

ENVIRONMENTAL IMPACT ASSESSMENT OF

NH- 730

A Dissertation

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Masters of Technology

in

Environmental Science and Technology

Submitted by

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Under the Guidance of

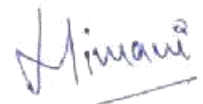
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DECLARATION

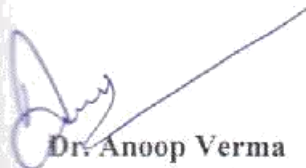
I hereby declare that the project work entitled "Environmental Impact Assessment of National Highway 730" is an authentic record of my own work carried out at SAI Consulting Engineers Pvt. Ltd., Noida as requirements of one year project internship for the award of degree of M.Tech. (Environmental Science and Technology) Thapar University, Patiala, under the guidance of Shailendra Kumar and Dr. Anoop Verma during July 2015 to July 2016.



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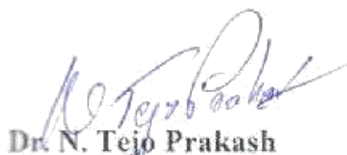
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ABSTRACT

The Environmental Impact Assessment (EIA) is a systematic investigation of both positive and negative impacts on the physical, biological socioeconomic environment, which would be caused or induced due to a proposed developmental project. EIA provides a plan to reduce the negative environmental effects of proposed development project through alternative approaches, design modifications and remedial measures. Highway construction is a major activity of economic development especially in developing countries. Road development is major source of damage to the environment, including ecological destabilization, habitat disturbance and damage to flora and fauna. In this study analyses the environmental impacts likely to occur due to the proposed 2 lane widening of a 38 km stretch of NH-730 from Pilibhit to Puranpur. The report highlights the importance of EIA in the sustainable development of highway project with a case study of vital link of about 38 Kilometers. The study concentrates on the environment impact assessment of the project in the light of the existing situation at the site. The parameters covered in study are Socio-Economic, Biological, Air (Dust), Water, Accidental, Noise, Ecological & Soil. Samples of air, water & soil were taken to analyze their present conditions. Data was also collected from various Government offices like the forest

Department and the accidental data was collected from police stations along the highway. The results demonstrated that the Total Dissolved Solids content were under prescribed limits in all of the groundwater and surface water samples, PM10 concentrations at all locations were under the prescribed limits. Noise levels were found slightly closer to permissible limits. Minimal soil contamination was observed. Highway capacity was analyzed and it was observed that the present highway is insufficient to handle the current traffic volume so the section requires two laning immediately to accommodate more traffic. After analyzing different parameters and discussing the probable impacts suggestions are made regarding the mitigation measures that can be taken at different stages in order to reduce the environmental impacts.

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1. INTRODUCTION

1.1 Environmental Impact Assessment (EIA)

The term environmental Impact Assessment is widely defined as the well organised identification, evaluation and monitoring of the possible impacts (effects) of proposed projects, programmes or legislative actions relative to the physical, chemical, biological, and social components of the total environment (**Canter, 1996**).

According to **Environmental Impact Assessment Guidance Manual for highways, 2010**

Environmental Impact Assessment (EIA) is a planning tool which is usually accepted as an integral component of sound decision-making. The main objective of EIA is to give the environment its due place in the decision-making process by estimating the environmental outcome of the proposed project activity before any action is taken. Prior identification and characterization of crucial environmental impacts of these projects allow the public and the government to form a perspective about the environmental acceptability of the proposed developmental project and the conditions that should be applied to mitigate those risks and effects.

In a developing country like India infrastructural development, especially travel and transportation of goods, is a guiding factor for economic progress. Highly increasing road traffic requires better quality of roads and uninterrupted vehicular movement. Also proper transportation of goods needs extensive transport systems and hence it is quite necessary to develop new roads. (**Sar et al., International Journal of Advanced Engineering Technology, 2013**).

