

# Initial Environmental Examination

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April 2017

## IND: South Asia Subregional Economic Cooperation Road Connectivity Investment Program – Tranche 2

Imphal-Moreh Road (Imphal- Khongkhang section) (Annexures)

Prepared by National Highways and Infrastructure Development Corporation Limited,  
Government of India for the Asian Development Bank.

## 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-Moreh Road Section (65.86 km) in the State of Manipur (Tranche 2 Subproject)

Screening questions	Yes	No	Remarks
<b>A. Project siting</b>			
<ul style="list-style-type: none"> <li>▪ Is the project area adjacent to or within any of the following environmentally sensitive areas?</li> </ul>			
<ul style="list-style-type: none"> <li>▪ Cultural heritage site</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Protected area</li> </ul>		X	There are no environmentally sensitive/protected areas along the project road. The nearest protected area is YLWLS which is 8.45 km away from the end point of the project road. About 33.28 km section of the project road passes through forest areas. Mitigation measures are included in the EMP to avoid impacts on flora and fauna in these forest areas. EA will obtain forest clearance from statutory authority at State and Central Level.
<ul style="list-style-type: none"> <li>▪ Wetland</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Mangrove</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Estuarine</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Buffer zone of protected area</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Special area for protecting biodiversity</li> </ul>		X	
<b>B. Potential environmental impacts</b>			
<ul style="list-style-type: none"> <li>▪ Will the project cause...</li> </ul>			
<ul style="list-style-type: none"> <li>▪ Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?</li> </ul>	X		The topography of project road from Pallel to Khongkhang village (end point) is hilly. 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.
<ul style="list-style-type: none"> <li>▪ Encroachment on precious ecology (e.g. Sensitive or protected areas)?</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?</li> </ul>	X		Imphal-Pallel section of the project road low lying areas and is high rainfall zone prone to flood. Also three rivers (Imphal, Thoubal and Wanjing) crosses the this section of the project road. Controlled construction activities will ensure sediment discharge into streams.

Screening questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>▪ Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?</li> </ul>		X	<p>During construction period suitable mitigation measures will be required to control the silt runoff.</p> <p>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.</p>
<ul style="list-style-type: none"> <li>▪ Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?</li> </ul>	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels.
<ul style="list-style-type: none"> <li>▪ 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?</li> </ul>	X		Possible. With appropriate mitigation measures such risks would be minimized.
<ul style="list-style-type: none"> <li>▪ Noise and vibration due to blasting and other civil works?</li> </ul>	X		Short term minor impact may occur during construction period, Suitable mitigation measures will be required to minimize the adverse effects
<ul style="list-style-type: none"> <li>▪ Dislocation or involuntary resettlement of people</li> </ul>	X		Yes. A Resettlement Plan is being prepared separately and compensation shall be paid as per approved entitlement matrix.
<ul style="list-style-type: none"> <li>▪ dislocation and compulsory resettlement of people living in right-of-way?</li> </ul>	X		Yes. A Resettlement Plan is being prepared separately and compensation shall be paid as per approved entitlement matrix.
<ul style="list-style-type: none"> <li>▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?</li> </ul>		X	Possible. Gender Action Plan and Indigenous People Development Plan shall be prepared as part of the Project.
<ul style="list-style-type: none"> <li>▪ Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?</li> </ul>	X		Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
<ul style="list-style-type: none"> <li>▪ Hazardous driving conditions where construction interferes with pre-existing roads?</li> </ul>		X	To minimized the impact suitable traffic management plan will be required
<ul style="list-style-type: none"> <li>▪ Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?</li> </ul>	X		<p>Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility.</p> <p>Workers will be made aware about communicable diseases</p>
<ul style="list-style-type: none"> <li>▪ Creation of temporary breeding habitats for mosquito vectors of disease?</li> </ul>		X	
<ul style="list-style-type: none"> <li>▪ Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?</li> </ul>	X		Adoption of suitable traffic signage system at sensitive places will reduce such possibility.

Screening questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>▪ Increased noise and air pollution resulting from traffic volume?</li> </ul>	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
<ul style="list-style-type: none"> <li>▪ Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?</li> </ul>	X		Controlled construction activities and proper drainage system will reduce this possibility.
<ul style="list-style-type: none"> <li>▪ social conflicts if workers from other regions or countries are hired?</li> </ul>		X	Not anticipated. Local labors would be hired to the extent possible.
<ul style="list-style-type: none"> <li>▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?</li> </ul>	X		Possible.
<ul style="list-style-type: none"> <li>▪ 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?</li> </ul>	X		Possible. EMP shall be followed to minimize this risk.
<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>		X	Not anticipated.

Climate Change and Disaster Risk Questions	Yes	No	REMARKS
<p>The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.</p>			
<ul style="list-style-type: none"> <li>• 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)</li> </ul>	X		Project is vulnerable to rainfall and landslides.
<ul style="list-style-type: none"> <li>▪ 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).</li> </ul>	X		Likely. Increase in rainfall will reduce lifespan of the project as this is a landslide prone area.
<ul style="list-style-type: none"> <li>▪ Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (eg., high incidence of marginalized populations, rural-urban</li> </ul>		X	

migrants, illegal settlements, ethnic minorities, women or children)?			
▪ 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 <sub>3</sub> 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 <sub>4</sub> ), Max	200	400	May be extended up to 400 provided (as Mg) does not exceed 30
15	Nitrate (as NO <sub>3</sub> ) mg/l, Max	45	100	
16	Fluoride (as F) mg/l, Max	1.0	1.5	
17	Phenolic Compounds (as C <sub>6</sub> H <sub>6</sub> OH) 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 (MOEFCC, 2009)**

Pollutant	Time Weighted Average	Concentration in Ambient air ( $\mu\text{g}/\text{m}^3$ )	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas
Sulphur Dioxide (SO <sub>2</sub> )	Annual Average*	50	20
	24 hr**	80	80
Oxides of Nitrogen (as NO <sub>2</sub> )	Annual Average *	40	30
	24 hr**	80	80
Particulate Matter: PM <sub>10</sub> (<10 $\mu\text{m}$ )	Annual Average *	60	60
	24 hr**	100	100
Particulate Matter: PM <sub>2.5</sub> (<2.5 $\mu\text{m}$ )	Annual Average *	40	40
	24 hr**	60	60
Lead	Annual Average *	0.5	0.5
	24 hr**	1.0	1.0
Carbon monoxide	8 hr	2000	2000
	1 hr	4000	4000

\* 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: MoEFCC 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: 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
  - No hot mix plant or other source of air pollution (especially dust pollution) within the degraded airshed for particulate matter (SPM/PM10).
  - 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  $\mu\text{g}/\text{m}^3$  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  
Installed Capacity (tph):

Date:  
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 6: 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.

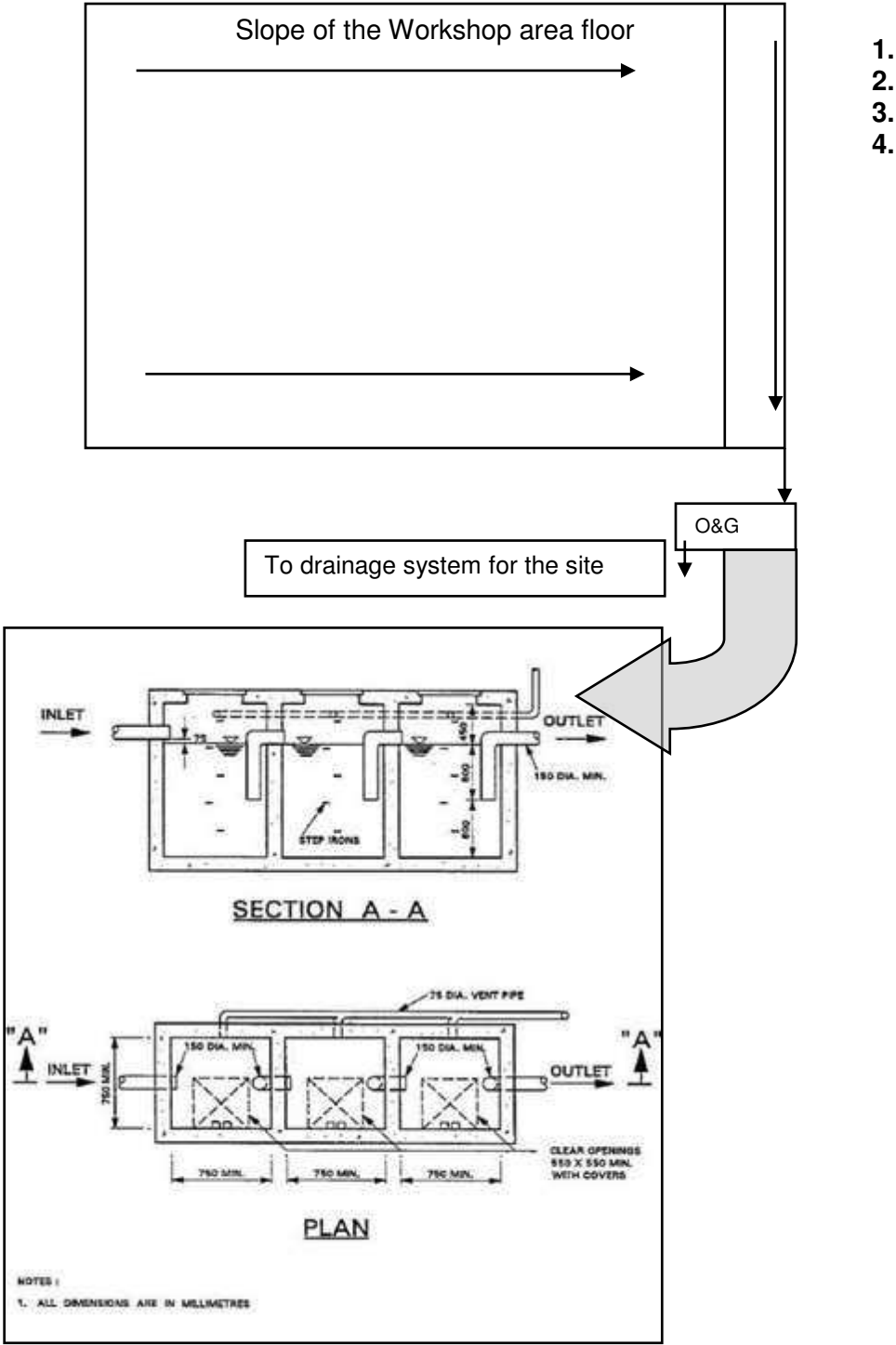


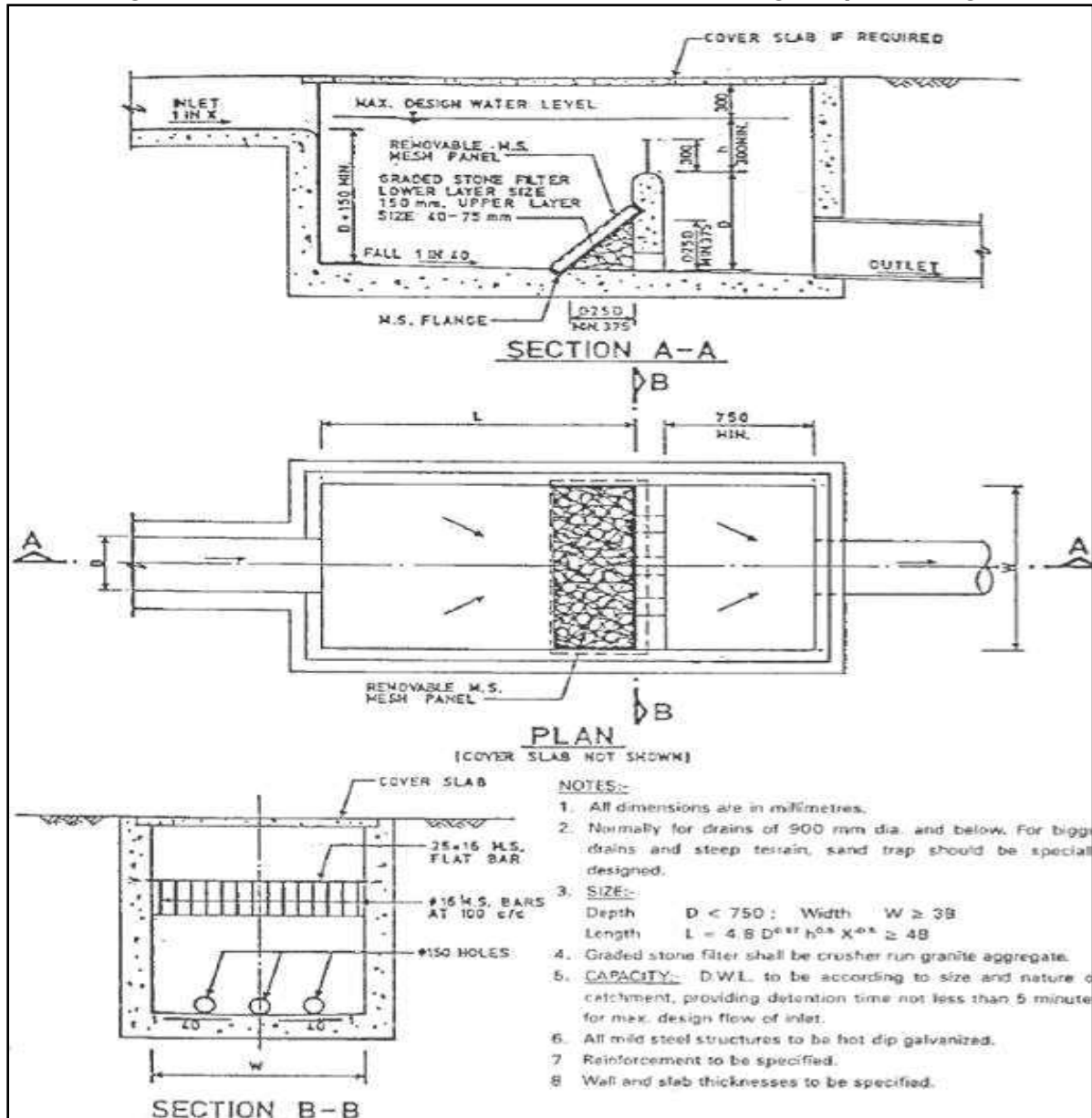
Figure 1: Workshop Area Pollution Control

- 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 banded. 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

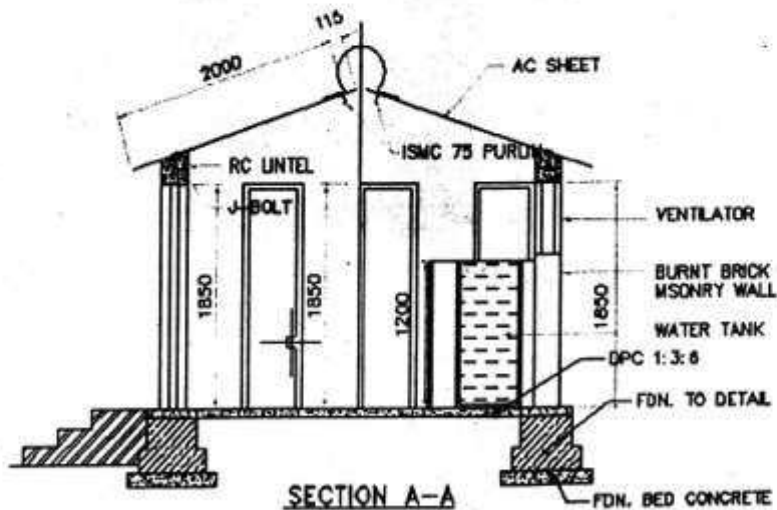
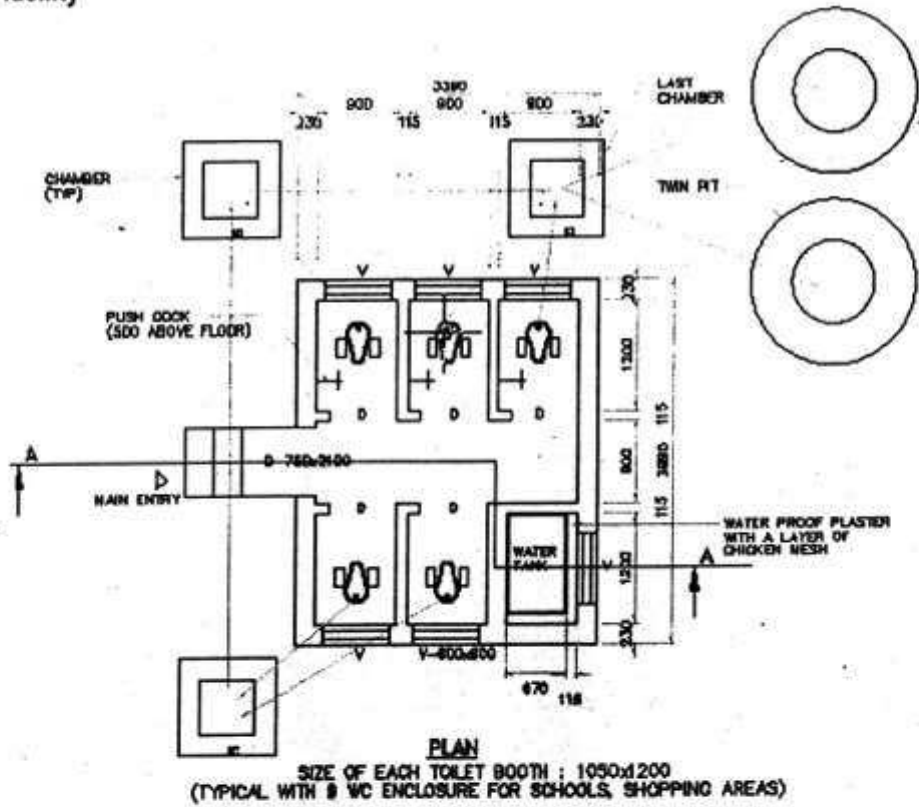
8. It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as 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

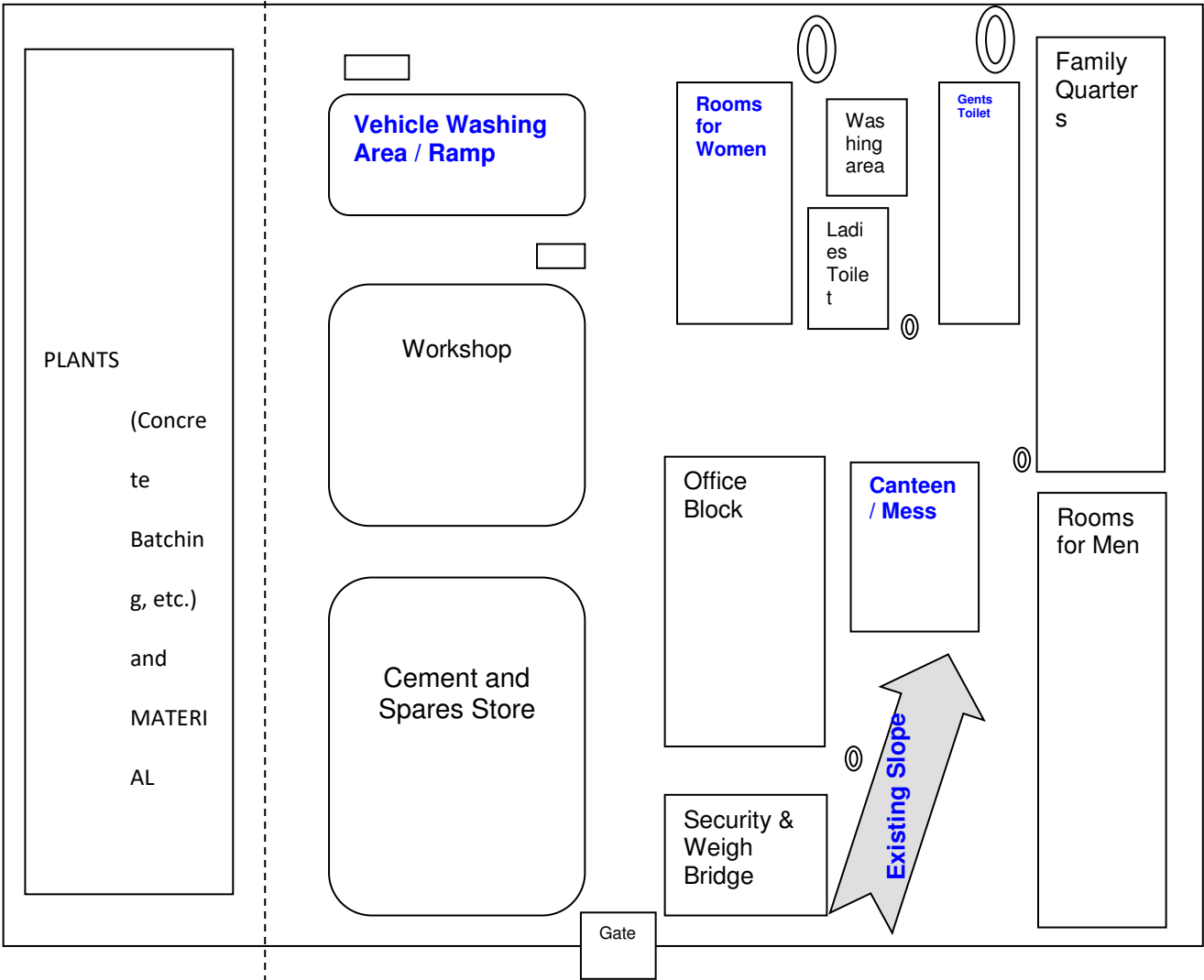
Sanitary facility







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



LEGEND:  Septic Tank + Soak Pit       Separator       Water Source       Oil & Grease

## **ANNEX 7: 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**

<b>Attributes</b>	<b>Requirements</b>
Construction material generation and re-use	<ul style="list-style-type: none"> <li>• Segregating debris and bitumen during generation;</li> <li>• Segregating re-usable portion of debris and bitumen and storing preferably near areas of re-use; and</li> <li>• Temporary storage of waste material at sites as directed by the Engineer.</li> </ul>
Waste disposal	<ul style="list-style-type: none"> <li>• Disposal of waste material at approved disposal site within a week of generation;</li> <li>• Disposal site should be properly demarcated;</li> <li>• Proper leveling / grading at disposal site/s;</li> <li>• Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented;</li> <li>• Recommended / agreed safeguard measures to avoid soil erosion are to be implemented;</li> <li>• Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.</li> </ul>

## ANNEX 8: 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 > 30cm<sup>29</sup>. 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 environmental

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<sup>29</sup> Plant having girth size more than 30cm is considered as tree.

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  
 Location of Borrow Area (Ch. & Offset):

Date:  
 Revenue Survey No.:

<b>Sl. No.</b>	<b>Item / Requirement</b>	<b>Details as per Actual (to be filled by Contractor &amp; checked by Engineer)</b>
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	<ul style="list-style-type: none"> <li>Only approved access road shall be used</li> </ul>
Top soil preservation	<ul style="list-style-type: none"> <li>Top soil, if any, shall be stripped and stored at corners of the area before start of excavation for material collection;</li> <li>Top soil should be re-used / re-laid as per agreed plan</li> </ul>
Depth of excavation	<ul style="list-style-type: none"> <li>For cultivable (agriculture) land, total depth of excavation should be limited to 45 cm including top 15 cm for top soil preservation;</li> <li>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;</li> <li>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;</li> <li>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.</li> </ul>
Damage to surrounding land	<ul style="list-style-type: none"> <li>Movement of man &amp; machinery should be regulated to avoid damage to surrounding land.</li> </ul>
Drainage control	<ul style="list-style-type: none"> <li>The surface drainage in and around the area should be merged with surrounding drainage;</li> <li>No water stagnation shall occur.</li> </ul>
Dust suppression	<ul style="list-style-type: none"> <li>Water should be sprayed on <i>kutchra</i> (earthen) haul road twice in a day or as may be required to avoid dust generation during transportation of material;</li> <li>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.</li> </ul>
Covering material transport vehicle	<ul style="list-style-type: none"> <li>Material transport vehicle shall be provided with tarpaulin cover</li> </ul>
Personal Protective Equipment	<ul style="list-style-type: none"> <li>Workers should be provided with helmet, gumboot and air mask and their use should be strictly enforced.</li> </ul>
Redevelopment	<ul style="list-style-type: none"> <li>The area should be redeveloped within agreed timeframe on completion of material collection as per agreed rehabilitation plan.</li> </ul>

## ANNEX 9: 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<sup>30</sup>:
- 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.

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<sup>30</sup> 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 (MoEFCC) 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:

Authority's Engineer:

Contractor:

Contract Package:

Location of Quarry (Ch. &amp; 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**

<b>Attributes</b>	<b>Requirements</b>
Access road	<ul style="list-style-type: none"> <li>• Only approved access road shall be used</li> </ul>
Top soil preservation	<ul style="list-style-type: none"> <li>• Top soil, if any, should be stripped and stored at designated area before start of quarry material collection;</li> <li>• Top soil should be re-used / re-laid as per agreed plan</li> </ul>
Controlled blasting & safety	<ul style="list-style-type: none"> <li>• Storage of explosive magazine as per threshold quantity with all the safety measures;</li> <li>• Handling of explosive by licensed blaster only;</li> <li>• Use low intensity explosive;</li> <li>• Check unfired explosive, if any, before drilling;</li> <li>• Carryout blasting at lean time only;</li> <li>• Cordoned the area within 500m radius with flagmen having whistle for signaling preparedness;</li> <li>• Using properly designed audio visual signal system i.e. siren and flagmen for blasting;</li> <li>• Keep ready an emergency vehicle near blasting area with first aid facility and with active emergency response system.</li> </ul>
Damage to surrounding land	<ul style="list-style-type: none"> <li>• Movement of man &amp; machinery should be regulated to avoid damage to surrounding land.</li> </ul>
Drainage control	<ul style="list-style-type: none"> <li>• The surface drainage in and around the area should be merged with surrounding drainage;</li> </ul>
Dust control	<ul style="list-style-type: none"> <li>• Haul road should be made metallic;</li> <li>• Suitable dust arrester for drilling;</li> <li>• Water spraying at quarry complex, if required.</li> </ul>
Covering material transport vehicle	<ul style="list-style-type: none"> <li>• Material transport vehicle should be provided with tail board, and cover</li> </ul>
Personal Protective Equipment	<ul style="list-style-type: none"> <li>• Workers shall be provided with helmet, safety shoes, ear muffler and air musk and their use should be strictly enforced.</li> </ul>
Redevelopment	<ul style="list-style-type: none"> <li>• The area should be redeveloped within two months (or as agreed) on completion of material collection as per agreed plan.</li> </ul>

## ANNEX 10: DETAILS OF THE PUBLIC CONSULTATIONS AND ISSUES DISCUSSED

### A. Details of Public Consultations (in 2013 during Feasibility Study)

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
1	Date: 27/08/2013 Village: Lailong Bazar Block: Thoubal District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Bank, Secondary school, Post office, Primary Health Centre, Irrigation, Electricity and drinking water supply facilities are available in the village.</li> <li>• Existing road condition is not so good. Road width is less. So it is a high risk zone for accident.</li> <li>• Peoples are aware about the project.</li> <li>• People perceived that subproject road will provide better transport facility and save time, money, and generate employment</li> <li>• No negative impacts perceived by the people.</li> <li>• 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.</li> <li>• Compensation should be in mode of cash for land and structure both.</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide better road connectivity to the nearby facilities.</li> <li>• Proper safety measures for new road are proposed in the design and it should be strictly follow during construction. Service roads are provided at some congested location to segregate local traffic.</li> <li>• Employment to local skilled and unskilled laborers should be preferred during road construction and operation.</li> <li>• Compensation should be given for structure loss at earliest.</li> <li>• Effected CPR should be built by Govt. before starting of construction.</li> <li>• Govt. should construct a shopping complex near to this market and shop should be</li> </ul>	MD SADIQURE	SERVICE	40	M
				MD JANE ALAM	BUSINESS	39	M
				HAFIZ MATIN	BUSINESS	55	M
				MD SAJID	BUSINESS	66	M
				MD AYUB ALI	BUSINESS	43	M
				MD ROSHAN	EX.COUNCILLOR	60	M
				R. KHATUMA	BUSINESS	36	F
				FATIMA KHAM	BUSINESS	33	F
				MD BURHANUDDIN	BUSINESS	40	M
				MD SIKANDAR	BUSINESS	38	M
				MD HABIBUR RAHMAN	BUSINESS	41	M
				MD NURUL HAQUE	RETD	66	M
				SHAH MUSA	ADVOCATE	50	M
				MD ABDUR RAUF	RETD	62	M
				SK.MOZIBUR RAHMAN	SERVICE	26	M
				MD ISLAMUDDIN	BUSINESS	45	M
				MD ZAKARIA	BUSINESS	37	M
				NASIR AHMAD	BUSINESS	33	M
				ISLAMUDDIN	BUSINESS	41	M
				DR. FAROOQUE	SERVICE	30	M
ABDUR RAHMAN	BUSINESS	45	M				
MD NASIR KHAN	TEACHER	40	M				
KHALIQA JOR	BUSINESS	44	F				
AYUBi SHEIKH	BUSINESS	39	F				







Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
		<p>supply facilities are available in the village.</p> <ul style="list-style-type: none"> <li>No irrigation facilities are available in this area.</li> <li>Existing road condition is not so good. Road width is less. So it is a high risk zone for accident.</li> <li>Peoples are aware about the project.</li> <li>People perceived that subproject road will provide better transport facility and save time, money, and generate employment</li> <li>No negative impacts perceived by the people.</li> <li>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.</li> <li>Compensation should be in mode of cash for land and structure both.</li> <li>Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered.</li> <li>People will provide social and moral support to the project authority.</li> <li>Local people will protest if govt will acquire more than 30M (100 ft)</li> </ul>	<p>construction and operation.</p> <ul style="list-style-type: none"> <li>Govt. should talk directly to the effected persons regarding all aspects.</li> <li>Govt. should understand practical problems of effected persons and it must be considered for solved.</li> <li>Govt. should engaged at least one person from effected family in any Govt.dept/ organization as under R&amp;R programme..</li> <li>Compensation should be distributed at earliest and process should be easy.</li> <li>Sewerage system should be constructed with the road to evacuate the water of village to avoid the water logging.</li> <li>Compensation should be high.</li> </ul>	<p>H.CHAOBA</p> <p>L.ETOB</p> <p>B.NEERA</p> <p>NG.IBEMU</p> <p>S.NORTON</p> <p>N.PRIYO KUMAR</p> <p>H.PREMILA DEVI</p> <p>L.BIRJIT</p> <p>M.BIHARJIT</p> <p>H.BROJEN</p> <p>S.TOMBI</p> <p>NG.SANJU</p> <p>H.TILOTMA</p> <p>H.RAJEN</p> <p>M.BISWAJIT</p> <p>TH.CHANDRO MEITI</p>	<p>COUNCILLOR</p> <p>COUNCILLOR</p> <p>COUNCILLOR</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>RETD</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>RETD.</p> <p>BUSINESS</p> <p>SERVICE</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>MEMBER</p>	<p>41</p> <p>70</p> <p>42</p> <p>60</p> <p>55</p> <p>60</p> <p>41</p> <p>64</p> <p>41</p> <p>46</p> <p>70</p> <p>28</p> <p>52</p> <p>54</p> <p>43</p> <p>38</p>	<p>F</p> <p>F</p> <p>F</p> <p>F</p> <p>M</p> <p>M</p> <p>F</p> <p>M</p> <p>M</p> <p>M</p> <p>F</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p>

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
							
4	Date: 26/08/2013 Village: Khongjom Block: Thoubal, District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Presence of flora and fauna in the forests areas,</li> <li>• Wildlife movement across highway.</li> <li>• Electricity, Weekly market, Primary health centre, and Secondary school facilities in the village.</li> <li>• No Bank, Post office, Irrigation, Telephone and drinking water supply facilities are available in the village.</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide better connectivity to the nearby facilities and state capital.</li> <li>• Employment to local skilled and unskilled labourers should be preferred during road construction and operation.</li> <li>• Govt. should engaged at least one person from effected family in any Govt .dept/organization as under R&amp;R programme.</li> </ul>	KH.KULABI H.IBOCHOUBA S.DEBEN S.NETYAI S.BIREN H.JADUMANI H.NANDA TH.BHAMA H.MANAO TH.GOBINDA S.ANITA DEVI SH.THADOI KH.TANDON TH.BENI S.RANJITA M.RABI S.SHUSHILA	RETIRED BUSINESS SERVICE SERVICE BUSINESS SERVICE BUSINESS BUSINESS RETD. BUSINESS BUSINESS BUSINESS WARD MEMBER BUSINESS BUSINESS BUSINESS BUSINESS SERVICE	68 42 54 56 61 61 55 58 72 80 37 30 50 63 40 38 47	M M M M M M M M M M F F F F F M F

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
		<ul style="list-style-type: none"> <li>Existing road condition is not so good. Road width is less.</li> <li>Peoples are aware about the project.</li> <li>People perceived that subproject road will provide better transport facility and save time, money, and generate employment</li> <li>No negative impacts perceived by the people.</li> <li>An underpass/foot over bridge must be constructed here.</li> <li>Compensation should be in mode of cash for land and structure both.</li> <li>Compensation should be distributed in village.</li> <li>Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered.</li> <li>People will provide social and moral support to the project authority.</li> <li>Local people will protest if govt will acquire more than 30M (100 ft)</li> </ul>	<ul style="list-style-type: none"> <li>More compensation should be given to effected person. Because they can settle easily at other place.</li> <li>Proper safety measures are proposed in the design and it should be strictly follow during construction. Service roads are provided at some congested location to to segregate local traffic.</li> <li>Compensation should be distributed at earliest.</li> <li>Compensation should be distributed in the village to all effected persons.</li> <li>Sewerage system should be constructed with the road to evacuate the water of village to avoid the water logging.</li> <li>Compensation should be prepared properly with the consideration of price hike.</li> <li>Adequate time must be given to evacuate and reconstruction.</li> </ul>	H.NUNGITON BROJEN L.CHAOBA TH.IBOMCHA	BUSINESS BUSINESS BUSINESS BUSINESS	55 45 62 55	F M M M



Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
							

### B. Details of Public Consultations (in 2016 during Environmental and Social Assesments)

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
1	Date: 31/07/2016 Village: Lilong Bazar Block: Thoubal District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Presence of flora and fauna in the forests areas,</li> <li>• Wildlife movement across highway.</li> <li>• Existing road condition is not so good. No zebra crossing and speed control barrier so it is a</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide better road connectivity to the nearby facilities.</li> <li>• Proper safety measures for new road are included in the design including Zebra crossings, padesrian footpath and service roads. Underpass is not</li> </ul>	MD. ALOUDDIN	FARMER	49	M
				MD. AZAD KHAN	FARMER	35	M
				MD. SIRAJ KHAN	BUSINESS	45	M
				MD. AMU	LABOUR	33	M
				ASHLAM KHAN	FARMER	45	M
				ZAHID KHAN	FARMER	28	M
				WAHIDUR RAHAMAN	FARMER	40	M
				HANEEF SHEIKH	BUSINESS	28	M
				TARIQUE ANWAR	TEACHER	26	M
				MAJIBUR	FARMER	33	M
SATAR	SERVICE	36	F				