1.2 Environmental Impact Assessment in the project

1.2.1 Objective and Need of Environmental Impact Assessment: The development of these road projects requires implementation of EIA to reduce their adverse effect on the environment. EIA is a tool which promotes a practical and dynamic mechanism of environmental protection that helps to avoid or reduce remarkable adverse impacts on the environment throughout the entire planning and design process. Road planning and design is a constant process where planning and designing evolve according to the environmental considerations. This makes sure that environmental considerations become an important integral part of the overall road project selection and road scheme planning and design process

1.2.2 Scope of EIA Report

The scope for the environmental impact assessment is decided on the basis of past records of consultants of similar projects and Terms of Reference of consultants. The scope of EIA study is finalised with the help of the results of the environmental screening study carried out by the consultants. There is massive dependency on roads to distribute goods for most of the organization. Although roads are facing criticism around the world yet they are considered as the pillar of economic development of a country. Important destinations such as cities, large towns and states are mainly travelled by the public on highway roads.

Noise and dust generated from construction, use of non- renewable materials, loss of nature, and green space are considered to be major impacts due to highway construction. Therefore Environmental impact assessment (EIA) should be undertaken before the road is designed.

1.3 Objective of the Report/Study

Development of road infrastructure is the first step towards wholesome development of State, cities, towns and people. The project is justified in terms of improvement of carriageway and road quality reduction of increased traffic congestion, improvement in road safety, improvement of environmental quality due to reduction of traffic congestion, improvement in existing transportation facilities, economic development and infrastructure development potential. An EIA report helps to evaluate full range effect on the environment due to the proposed project road and this is done through Environmental Impact Assessment tool. The main points discussed in the report are the procedure of EIA, its purposes, its main stages, its effectiveness and also analysis its evolution in the near future. It also handles the concept of environmental evaluation by providing an overview of its objectives and by reviewing the approaches proposed in the literature, as well as their main shortcomings.

2. LITERATURE REVIEW

In the last few decades various activities aroused by human have steadily drawn attention towards the concerns of environmental degradation and natural resource depletion. The potential environmental consequences of these development projects make it necessary for the planning authorities to look into these concerns. The Environmental Impact Assessment (EIA) is one of the tools which is available to fulfill this need. This approach involves the systematic identification and evaluation of the impacts on the environment generated by a proposed project. EIA is now applied worldwide. The potential role of EIA is to attain sustainable development and this was clearly recognised during the 1992 Earth Summit held in Rio de Janeiro (**United Nations 1992**).

2.1 Effects of the Road on the Environment

Road mobility is strengthened by development of highways. These highways are also critical to the economic growth of the society and a country as a whole. But inappropriately designed constructed and planned highways can bother the conditions of the public and also have an adverse impact on the natural and social environment. Some of the common highway development impacts are given below:

2.1.1 Effects of pollution and disturbance on biota and ecosystems: Major factors like light, noise, sand, dust and other particulates, metals such as Pb, Cd, Ni and Zn, and gases such as CO and NO are the pollutants which affect the biota. Run-off water from roads have broad range of these pollutants which lead to extensive studies for these pollutants (**Gjessing et al., 1984**). Some authors (**Schonewald-Cox & Buechner, 1992**) have studied the extent of the emissions and disturbances generated from a road. For example, in plants evidence of heavy metals up to 150m from roads have been observed which is above than normal. There are many complex operations in the secondary and combined effects of these pollutants such as they may cause physiological stress in some flora and make pest attack more susceptible. This has been shown by study on aphid infestations of roadside trees in Switzerland (**Braun & Fluckiger, 1984**). In a review by **Hellawell, 1988** the effect of a wide range of potential pollutants in flowing water and their toxic effects on biota was studied. Different species of flora and fauna tend to respond to different pollutants in different ways and even different

stages in their life span. Various factors involving road pollutants which disturb the biota and ecosystem are:

- i) *Noise and artificial lighting*: Some wildlife have remarkable impact of noise and artificial lighting. For example the effects of traffic on breeding bird population in Netherlands have been studied by **Reijnen, Veenbass & Baker, 1995**. They found that there was decrease in these bird population densities and they explained that noise load is the most probable cause behind it. There has been few studies e.g. **Environmental Resources Management (1996)** which reviewed the effects of road lighting and traffic lights on various species of flora and fauna. These effects can vary widely. For e.g. artificial road lighting extends the feeding time for some birds species (**Hill, 1992**), also road sodium vapour lamps may affect the growth of some crop plants (**Sinnadurai, 1981**).
- ii) *Dust and sand*: There are few studies done on chemical and physical effects of road dust on nature; in which Tundra and Taiga are some of the related specific biomes (review by **Walker & Everett, 1987**). Cell destruction and blocked stomata are the major physical effects on plants due to sand and dust. A report by **Farmer, 1993** includes the effects of dust on plants and plant species of crops, grasslands, trees, arctic bryophyte and lichen. Dust also promote effects of gaseous pollutants and may effect photosynthesis, respiration and transpiration. Farmer studied most sensitive species of epiphytic lichens, sphagnum and other mosses.
- iii) *Heavy metals (trace metals)*: The variety and levels of trace metals in road dust can influence the Land-use pattern. For example, the effects of roadside dust on germination of seed and root growth in vegetable crops in China were studied by **Wong, Cheung & Wong, 1984**. They found enlarged root growth for plants in areas of low traffic density and remarkably reduced root growth in high traffic density site. The effects of heavy metals may or may not be detrimental for invertebrates. For example, the combustion gases which contain lead may reduce the arthropod density, on the other hand, members of a family Aphididae and some Heteroptera flourished in the agriculture and horticultural areas of Poland (**Przybylski, 1979**).
- iv) *Gases*: Traffic gases such as (SO₂, CO₂, CO, NO, and Hydrocarbons) have direct effects on humans and biota. Study of effect on plant growth has been done, for example, plants with reduced growth were found near highways in Calcutta by **Sarkar, Banerjee & Mukherji, 1986**. Detailed study of ecological effects of road

pollutants have been done on heathland community in southern England by **Angold, 1997**. In this study it was observed that the plant species had increased growth due to nitrogen (nitrogen oxides from traffic), these effects were measured upto 200m into heathland and the result was consequent change in the composition of species.

v) *Effects on aquatic systems and biota*: Severe attentions have been focused on aquatic biota and aquatic ecosystem due to run off from roads. It has also been observed that the wetlands are used as sinks for metals and macronutrients from roads (**Yousef, Baker & Hvitved-Jacobsen, 1996**). There are severe conflicts that on one hand the wetlands are used as pollution sinks and on the other hand many attempts are made to avoid pollution of wetlands.

2.1.2 Other effects of roads on biota and habitats: There is incremental effect of road development observed by **Southerland, 1995** which marks that there is a loss of biological diversity due to roads. Both the negative and positive effects are described on biota and habitats due to road. For example, road kills are considered to be as negative effect and an increase in edge habitat is considered except for the species of declining population the road kills generally not seems to have any destructive effect on animal population. A review on wildlife road mortality has been done by **Bennett, 1991**. There are few studies on secondary effects also. One example of a secondary effect is the spread of a pathogenic fungus in the forests of southern Australia due to the transportation of fungal spores along roadside (**Weste, 1977**). Some surveys also observed the dispersal of plant species via road traffic (**Wace, 1977**). Major attention was caught in the U.S.A., Australia and New Zealand when the dispersal of potential weeds and alien flora via traffic was observed. **Timmins & Williams, 1990** argued that the accidental spread of weed through reserves can be controlled by reduction in roads.

2.2 Evolution of EIA worldwide

Although early implementation of EIA results to be more efficient and effective but the procedure and the scope as well as the implementation period of EIA vary in different countries and different agencies and each of them are characterized uniquely. The field of environment impact assessment has been evolving rapidly year to year around the world. In 1969, United States of America was first country to launch mandatory through its National Environmental Protection Act (NEPA). Since then EIA procedure have been implemented by many countries. Country such as Canada, Australia, the Netherlands and Japan approved EIA