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
		<p>high risk zone for accident. No footpath so risky for children &amp; senior citizens.</p> <ul style="list-style-type: none"> <li>• Peoples are welcome this project but due to taking lengthy time they are annoyed.</li> <li>• People perceived that subproject road will provide better transport facility and save time, money, and generate more business &amp; employment.</li> <li>• No negative impacts perceived by the people except some movable and immovable properties losses.</li> <li>• 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, school and resident.</li> <li>• Compensation should be in mode of cash for land and structure both.</li> <li>• Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered.</li> <li>• People will provide social and moral support to the project authority.</li> <li>• Demand of the Local people that whatever land required for the widening should acquire in one time not again and again.</li> </ul>	<p>warranted at this location.</p> <ul style="list-style-type: none"> <li>• Employment to local skilled and unskilled laborers should be preferred during road construction and operation.</li> <li>• Compensation should be given for structure loss at earliest.</li> <li>• Effected CPR should be built by Govt. before starting of construction.</li> <li>• Govt. should construct a shopping complex near to this market and shop should be allotted to the effected persons.</li> <li>• Compensation should be distributed at least 4 month before from demolish of structure.</li> <li>• Compensation should be paid by Cheque to PAPs</li> </ul>	<p>MAJID</p> <p>MD. BASIR AHMED</p> <p>KHOMEI</p> <p>LEHAJUDDIN</p> <p>S. N. AHMED</p> <p>NASHIR KHAN</p> <p>SAJID AHMED</p> <p>MD. NIJAMUDDIN</p> <p>MD. GAFFAR</p> <p>ABDUL HAFIZ</p> <p>MUKTAR</p> <p>HEDAYATTULLA H</p> <p>ABDUL MATALIP</p> <p>SAFINAQ</p> <p>SAHNAAZ</p>	<p>BUSINESS</p> <p>BUSINESS</p> <p>SERVICE</p> <p>SERVICE</p> <p>PRESIDENT - JAC</p> <p>BUSINESS</p> <p>STUDENT</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>STUDENT</p> <p>SERVICE</p> <p>SERVICE</p> <p>TEACHER</p> <p>SERVICE</p>	<p>28</p> <p>47</p> <p>61</p> <p>47</p> <p>62</p> <p>49</p> <p>28</p> <p>60</p> <p>39</p> <p>34</p> <p>22</p> <p>40</p> <p>54</p> <p>45</p> <p>45</p>	<p>M</p> <p>M</p> <p>F</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>F</p> <p>M</p> <p>F</p> <p>F</p>

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
2	Date: 27/07/2016 Village : Kiyam Siphai Block : Thoubal District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Presence of flora and fauna in the forests areas,</li> <li>• Wildlife movement across highway.</li> <li>• Existing road condition is not so good because of heavy traffic which generates lots of noise as well as sound population.</li> <li>• Requirement of underpasses/foot over bridge has been demanded by peoples due to major transition of the peoples, including children and women to both side of the resident.</li> <li>• No major negative impacts perceived by the people.</li> <li>• Compensation should be in mode of cash for land and structure both and it should be directly distributed to the effected persons.</li> <li>• Land and location for resettlement site is major concern for the displaced peoples.</li> <li>• People will support to the project if authority will consider their concern.</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide better connectivity to the nearby facilities and state capital.</li> <li>• Proper safety measures for new road are included in the design including Zebra crossings, padesrian footpath and service roads. Underpass is not warranted at this location.</li> <li>• Employment to local skilled and unskilled labourers should be preferred during road construction and operation.</li> <li>• Road should be constructed with quality materials for better lasting.</li> <li>• Govt. should engaged at least one person from effected family in any Govt. dept/organization as under R&amp;R programme.</li> <li>• More compensation should be given to effected person. Because they can settle easily at other place.</li> </ul>	KH. MANITON SINGH	OLD & INACTIVE	74	M
				M. IBOPISHAK SINGH	OLD & INACTIVE	74	M
				S. OKENDRO SINGH	LABOUR	59	M
				M. MOCHABI SINGH	FARMER	28	M
				L. SHARAT CHANDRA	FARMER	45	M
				M. ROMEN SINGH	SERVICE	31	M
				L. MEMM DEVI	BUSINESS	64	F
				Y. HEMANTA	BUSINESS	55	F
				M. ANAND	SOCIAL WORKER	47	M
				M. ROBINDRO	SERVICE	44	M
				M. BRIJOY	LABOUR	60	M
				KH. JOY MEITEI	LABOUR	40	M
				L. BASANTA	BUSINESS	46	F
				MANAO TOMBI	SOCIAL WORKER	66	M
				S. MAIPAK	SERVICE	60	M
Y. RANJIT	TEACHER	55	M				
L. RABINDRA	BUSINESS	37	M				
L. IBOYAIMA	SERVICE	41	M				

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
			<ul style="list-style-type: none"> <li>• Compensation should be distributed at earliest, so can arrange their house /shop before evacuation.</li> </ul>				
3	Date: 26/07/2016 Village: Khangabok Block: Thoubal District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Presence of flora and fauna in the forests areas,</li> <li>• Wildlife movement across highway.</li> <li>• Bank, Secondary school, Post office, Primary Health Centre, Electricity and drinking water supply facilities are available in the village.</li> <li>• No irrigation facilities are available in this area.</li> <li>• Existing road condition is not so good. Road width is less. So it is a high risk zone for accident.</li> <li>• Peoples are aware about the project.</li> <li>• People perceived that subproject road will provide better transport facility and save time, money, and generate employment</li> <li>• No negative impacts perceived by the people.</li> <li>• An underpass/foot over bridge has been demanded by peoples</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide all weather road connectivity to the nearby facilities and state capital.</li> <li>• Employment to local skilled and unskilled labourers should be preferred during road construction and operation.</li> <li>• Govt. should talk directly to the effected persons regarding all aspects.</li> <li>• Proper safety measures for new road are included in the design including Zebra crossings, padesrian footpath and service roads.</li> <li>• Govt. should understand practical problems of effected persons and it must be considered for solved.</li> <li>• Govt. should engaged at least one person from effected family in any Govt.</li> </ul>	M. BIOSAKHI M. MADHUMATI TH. DHASHINI TH. SANAHANBI L. CHAND M. INGOCHA SINGH L. PREMJIT L. RANJIT L. NABACHANDRA TH. BASANTA KUMAR M. ANOUBI M. MOHORI N. IBEMHAL L. BAJASHORI W. BILASHINI TH. THOIBI L. KOKLEI TH. NANAD KH. MUHINDRO S. RAJEN L. HEMABATI L. MOHEN SINGH KH. LOLINI	BUSINESS CULTIVATOR BUSINESS BUSINESS BUSINESS BUSINESS BUSINESS BUSINESS CULTIVATOR SERVICE CULTIVATOR CULTIVATOR CULTIVATOR BUSINESS BUSINESS OLD & INACTIVE OLD & INACTIVE BUSINESS BUSINESS SERVICE BUSINESS STUDENT BUSINESS	65 66 48 70 40 33 27 50 38 50 60 47 60 50 40 85 81 40 59 53 41 22 36	F F F F M M M M M F M F F F F F M M M F M F



Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
		<p>better transport facility and save time, money, and generate employment</p> <ul style="list-style-type: none"> <li>An underpass/foot over bridge must be constructed here as both side market and resident.</li> <li>Compensation should be in mode of cash for land and structure both.</li> <li>Compensation should be distributed in village and goes to affected pattadar.</li> <li>Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered.</li> <li>People will provide social and moral support to the project authority.</li> </ul>	<p>construction and operation.</p> <ul style="list-style-type: none"> <li>Govt. should engaged at least one person from effected family in any Govt. dept/organization as under R&amp;R programme.</li> <li>More compensation should be given to effected person. Because they can settle easily at other place.</li> <li>Compensation should be distributed at earliest.</li> <li>Compensation should be distributed in the village to all effected persons.</li> <li>Sewerage system should be constructed with the road to evacuate the water of village to avoid the water logging.</li> <li>Compensation should be prepared properly with the consideration of price hike.</li> <li>Adequate time must be given to evacuate and reconstruction.</li> </ul>	<p>M. RAK KUMAR</p> <p>K. KESHO</p> <p>L. IBOYAIMA</p> <p>TH. SANTI KUMAR</p> <p>TH. TOMBI</p> <p>TH. INGOCHA</p> <p>L. KUMAR</p> <p>L. AMUTOMBI</p> <p>L. SANJIT</p> <p>H. MANGLEM</p> <p>TH. BROJENDRO</p> <p>H. IBOCHOUBA</p> <p>S. BASANTA</p> <p>S. ROMA</p> <p>H. MOMON</p> <p>TH. PRAMO</p> <p>A.TOMBIMACHA</p> <p>CH. PRABAPATI</p> <p>H. BINASAKHI</p> <p>MD. SHUJALI ALI</p> <p>S. INDRAMANI</p> <p>S. SUREN</p>	<p>LABOUR</p> <p>FARMER</p> <p>LABOUR</p> <p>FARMER</p> <p>FARMER</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>SERVICE</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>CULTIVATOR</p> <p>OLD &amp; INACTIVE</p> <p>OLD &amp; INACTIVE</p> <p>BUSINESS</p> <p>HOUSEWIFE</p> <p>BUSINESS</p> <p>BUSINESS</p> <p>SERVICE</p> <p>BUSINESS</p> <p>SERVICE</p>	<p>40</p> <p>38</p> <p>60</p> <p>57</p> <p>58</p> <p>25</p> <p>28</p> <p>28</p> <p>30</p> <p>42</p> <p>50</p> <p>42</p> <p>55</p> <p>70</p> <p>85</p> <p>82</p> <p>48</p> <p>45</p> <p>45</p> <p>65</p> <p>64</p> <p>46</p>	<p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>M</p> <p>F</p> <p>F</p> <p>F</p> <p>F</p> <p>M</p> <p>M</p> <p>M</p>
5	Date: 25/07/2016			MD. ABDUL SATTAR	SERVICE	37	M

Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
	Village: Irengband Block: Kakching District: Thoubal	<ul style="list-style-type: none"> <li>• Presence of protected areas around project areas,</li> <li>• Environmental issues in the areas,</li> <li>• Impacts of the project in environmental quality,</li> <li>• Presence of flora and fauna in the forests areas,</li> <li>• Wildlife movement across highway.</li> <li>• People perceived that subproject road will provide better transport facility and save time, money, and generate employment</li> <li>• Number of accident and pollution will increase due to more traffic on the road.</li> <li>• Rate &amp; time of compensation is the major concern for the locals.</li> <li>• 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.</li> <li>• Compensation should be in mode of cash for land and structure both.</li> <li>• Problem in restoration of their source of income of shopkeepers. Local people will fully cooperate to the govt. if local needs will be considered.</li> <li>• People will provide social and moral support to the project authority.</li> </ul>	<ul style="list-style-type: none"> <li>• The subproject road will provide all weather road connectivity to the nearby facilities</li> <li>• Proper safety measures for new road are proposed in the design and care will be taken during construction.</li> <li>• Employment to local skilled and unskilled labourers should be preferred during road construction and operation.</li> <li>• Road should be constructed with best materials for long lasting.</li> <li>• Compensation should be given earlier to the effected persons for their business loss.</li> <li>• Effected Common property should be shifted before starting of work on other location.</li> <li>• Compensation should be distributed in the village to all effected persons.</li> <li>• Compensation should be given earliest.</li> <li>• Compensation should be high. Because</li> </ul>	MD. NURULLAH	OLD & INACTIVE	60	M
				MD. AJURAHMAN	OLD & INACTIVE	70	M
				MD. SATAR	LABOUR	21	M
				MD. IMRAL	STUDENT	19	M
				M. AYAJUDDIN	LABOUR	40	M
				NURULLAHIAN	BUSINESS	45	F
				MD. BANIYAMIN	BUSINESS	40	M
				MD. ABDUL KALAM	MISTRY	35	M
				MD. AZIZUR RAHAMAN	BUSINESS	35	M
				MD. ABDUL KUDUS	MISTRY	25	M
				MD. RAMIJUDDIN	MISTRY	27	M
				NURLIN	FARMER	49	F
				MD. HAFIJ SADAM	FARMER	21	M
				MD. MAKABUL	FARMER	47	M
				MD. ABDUL HAMID	DRIVER	43	M
				MD. IQBAL	FARMER	42	M
				TAJUDDINI	TEACHER	33	F
SAVITRI	CULTIVATOR	50	F				





Sl. No.	Date and Location	Issues Discussed	Measures Taken	Name of Participants	Profession	Age	Sex
		<ul style="list-style-type: none"> <li>Govt. should provide some basic amenities for this village like, PHC, Hand pumps, High school etc.</li> </ul>	affected persons for R&R Purpose.	M. MEKHAM	LABOUR	25	M
				M. PAOGUNHAO	FARMER	34	M
				H. JAMKHOCHAN	LABOUR	23	M

C. Photographic Record of Public Consultation



Public Consultation at Khangabok Village, Thoubal



FGD Session at Khongjom Village, Thoubal



Public Consultation at Kiy Siphai Village, Thoubal



FGD Session at Lilong Village

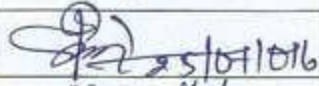



Public Consultation in village along project road




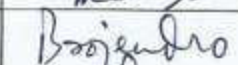


Public Consultation in village along project road

## D. Sample Attendance sheets of the Public Consultation

4. List of Participants				
Name	Profession	Age	Sex	Signature
M.D. ABDUL SATTAR	MR.	37	M	
M.V. NORULLAH	old an inachine Lenseon	60	M	M. Norullah
MD. AJURAHMAN	ate an inachine Lenseon	70	M	Md. Ajijurrahman
MDSATAR	Labour	21	M	Md Satar
MD. IMRAL	student	19	M	ms an
M. AYAJUDDIN	Levir	40	M	M. Ayajuddin
MD. NURULLAH	BUSINESS	45	M	Md Nurullah
MD. BANIAMIN	BUSINESS	40	M	Md. Baniamin
MD. ABUDL KALAM	Mistry	35	M	Md. Abdul Kalam
MD. AZIZUR RAHAMAN	BUSINESS	35	M	Md. Azizurrahman
MD. ABDUL KUDUS	Mistry	25	M	MD. ABDUL KUDUS
MD. RAMIJUDDIN	MISTRY	27	M	Md. Ramijuddin
MD. NURUL HAQUE	Farmar	49	m	md Nurulhaque
MD. HAFIJ. SADAM	Farmar	21	m.	Hafij Sadam.
MD. MAKABUL	Farmar	47	M.	MAKABUL
MD ABUUL HAMID	Devar	43	M.	Md Abdul Hamid
MD IQBAL	Farmar	42	m	Iqbal
Md. Tajuddin	Teacher	33	M	
MAHAMUD	Cultivator	50	M	Mohamad

## 4. List of Participants

Name	Profession	Age	Sex	Signature
S. ANITA	BUSINESS	40	F	S. Anita Devi
SH. THADOI	BUSINESS	31	F	Sh. Thadoi Devi
TH. TAMPAKLEIMA D	BUSINESS	56	F	TH. Tampakleima
KSH. SUMO DEVI	BUSINESS	45	F	Ksh. Sumo Devi
S. ACHODBI DEVI	SERVICE	54	F	S. Achodbi Devi
H. NUNGESITON DEVI	BUSINESS	61	F	H. Nungesiton Devi
L. SHOBHASINI DEVI	BUSINESS	35	F	L. Subhasini Devi
K. PREMABATI DEVI	BUSINESS	48	F	K. Premabati Devi
KH. REENA DEVI	BUSINESS	30	F	Kh. Reena Devi
CH. PRABHAPATI	BUSINESS	46	F	C. Prabhapati
S. SUSHILA DEVI	SERVICE	53	F	S. Sushila Devi
M. ACHOBA	LABOUR	42	M	M. Achoba Singh
M. RAJKUMAR	LABOUR	40	M	M. Rajkumar
K. KESHO	FARMER	38	M	K. Kesho
L. IBOYAIMA	LABOUR	60	M	L. Iboyaima
TH. SANTIKUMAR	FARMER	57	M	Th. Santikumar
TH. TOMBI	FARMER	58	M	Th. Tombi
TH. INGOCHA	BUSINESS	25	M	Th. Ingocha
L. KUMAR	BUSINESS	28	M	L. Kumar
L. AMUTOMBI	BUSINESS	28	M	L. Amutombi Singh
L. SANJIT	BUSINESS	30	M	L. Sanjit Singh

Name	Profession	Age	Sex	Signature
H. MANGLEM	SERVICE	42	M	
TH. BROJENDRO	Business	50	M	
H. BOCHOUBA	Business	42	M	
S. BASANTA	Cultivator	55	M	
S. ROMA	old	70	F	S. Romasari
H. MOMON	old	85	F	H. Momon Devi
TH. PRAMO	Business	82	F	TH. Pramono Dewi
A. TOMBIMACHA	<del>Housewife</del>	48	F	A. Tombimacha D
CH. PRABAPATI	Business	45	F	CH. Prabapati D
H. BINASAKHI	Business	45	F	H. Binarsakhi D
MD. SHUJALI ALI	SERVICE	65	M	Md. Sufali
S. INDRAMANI	Business	64	M	S. Indramani
S. SUREN	SERVICE	46	M	S. Sumsudaku

## 4. List of Participants

Name	Profession	Age	Sex	Signature
M.D. ALOUDIN	FARMER	49	M	Md. Alaudin
M.D. AZAB KHAN	FARMER	35	M	Md. Azad Khan
MD. SIRAJ KHAN	BUSINESS	45	M	Md. Siraj Khan
M.D. AMU	LABOUR	33	M	Md. Amu
ASHLAM KHAN	FARMER	45	M	Aslam Khan
ZAHID KHAN	FARMER	28	M	Zahid Khan
WAHIDUR RAHAMAN	FARMER	40	M	Md. Wahidur Rahman
HANEEF SHEIKH	BUSINESS	28	M	Md. Hanef Sheikh
TARIQUE ANWAR	TEACHER	26	M	Md. Tarique Anwar
MAJIBUR	FARMER	33	M	Md. Majibur
SATAR	SERVICE	36	M	Satar
MAJID	BUSINESS	28	M	Majid
MD BASIR AHMED	BUSINESS	47	M	Md. Basir Ahmed
KHOMEI	SERVICE	61	M	Khomei
LEHAJUDDIN	do	47	M	Lehajuddin
S. N. AHMED	PRESIDENT-JAC	62	M	S. N. Ahmed
NASHIR KHAN	BUSINESS	49	M	Nashir Khan
SAJID AHMED	STUDENT	28	M	Sajid
MD NIJAMUDDIN	BUSINESS	60	M	Md. Nizamuddin
M.D. GAFFAR	do	39	M	Md. Gaffar
ABDUL HAFIZ	do	34	M	Abdul Hafiz

**ANNEX 11: DETAILS OF TRAINING PROGRAM**

<b>Module</b>	<b>Title</b>	<b>Objectives</b>	<b>Duration (Day)</b>	<b>Participants</b>
1	Environmental Legislations and Bank's Safeguard Policies	<ul style="list-style-type: none"> <li>• Brush up latest on environmental legislations</li> <li>• Brush up safeguard policies</li> </ul>	1	PIU and Authority's Engineer staff
2	Environmental Supervision and Monitoring	<ul style="list-style-type: none"> <li>• EMP requirements</li> <li>• Implementation, Supervision and Monitoring Mechanism</li> <li>• Provision made in Contract Documents for Works</li> <li>• Provision made in contract Agreement for Supervision Services</li> </ul>	1	PIU and Authority's Engineer staff
3	Orientation Workshop on EMP Implementation	<ul style="list-style-type: none"> <li>• EMP requirements</li> <li>• Implementation, Supervision and Monitoring Mechanism</li> <li>• Roles and Responsibilities of Contractors and SCs</li> </ul>	1	PIU, Contractor and Authority's Engineer
4	Focused Training on Specific Issue/s (three during course of implementation)	<ul style="list-style-type: none"> <li>• Analyzing problems, referring stipulations in Contract and EMP and agreed to feasible solution within specified timeframe</li> </ul>	0.5	PIU, Contractor and Authority's Engineer

## **ANNEX 12: PREDICTION OF AIR QUALITY ALONG THE SUBPROJECT ROAD(LILONG-WANJING SECTION – PACKAGE 1)**

### **A. Introduction**

1. The major impact on the air quality during the operation stage will be due to plying of vehicles on the proposed Highway 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 corridor 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 hourly increment in CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations. The impacts of other pollutant concentrations is also insignificant. Therefore, this study only focus on the CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> dispersion, generated from the traffic on the proposed Highway.

### **B. Model descriptions**

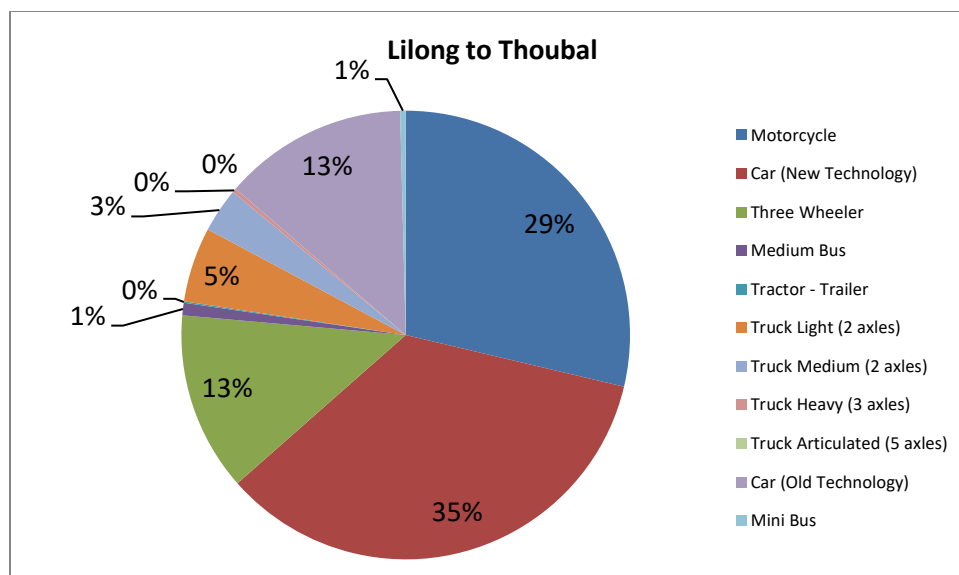
2. CALINE-4 is the fourth generation simple line source Gaussian plume dispersion model (Benson, 1984). It employs a mixing zone concept to characterize pollutant dispersion over the roadway. The main purpose of the model is to assess air quality impacts near transportation facilities. The input parameters 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 project report of the project. The annual average daily traffic (AADT) data is available for the proposed highway corridor through traffic survey. CALINE 4 model needs hourly average traffic volume. However, model has been setup for peak traffic hours assuming 3 times of average hourly 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 existing highway corridor (Figure 12.1).





**Figure 12.1: Traffic Fleet on the proposed Highway Corridor**

4. The annual average daily motorized traffic data are given in table 12.1 of proposed corridor.

**Table 12.1: Annual average daily motorized traffic data Lilong to Thoubal**

Types of Vehicles	2016	2020	2025	2030	2035	2040
Motorcycle	7314	8890	14470	17102	19254	21258
Car (New Technology)	8868	10779	15521	18344	20652	22802
Three Wheeler	3287	3996	5503	6504	7323	8085
Medium Bus	229	279	401	474	534	590
Tractor - Trailor	25	31	43	50	57	63
Truck Light (2 axles)	1376	1673	2723	3218	3623	4000
Truck Medium (2 axles)	815	991	1862	2200	2477	2735
Truck Heavy (3 axles)	76	93	221	261	294	325
Truck Articulated (5 axles)	0	0	0	0	0	0
Car (Old Technology)	3389	4120	5932	7011	7893	8715
Mini Bus	102	124	178	211	237	262

## 2. Road geometry

5. In the CALINE-4 model the entire length of the selected road section is divided into various road links. 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 and alignment. 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 21 m (1m + 3 m + 3 m + 14 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<sub>10</sub>, 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<sub>2.5</sub> is 0.15 g/VKT

sL = road surface silt loading (g/m<sup>2</sup>) = 0.531 g/m<sup>2</sup> (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, PM<sub>2.5</sub> and NO<sub>x</sub> used in the present study for different vehicles type are given in table 12.2. The calculated WEF for CO, PM<sub>2.5</sub> and PM<sub>10</sub> for peak traffic hours is given in table 12.3. The calculation of SO<sub>2</sub> emission factor for different categorized of vehicles are described in table 12.4.

**Table 12.2: Emission factors for different types of Vehicle (ARAI, 2007)**

Vehicle type	CO Emission factor (gm/km)	PM <sub>2.5</sub> Emission factor (gm/km)	NO <sub>x</sub> Emission factor (gm/km)
Two wheeler	3.08	0.20	0.412
Three Wheeler	2.50	0.24	0.532
Cars/Jeep	1.53	0.06	0.424
LCV	2.02	0.49	1.723
BUS	8.40	1.08	6.53
HCV	12.65	1.60	6.53

**Table 12.3: Weighted Emission Factor for proposed traffic**

Weighted Emission factor for CO (g/mile)	Weighted Emission factor for PM <sub>2.5</sub> (g/mile)	Weighted Emission factor for PM <sub>10</sub> (g/mile)	Weighted Emission factor for NO <sub>x</sub> (g/mile)
4.78	0.41	0.67	1.28

**Table 12.4: Emission Factor of SO<sub>2</sub> for proposed traffic**

Vehicle Category	Vehicle mileage(km l <sup>-1</sup> )	Fuel consumed per km (ltrs)	Sulphur content (%)	Density (kg/m <sup>3</sup> )	SO <sub>2</sub> (g/km)
2Ws	45.1	0.022	0.015	750	0.004989
LMVs-passenger	20.5	0.049	0.015	750	0.010976
4Ws-Petrol	12.6	0.079	0.015	750	0.017857
4Ws-Diesel	13.8	0.072	0.035	876	0.044435
LMV-goods	10	0.100	0.035	876	0.06132
HDVs-truck	4.6	0.217	0.035	876	0.133304
Buses	4.6	0.217	0.035	876	0.133304

#### **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, 70 m, 100m 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<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations generated from traffic movement on proposed highway. The predicted hourly average concentration of CO, PM<sub>2.5</sub>, PM<sub>10</sub> and SO<sub>2</sub> and NO<sub>x</sub> during peak traffic is shown in table 5 proposed highway corridor at selected receptor location. The results indicate the CALINE 4 does predict any value for NO<sub>x</sub> and SO<sub>2</sub>, and predict zero at all receptor locations. It is the limitation of the model to give output in units of ppm and up to one decimal point only which result that it can predict minimum value of any gaseous pollutant of 0.1 ppm. However, vehicles emit a very less amount of SO<sub>2</sub> and NO<sub>x</sub> and does not assess by CALINE 4. However, vehicular pollution must be represented by CO concentration (up to 70-80 % of total emission) which is an indicator for vehicular pollution. Therefore, predicted result for SO<sub>2</sub> and NO<sub>x</sub> are zero which means vehicles emit these pollutants insignificantly. The graphical representation of hourly average pollutant concentrations on both sides of the road sections shown in figures 2 – 4 at different locations.

**Table 12.5: Pollutant predicted concentrations along the proposed highway corridor for peak traffic hour**

Road Stretch	Year	Pollutant concentration													
		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
CO	2016	0.0	0.1	0.3	0.5	0.9	1.2	1.3	1.3	1.2	1.0	0.9	0.4	0.1	0.0
	2020	0.0	0.2	0.4	0.7	1.3	1.7	1.8	1.8	1.7	1.4	1.2	0.5	0.2	0.0
	2025	0.0	0.2	0.5	0.9	1.6	2.1	2.3	2.3	2.2	1.7	1.6	0.7	0.2	0.0
	2030	0.0	0.2	0.4	0.8	1.5	1.9	2.1	2.1	2.0	1.6	1.4	0.6	0.2	0.0
	2035	0.0	0.3	0.7	1.3	2.3	3.0	3.3	3.3	3.1	2.5	2.2	1.0	0.3	0.0
	2040	0.0	0.2	0.5	0.9	1.6	2.1	2.3	2.3	2.2	1.7	1.6	0.7	0.2	0.0
PM <sub>2.5</sub>	2016	4.38	5.29	10.59	21.17	37.05	48.70	52.93	52.93	50.28	39.70	35.99	15.88	5.29	4.76
	2020	7.53	9.09	18.19	36.37	63.65	83.66	90.93	90.93	86.38	68.20	61.83	27.28	9.09	8.18
	2025	7.86	9.49	18.99	37.97	66.45	87.34	94.93	94.93	90.18	71.20	64.55	28.48	9.49	8.54
	2030	8.19	9.89	19.79	39.57	69.25	91.02	98.93	98.93	93.98	74.20	67.27	29.68	9.89	8.90
	2035	8.94	10.79	21.59	43.17	75.55	99.30	107.93	107.93	102.53	80.95	73.39	32.38	10.79	9.71
	2040	9.85	11.89	23.79	47.57	83.25	109.42	118.93	118.93	112.98	89.20	80.87	35.68	11.89	10.70
PM <sub>10</sub>	2016	9.56	11.55	23.10	46.19	80.84	106.24	115.48	115.48	109.71	86.61	78.53	34.64	11.55	10.39
	2020	15.04	18.17	36.34	72.67	127.18	167.15	181.68	181.68	172.60	136.26	123.54	54.50	18.17	16.35
	2025	15.61	18.85	37.70	75.39	131.94	173.40	188.48	188.48	179.06	141.36	128.17	56.54	18.85	16.96
	2030	16.52	19.95	39.90	79.79	139.64	183.52	199.48	199.48	189.51	149.61	135.65	59.84	19.95	17.95
	2035	16.85	20.35	40.70	81.39	142.44	187.20	203.48	203.48	193.31	152.61	138.37	61.04	20.35	18.31
	2040	17.51	21.15	42.30	84.59	148.04	194.56	211.48	211.48	200.91	158.61	143.81	63.44	21.15	19.03
SO <sub>2</sub> *#	2016	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
	2020	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
	2025	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
	2030	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
	2035	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
	2040	0.00	0.92	1.83	3.66	6.41	8.42	9.15	9.15	8.69	6.86	6.22	2.75	0.92	0.00
NO <sub>x</sub> *	2016	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00
	2020	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00
	2025	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00
	2030	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00
	2035	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00
	2040	0.00	3.55	7.10	14.20	24.84	32.65	35.49	35.49	33.72	26.62	24.13	10.65	3.55	0.00

\*CALINE 4 gives results in ppm for gaseous pollutant and show zero output in PPM.

# SO<sub>2</sub> predict as inert gas as CALINE-4 does not have option for SO<sub>2</sub>

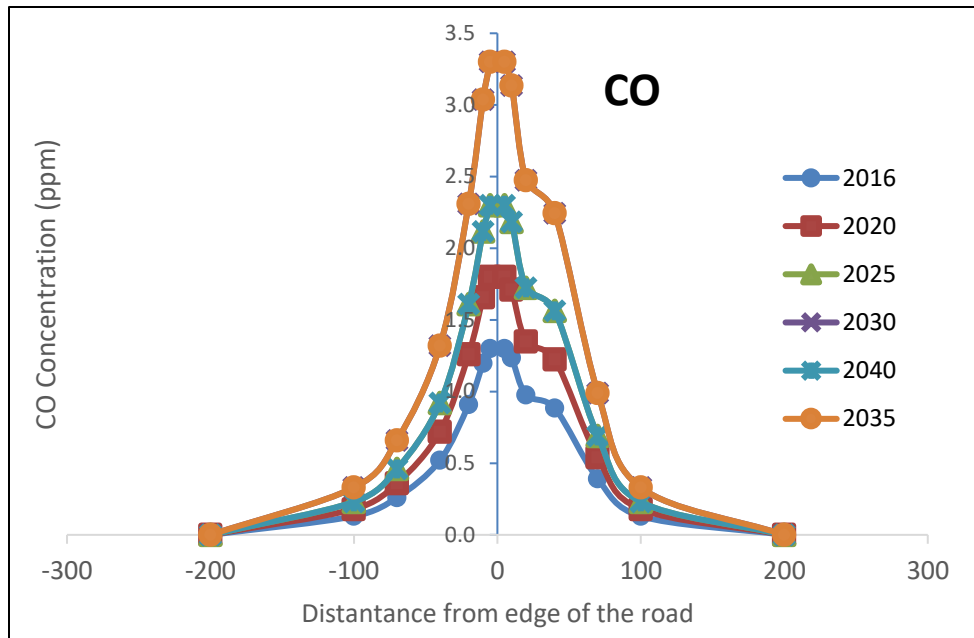


Figure 12.2: CO predicted concentrations (ppm) along the proposed highway corridor

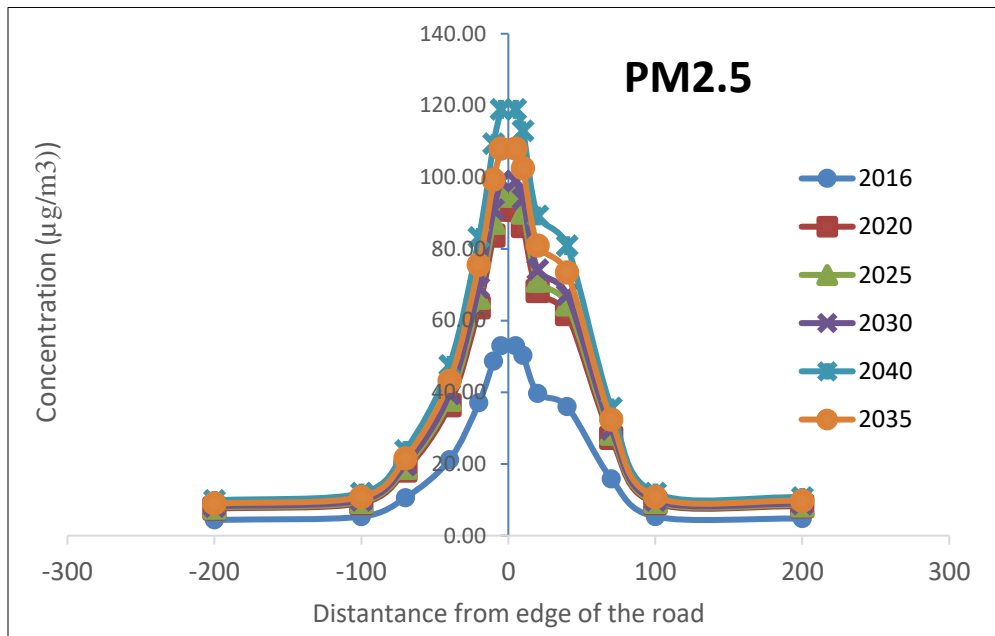
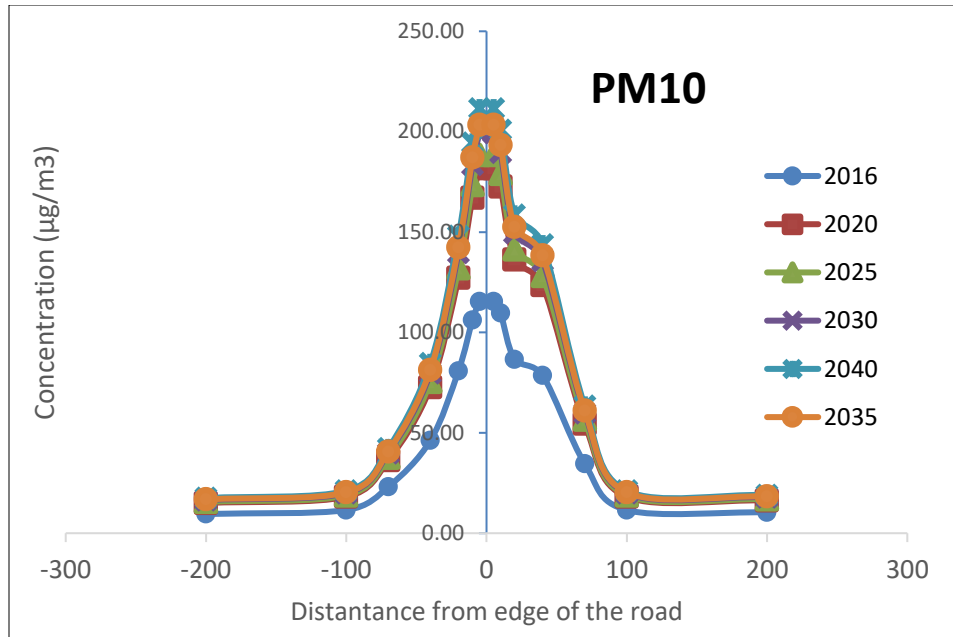


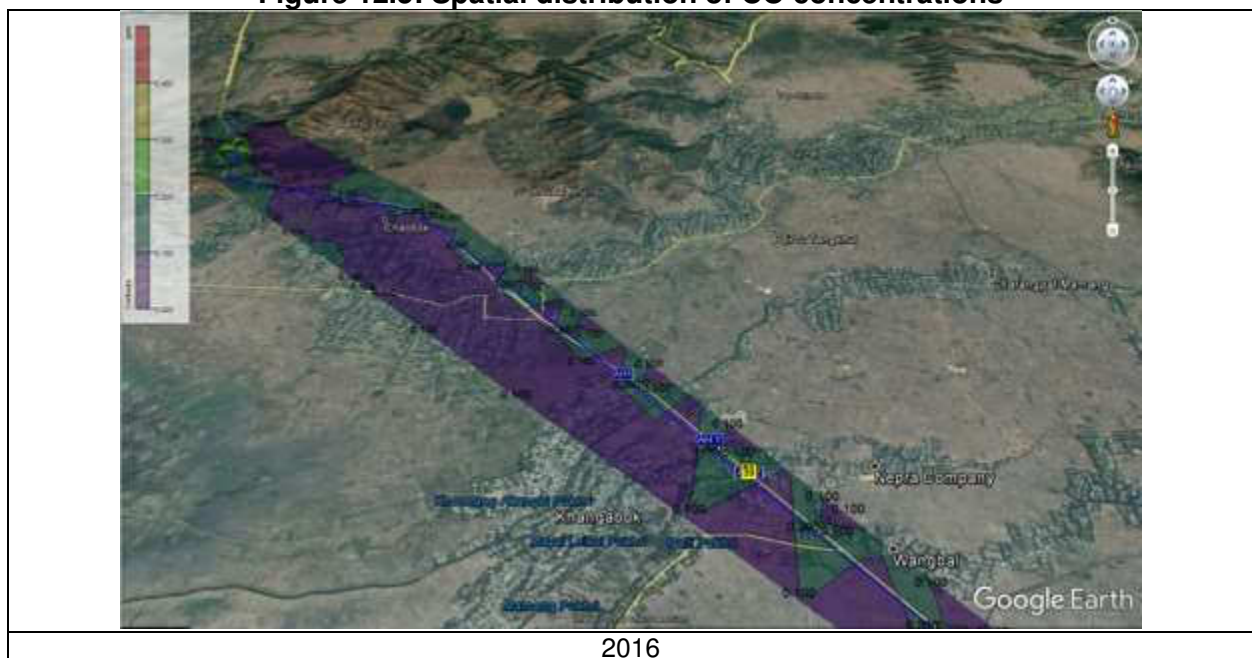
Figure 12.3: PM<sub>2.5</sub> predicted concentrations (µg/m<sup>3</sup>) along the proposed highway corridor

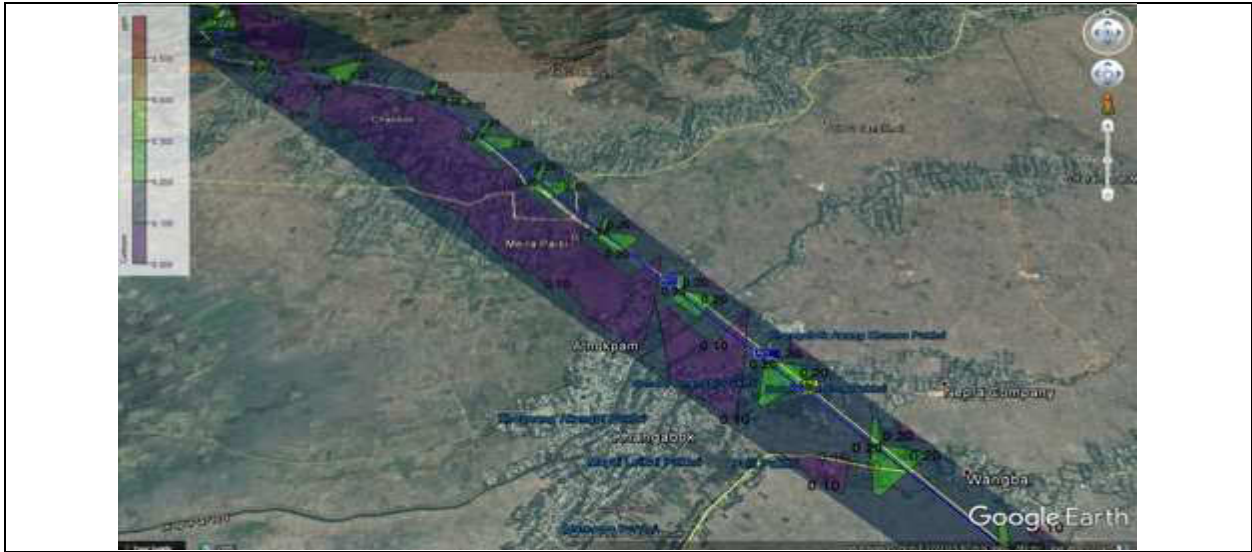


**Figure 12.4: PM<sub>10</sub> predicted concentrations (µg/m<sup>3</sup>) along the proposed highway corridor**

11. In addition, the spatial distribution of hourly average predicted CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations have been plotted in figures 5-9, respectively for peak traffic hour which shows that pollutant concentrations is decreasing when goes away from the highway corridor. From the CALINE4 modelling results, it is observed that maximum dispersion of pollutants concentration emitted from traffic volume at proposed highway corridor is up to 70m. Therefore, the impacts of traffic movement at proposed highway project will not impact the surrounding atmosphere.

**Figure 12.5: Spatial distribution of CO concentrations**





2020



2025



2030



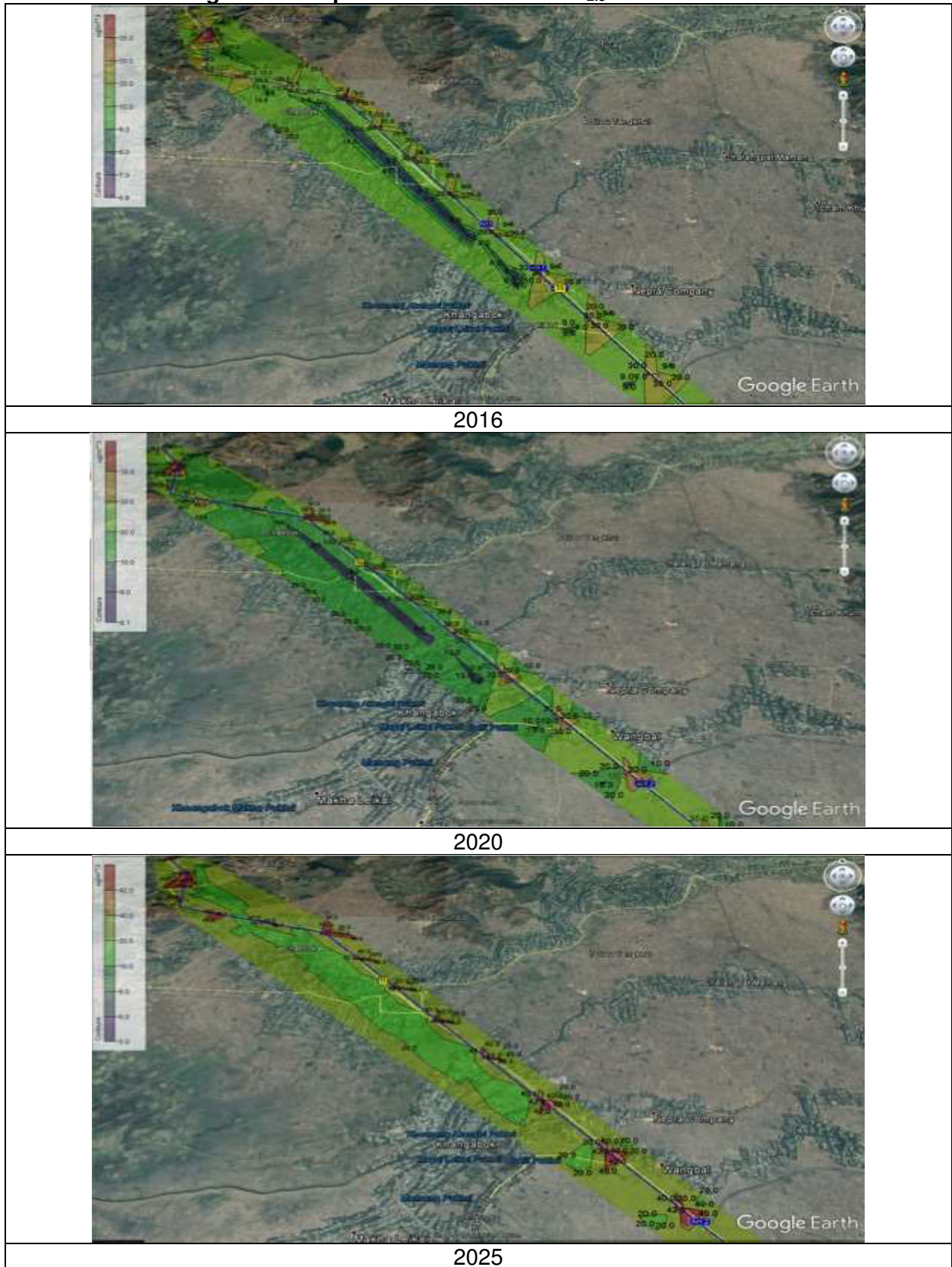
2035



2040

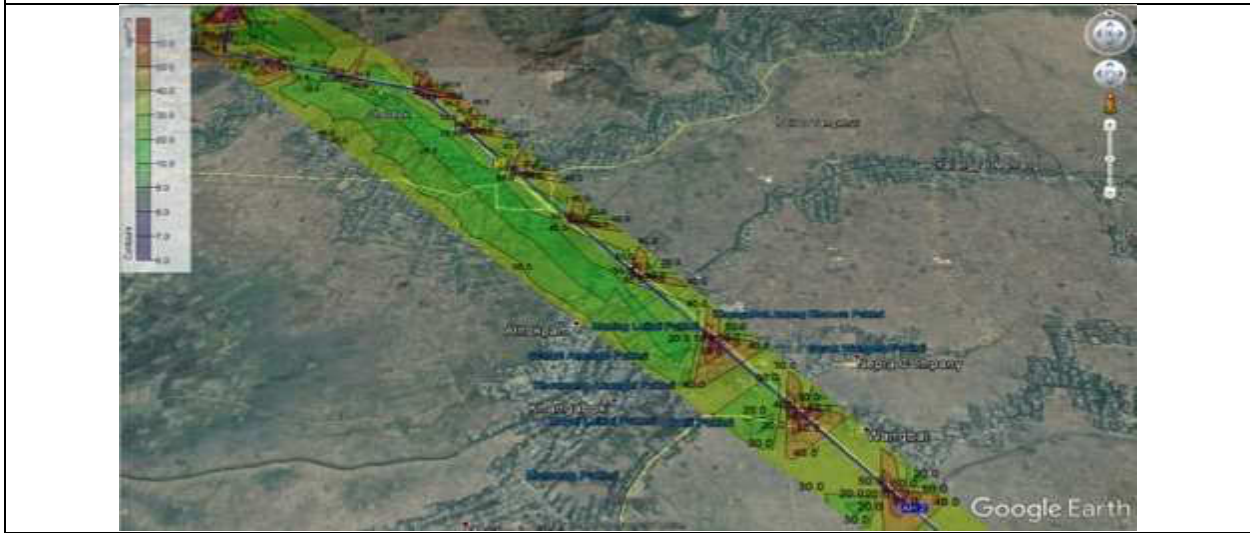


Figure 12.6: Spatial distribution of PM<sub>2.5</sub> concentrations





2030

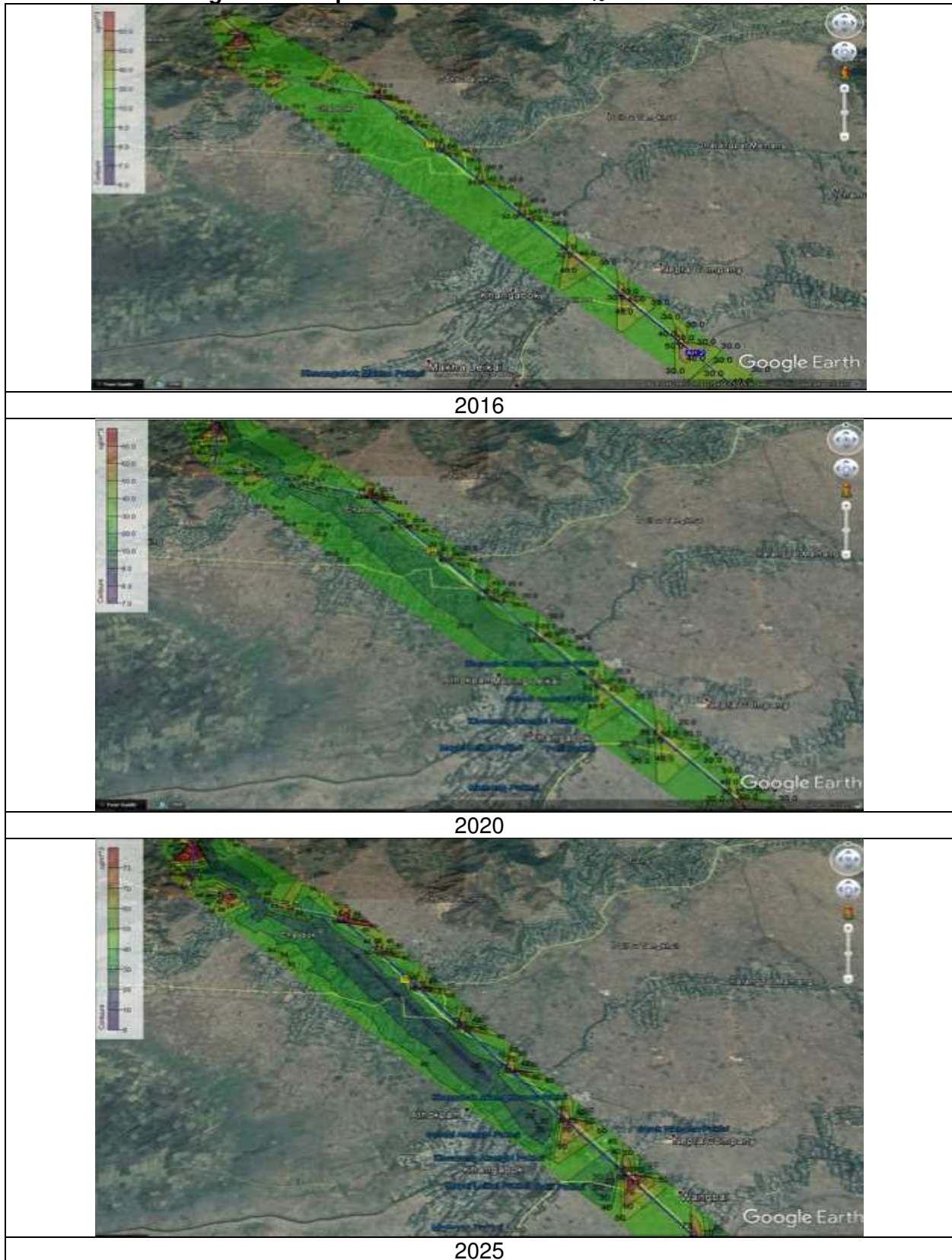


2035



2040

Figure 12.7: Spatial distribution of PM<sub>10</sub> concentrations





**Figure 12.8: Spatial distribution of SO<sub>2</sub> concentration ( No impact)**

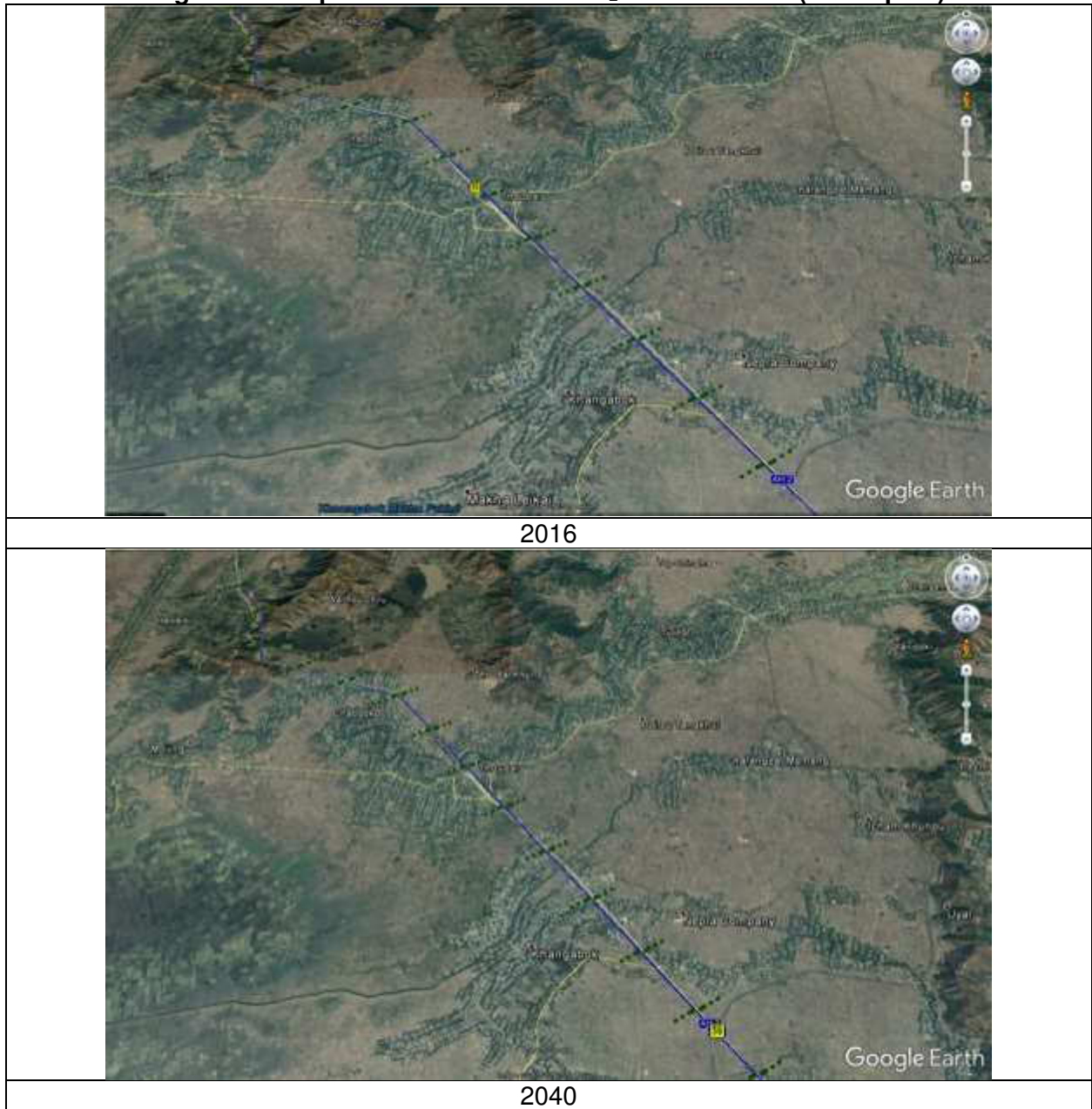
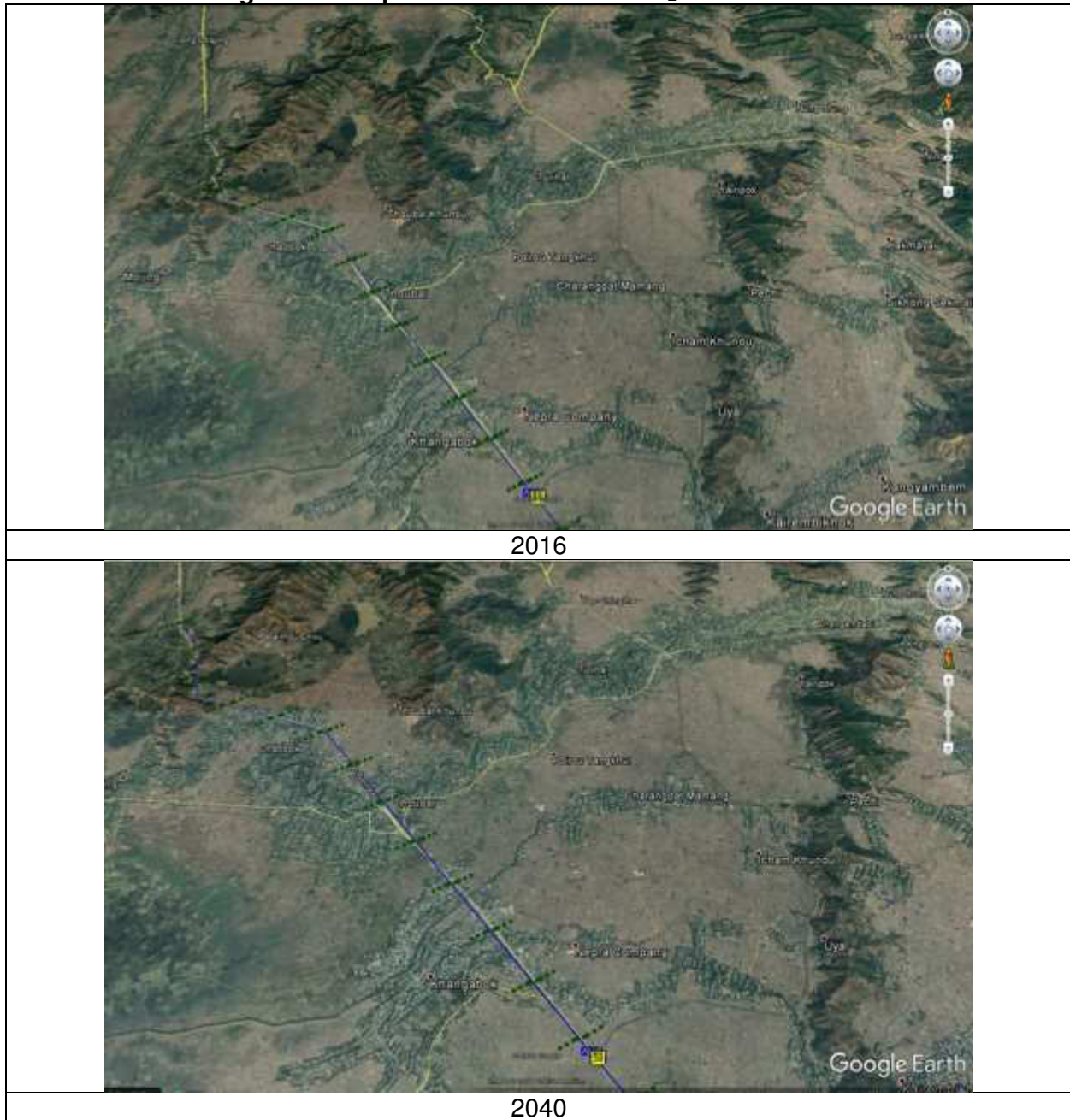


Figure 12.9: Spatial distribution of NO<sub>2</sub> concentrations



## **ANNEX 13: PREDICTION OF AIR QUALITY ALONG THE SUBPROJECT ROAD (WANJING-KHUDENGTHABII SECTION – PACKAGE 2)**

### **A. Introduction**

1. The major impact on the air quality during the operation stage will be due to plying of vehicles on the proposed Highway 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 corridor 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 hourly increment in CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations. The impacts of other pollutant concentrations is also insignificant. Therefore, this study only focus on the CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> dispersion, generated from the traffic on the proposed Highway.

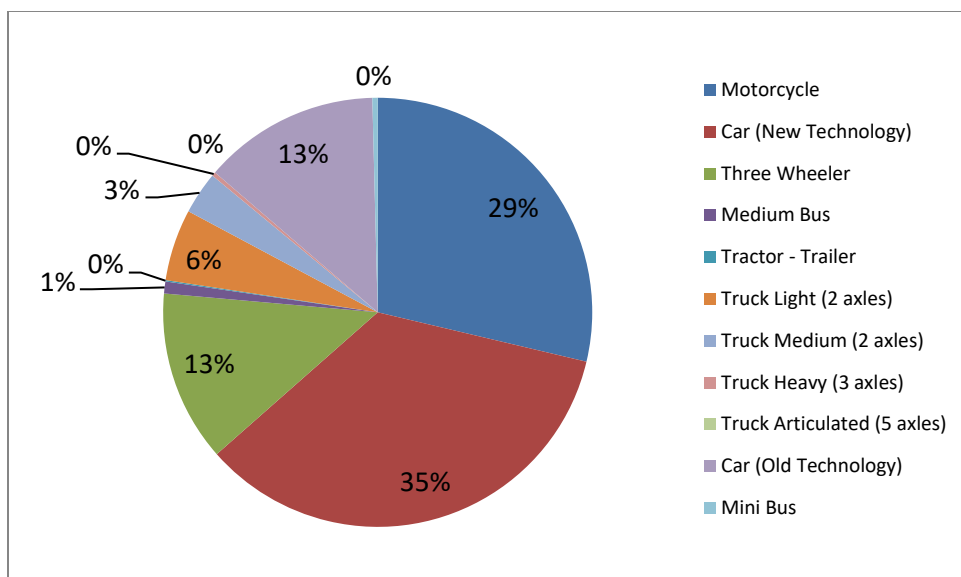
### **B. Model descriptions**

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 project report of the project. The annual average daily traffic (AADT) data is available for the proposed highway corridor through traffic survey. CALINE 4 model needs hourly average traffic volume. However, model has been setup for peak traffic hours assuming 3 times of average hourly 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 existing highway corridor (Figure1).



**Figure 13.1: Traffic Fleet on the proposed Highway Corridor**

4. The annual average daily motorized traffic data are given in table 1 of proposed corridor.

**Table 13.1: Annual average daily motorized traffic**

Types of Vehicles	2016	2020	2025	2030	2035	2040
Motorcycle	999	1,588	2,324	3,119	3,950	4,899
Car (New Technology)	1,153	2,990	4,993	6,519	8,085	9,836
Three Wheeler	419	694	933	1,170	1,404	1,660
Medium Bus	28	81	100	122	144	167
Tractor - Tractor	3	4	5	7	8	9
Truck Light (2 axles)	173	294	817	1,088	1,362	1,657
Truck Medium (2 axles)	101	272	764	972	1,196	1,455
Truck Heavy (3 axles)	9	37	130	165	203	247
Truck Articulated (5 axles)	0	1	2	3	3	4
Car (Old Technology)	441	0	0	0	0	0
Mini Bus	12	25	36	44	52	61

## 2. Road geometry

5. In the CALINE-4 model the entire length of the selected road section is divided into various road links. 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 and alignment. 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 21 m (1m+ 3 m + 3 m + 14 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<sub>10</sub>, 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<sub>2.5</sub> is 0.15 g/VKT

sL = road surface silt loading (g/m<sup>2</sup>) = 0.531 g/m<sup>2</sup> (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, PM<sub>2.5</sub> and NO<sub>x</sub> used in the present study for different vehicles type are given in table 13. 2. The calculated WEF for CO, PM<sub>2.5</sub> and PM<sub>10</sub> for peak traffic hours is given in table 13.3. The calculation of SO<sub>2</sub> emission factor for different categorized of vehicles are described in table 13.4.

**Table 13.2: Emission factors for different types of Vehicle (ARAI, 2007)**

Vehicle type	CO Emission factor (gm/km)	PM <sub>2.5</sub> Emission factor (gm/km)	NO <sub>x</sub> Emission factor (gm/km)
Two wheeler	3.08	0.20	0.412
Three Wheeler	2.50	0.24	0.532
Cars/Jeep	1.53	0.06	0.424
LCV	2.02	0.49	1.723
BUS	8.40	1.08	6.53
HCV	12.65	1.60	6.53

**Table 13.3: Weighted Emission Factor for proposed traffic**

Weighted Emission factor for CO (g/mile)	Weighted Emission factor for PM <sub>2.5</sub> (g/mile)	Weighted Emission factor for PM <sub>10</sub> (g/mile)	Weighted Emission factor for NO <sub>x</sub> (g/mile)
4.76	0.41	0.66	1.28

**Table 13.4: Emission Factor of SO<sub>2</sub> for proposed traffic**

Vehicle Category	Vehicle mileage(km l <sup>-1</sup> )	Fuel consumed per km (ltrs)	Sulphur content (%)	Density (kg/m <sup>3</sup> )	SO <sub>2</sub> (g/km)
2Ws	45.1	0.022	0.015	750	0.004989
LMVs-passenger	20.5	0.049	0.015	750	0.010976
4Ws-Petrol	12.6	0.079	0.015	750	0.017857
4Ws-Diesel	13.8	0.072	0.035	876	0.044435
LMV-goods	10	0.100	0.035	876	0.06132
HDVs-truck	4.6	0.217	0.035	876	0.133304
Buses	4.6	0.217	0.035	876	0.133304

#### 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, 70 m, 100m 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<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations generated from traffic movement on proposed highway. The predicted hourly average concentration of CO, PM<sub>2.5</sub>, PM<sub>10</sub> and SO<sub>2</sub> and NO<sub>x</sub> during peak traffic is shown in table 5 proposed highway corridor at selected receptor location. The results indicate the CALINE 4 does predict any value for NO<sub>x</sub> and SO<sub>2</sub>, and predict zero at all receptor locations. It is the limitation of the model to give output in units of ppm and up to one decimal point only which result that it can predict minimum value of any gaseous pollutant of 0.1 ppm. However, vehicles emit a very less amount of SO<sub>2</sub> and NO<sub>x</sub> and does not assess by CALINE 4. However, vehicular pollution must be represented by CO concentration (up to 70-80 % of total emission) which is an indicator for vehicular pollution. Therefore, predicted result for SO<sub>2</sub> and NO<sub>x</sub> are zero which means vehicles emit these pollutants insignificantly. The graphical representation of hourly average pollutant concentrations on both sides of the road sections shown in figures 2 – 4 at different locations.

**Table 13.5: Pollutant predicted concentrations along the proposed highway corridor for peak traffic hour**

Road Stretch	Year	Pollutant concentration													
		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
CO	2016	0.0	0.1	0.1	0.3	0.5	0.6	0.7	0.706	0.7	0.5	0.5	0.2	0.1	0.0
	2020	0.0	0.1	0.2	0.4	0.6	0.8	0.9	0.9	0.9	0.7	0.6	0.3	0.1	0.0
	2025	0.0	0.2	0.5	0.9	1.6	2.1	2.3	2.3	2.2	1.7	1.6	0.7	0.2	0.0
	2030	0.0	0.1	0.2	0.4	0.8	1.0	1.1	1.1	1.1	0.8	0.8	0.3	0.1	0.0
	2035	0.0	0.3	0.7	1.3	2.3	3.0	3.3	3.3	3.1	2.5	2.2	1.0	0.3	0.0
	2040	0.0	0.1	0.2	0.5	0.8	1.1	1.2	1.2	1.1	0.9	0.8	0.4	0.1	0.0
PM <sub>2.5</sub>	2016	3.43	4.14	8.27	16.55	28.96	38.06	41.37	41.37	39.30	31.03	28.13	12.41	4.14	3.72
	2020	4.64	5.61	11.21	22.43	39.25	51.58	56.07	56.07	53.27	42.05	38.13	16.82	5.61	5.05
	2025	5.36	6.48	12.95	25.91	45.34	59.59	64.77	64.77	61.53	48.58	44.04	19.43	6.48	5.83
	2030	5.91	7.14	14.27	28.55	49.96	65.66	71.37	71.37	67.80	53.53	48.53	21.41	7.14	6.42
	2035	6.41	7.74	15.47	30.95	54.16	71.18	77.37	77.37	73.50	58.03	52.61	23.21	7.74	6.96
	2040	7.00	8.46	16.91	33.83	59.20	77.80	84.57	84.57	80.34	63.43	57.51	25.37	8.46	7.61
PM <sub>10</sub>	2016	6.95	8.40	16.79	33.58	58.77	77.24	83.96	83.96	79.76	62.97	57.09	25.19	8.40	7.56
	2020	8.91	10.77	21.53	43.06	75.36	99.05	107.66	107.66	102.28	80.75	73.21	32.30	10.77	9.69
	2025	10.11	12.21	24.41	48.82	85.44	112.30	122.06	122.06	115.96	91.55	83.00	36.62	12.21	10.99
	2030	10.98	13.26	26.51	53.02	92.79	121.96	132.56	132.56	125.93	99.42	90.14	39.77	13.26	11.93
	2035	11.85	14.31	28.61	57.22	100.14	131.62	143.06	143.06	135.91	107.30	97.28	42.92	14.31	12.88
	2040	12.78	15.44	30.87	61.74	108.05	142.01	154.36	154.36	146.64	115.77	104.96	46.31	15.44	13.89
SO <sub>2</sub> *#	2016	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
	2020	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
	2025	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
	2030	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
	2035	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
	2040	0.00	0.38	0.76	1.52	2.65	3.49	3.79	3.79	3.60	2.84	2.58	1.14	0.38	0.00
NO <sub>x</sub> *	2016	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00
	2020	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00
	2025	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00
	2030	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00
	2035	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00
	2040	0.00	0.78	1.55	3.10	5.43	7.14	7.76	7.76	7.37	5.82	5.28	2.33	0.78	0.00

\*CALINE 4 gives results in ppm for gaseous pollutant and show zero output in ppm.

# SO<sub>2</sub> predict as inert gas as CALINE-4 does not have option for SO<sub>2</sub>.

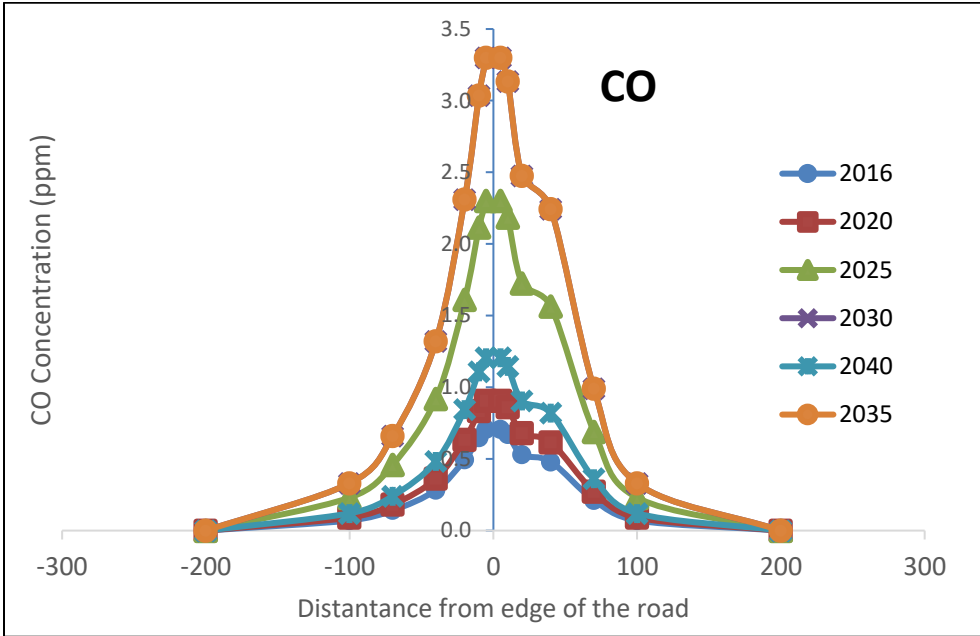


Figure 13.2: CO predicted concentrations (ppm) along the proposed highway corridor

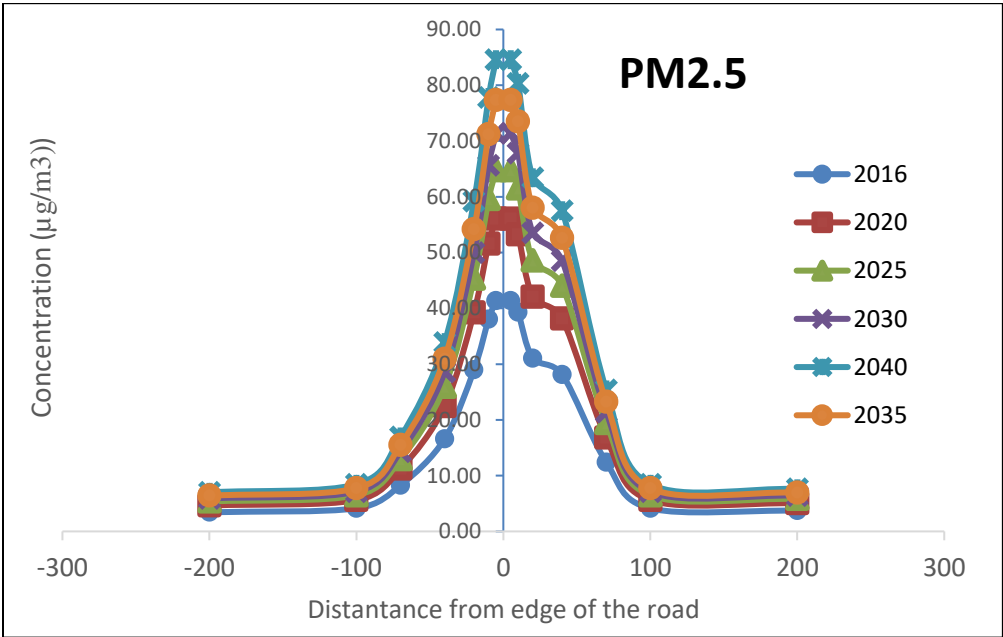
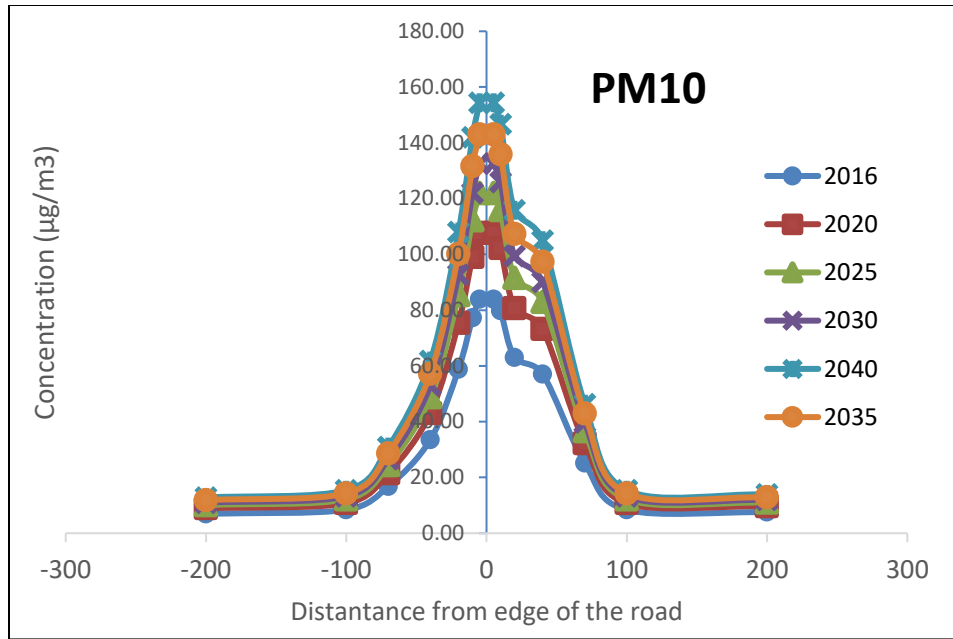


Figure 13.3: PM<sub>2.5</sub> predicted concentrations (µg/m3) along the proposed highway corridor



**Figure 13.4: PM<sub>10</sub> predicted concentrations (µg/m<sup>3</sup>) along the proposed highway corridor**

11. In addition, the spatial distribution of hourly average predicted CO, PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NOx concentrations have been plotted in figures 5-9, respectively for peak traffic hour which shows that pollutant concentrations is decreasing when goes away from the highway corridor. From the CALINE4 modelling results, it is observed that maximum dispersion of pollutants concentration emitted from traffic volume at proposed highway corridor is up to 70m. Therefore, the impacts of traffic movement at proposed highway project will not impact the surrounding atmosphere.

**Figure 13.5: Spatial distribution of CO concentrations**



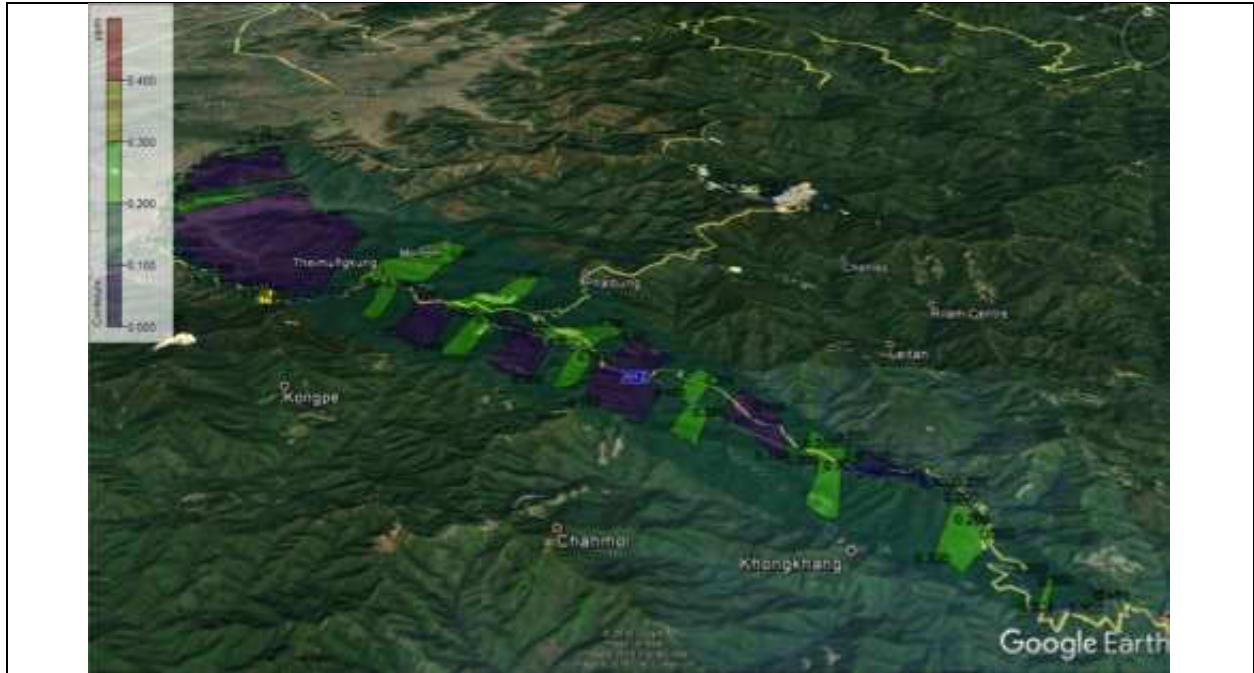
2016



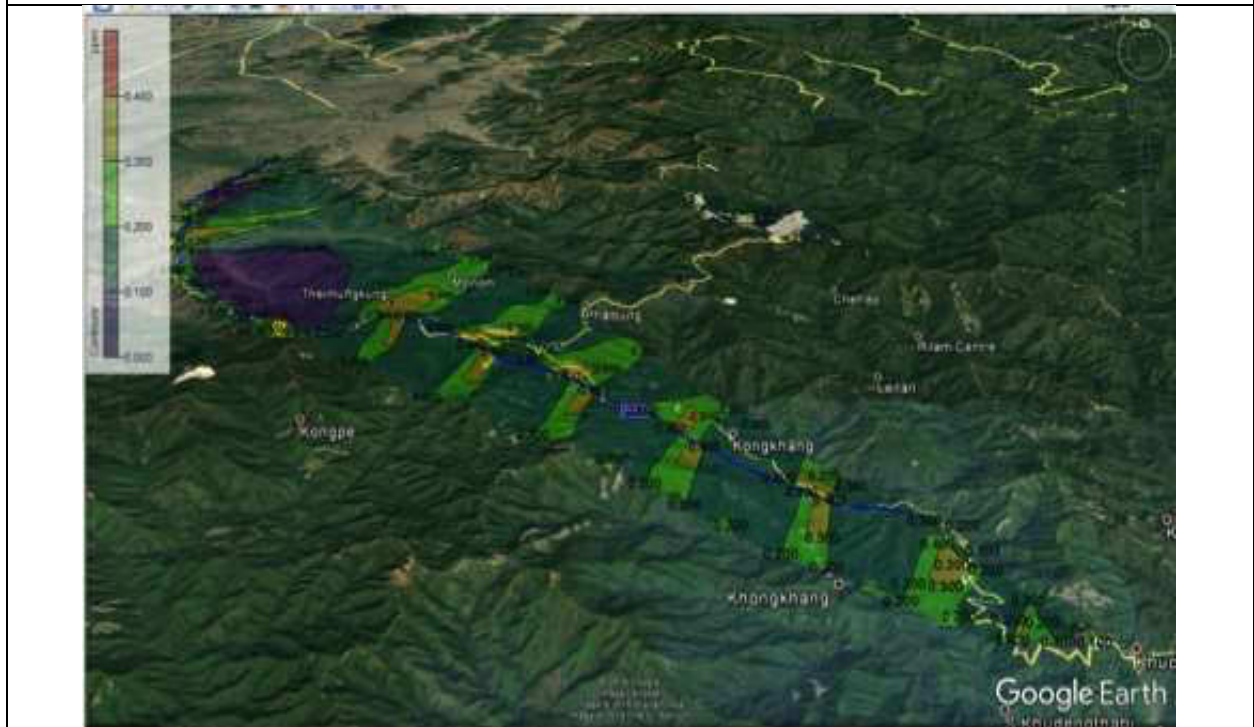
2020



2025



2030



2035

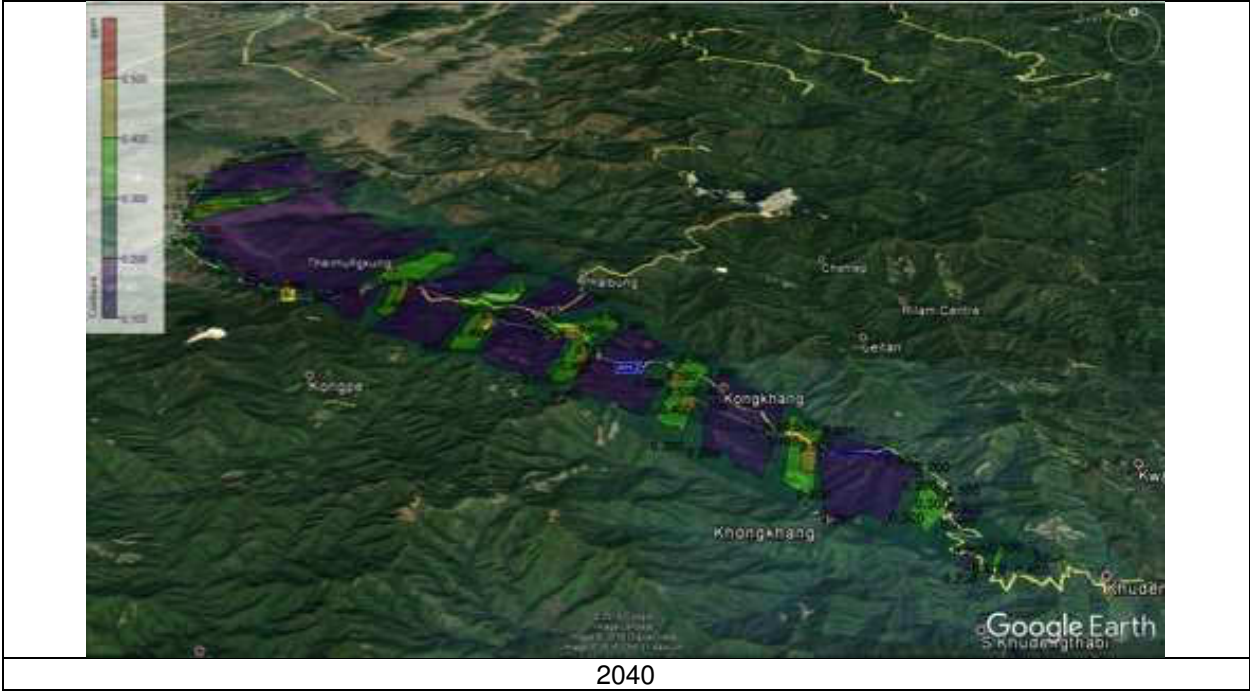
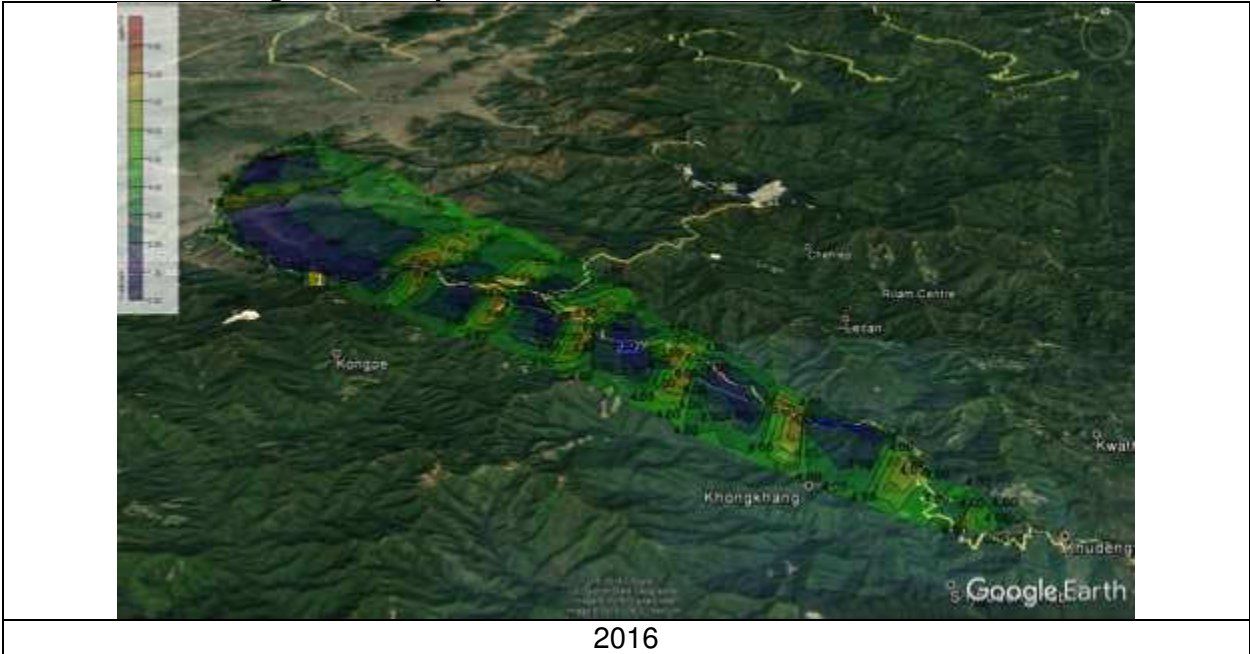
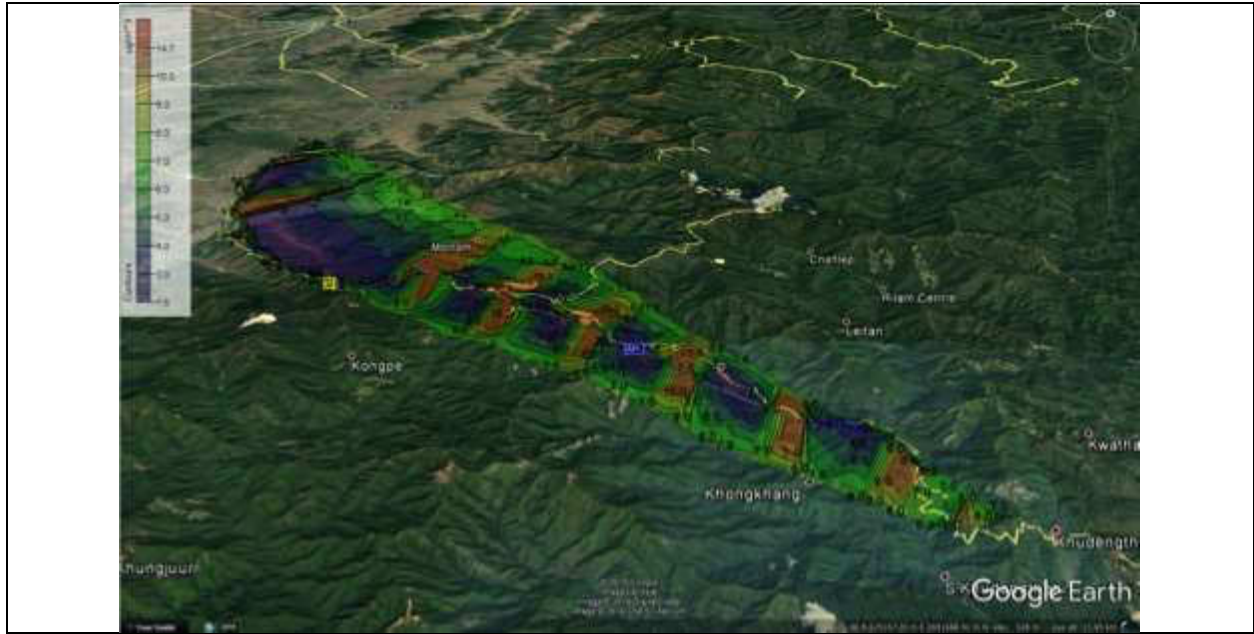


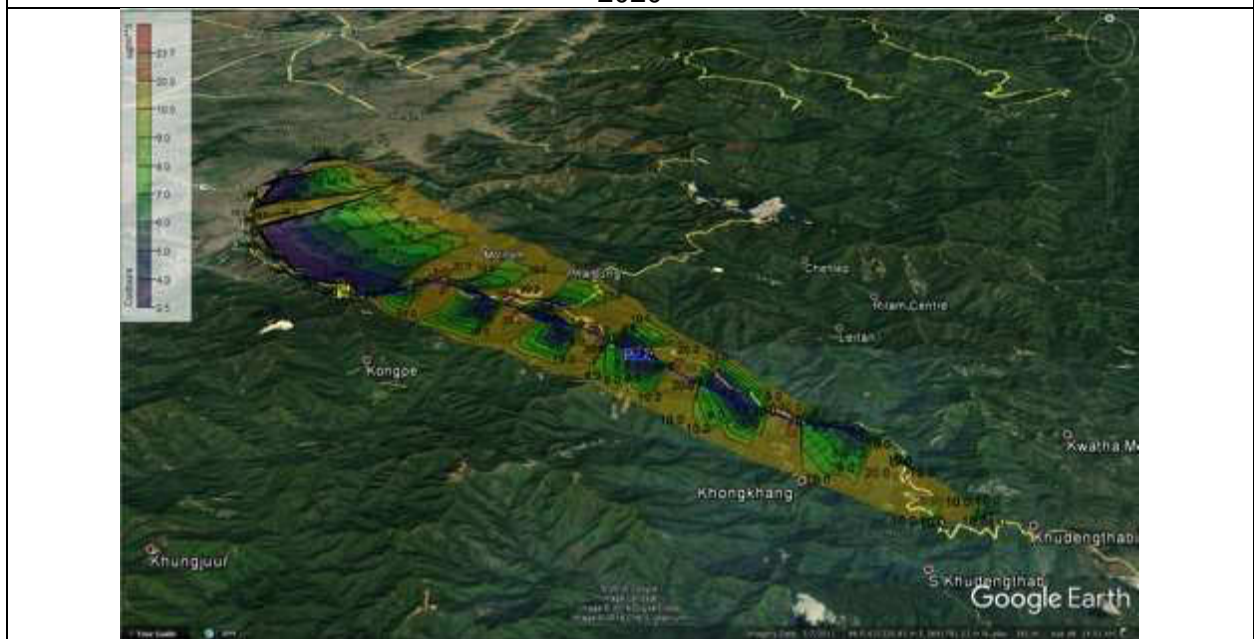
Figure 13.6: Spatial distribution of PM<sub>2.5</sub> concentrations







2020



2025



2030



2035

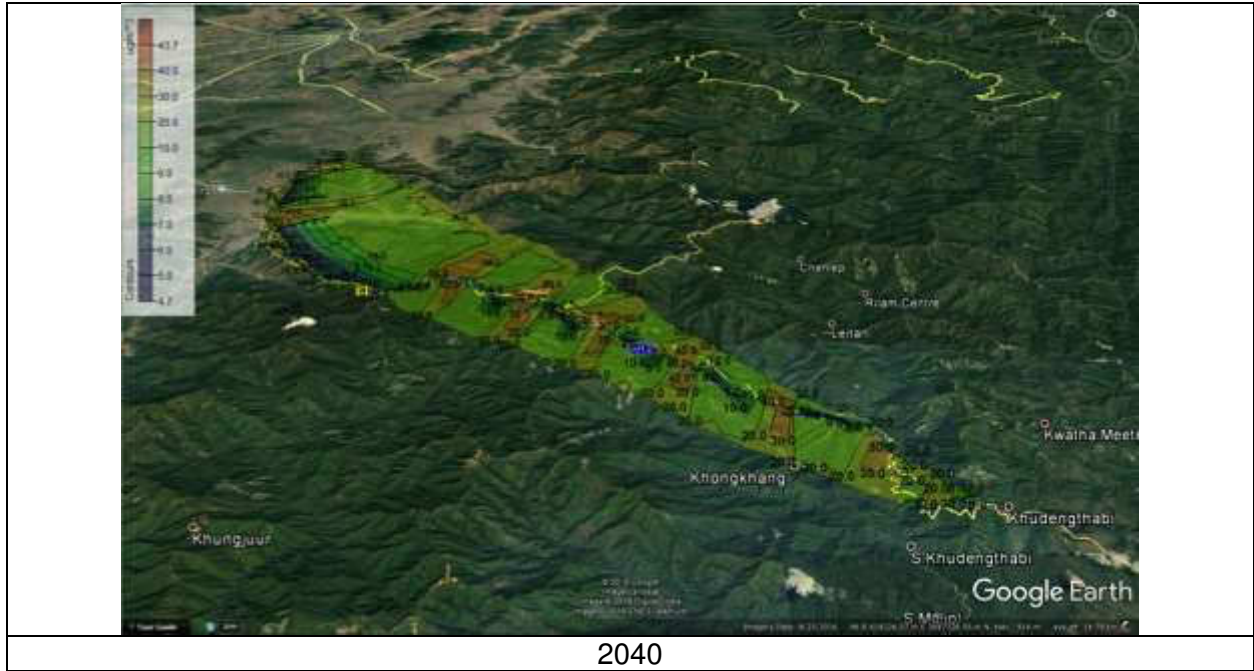
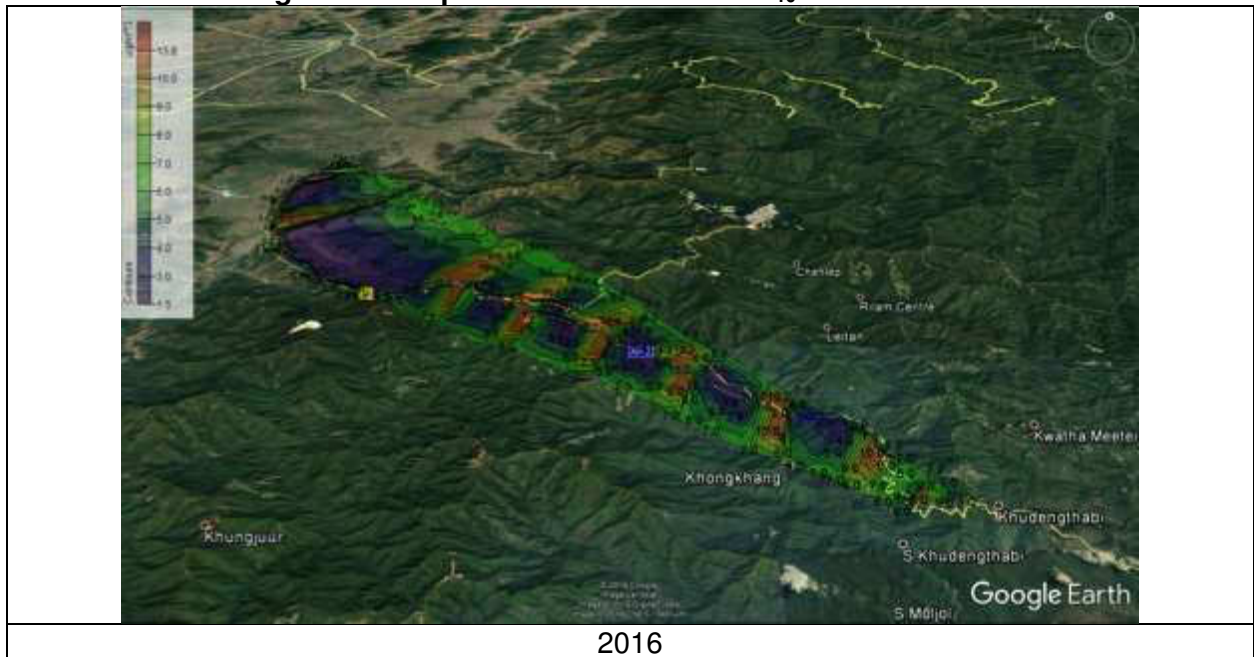


Figure 13.7: Spatial distribution of PM<sub>10</sub> concentrations





2020



2025



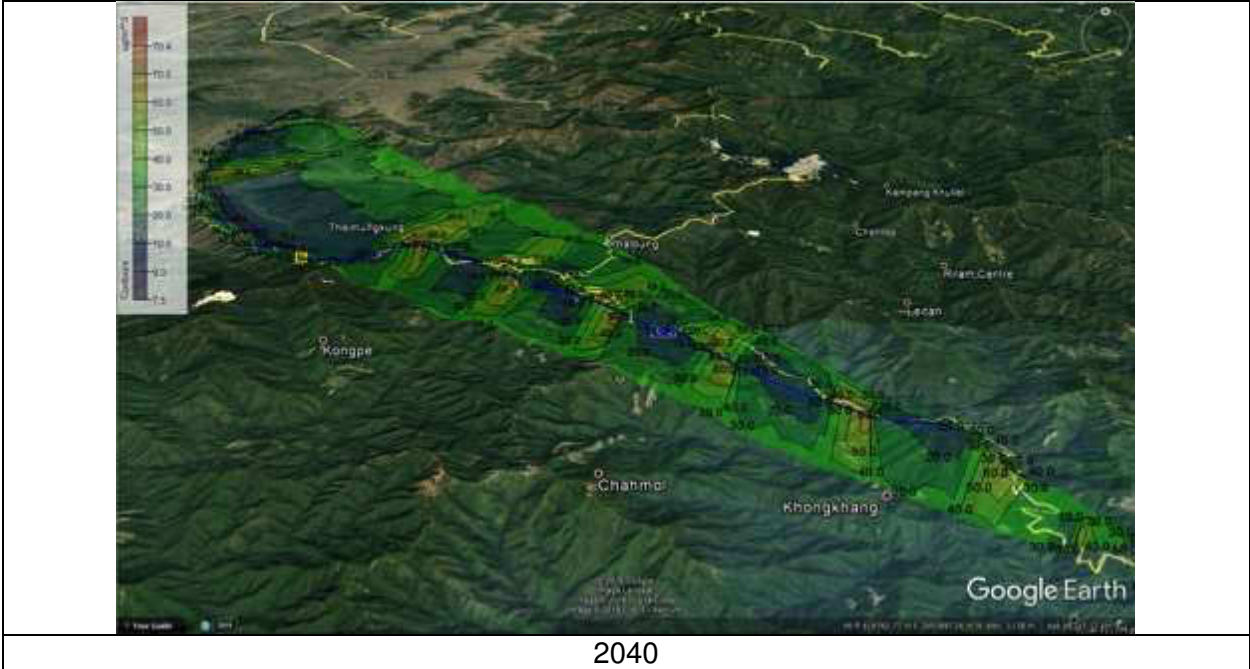
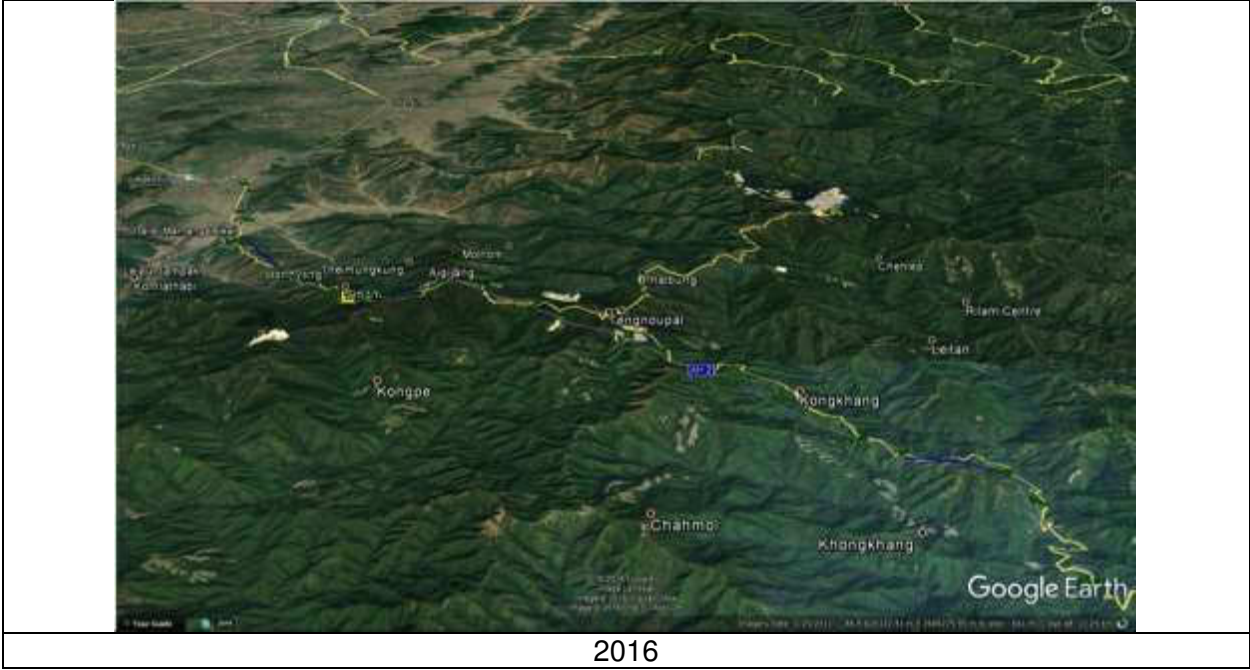


Figure 13.8: Spatial distribution of SO<sub>2</sub> concentration ( No impact)







2040