legislation in 1973,1974,1981,1984 respectively. Environment assessment was made mandatory for projects of certain categories in the European Community (EC) in the year 1985 (**Wood, 1994**). Columbia, in 1974 became the first Latin American country amongst the developing countries to implement EIA. Thailand and the Philippines were the countries to take the initiative in Asia pacific region they established EIA regulations in 19980s and 1990s. There is a broad difference in Asian countries in terms of legislation ranging from none (Myanmar) to not so widely applied one (Laos and Cambodia), to extensive and detailed EIA regulation frame work(Japan, Hongkong, Southkoria). According to **Klive Briffet 1999**, many poor Asian countries have inadequate quality of EIA with limited or no public participation and poor impact prediction. This is because such countries are generally preoccupied with economic growth and EIA are considered to be potential obstacle on economic growth. Srilanka made EIA mandatory in 1984 although a number of nations including Rwanda, Botswana and Sudan have some EIA practice but still it is superficial in Africa (**Wathern, 1988**). In general, however due to reasons like lack of trained personnel, inadequate budget and the conception that EIAs might cause lack in economic development, EIAs in Africa still appears to be in trouble (**Kakonge, 1999**).

EIA has been recognised as a valuable decisions making tool by many bilateral and multilateral agency around the world. The Organization for Economic Cooperation and Development (OECD) issued recommendation on EIA to its constituent states in 1974 and 1979. Guidelines for good practices were issued by OECD in 1992 (**OECD, 1992**). UNEP, United Nations Environmental Program issued guidance for development proposal on EIA in 1980 and many developing countries were supported by UNEP for research on EIA (**Ahmad and Swami, 1985**). World Bank also made EIA integral part of its policy in 1987 which says that overall economic policy of a country is affected by its environmental issues.

Various environmental protection legislation that includes requirements for at least some aspects of EIAs is the integral part of all countries in Central and South America. Factors like political instability inefficient bureaucracy and economic debt are the reason for hampered development of EIA Specifically, in South America (**Brito and Verocai 1999**). According to **Glasson and Salvador, 2000**, authorized projects undergo EIA with little or no public participation in South America. There is a relatively less developed EIA system in the countries of Southeastern Europe Albania, Bosnia and Herzegovina, Croatia, Kosovo (UN administered territory), Macedonia, Montenegro, and Serbia EU (**Dalal-Clayton and Sadler 2004; Glasson et al. 2005**).

2.3 Evolution of EIA in India

In India, the foundation of EIA was set in 1976-1977 when the planning commission asked to survey the river valley projects from environmental point of view. However at that time it lacks legislative support (**Valappil et al., 1994**). To fill this, the government of India on 23rd May 1986 enacted the Environmental Protection Act (EPA) under which EIA was made statutory on 27th January 1994, for a number of projects which are likely to have many health complications and significant environmental impacts.. In 1980 the Department Of Environment (DOE) was established by National Committee on Environmental Planning and Coordination(NCPC) which was finally converted to a full-fledged Ministry of Environment and Forest (MoEF) after 5 years (**Rao, 1997**), (now Ministry of Environment Forest and Climate Change, MoEFCC). The first environmental protection act was enacted by MoEFCC in 1986. Since then, EIA notification has undergone 12 amendments which, in 1997 incorporated the public hearing procedure and brought several other important changes. EIA notification was further revised on September 14, 2006 to improve EIA procedure in India. Under this notification projects activities were divide into 8 major categories depending on the requirement of Environmental Clearance(EC) either from Central government i.e.MOEFCC(Category A projects) or from State Environmental Impact Assessment Authority(SEIAA)(category B) is further divided into 'B1' and B2 categories. In which B1 are the projects which require to submit EIA report whereas 'B2' are the projects do not require it. Both the A and B1 projects undergo public hearing. Public hearing makes the EIA procedure more transparent and socially aware. The main objective of 2006 notification is to impose restrictions on new or existing projects (expansion or modernization) according to their potential environment impacts.

Category A projects are to develop an EIA based on a Terms of Reference and presented to the MoEF. The notification contains schedules which mention activities and projects that come under Category A and B. It also contains application forms 1 and 1A, a generic structure for an EIA document, framework for contents for a summary of the EIA report, the procedures for the public hearing and appraisal process. The notification also explains who is an 'expert' eligible for positions, the composition and term of office of the EAC and SEAC.

2.3.1 EIA Notifications

- i) *EIA Notification, 1994*: As already stated, the environment impact process was integrated into the Indian legal system in 1994 when Environmental Impact

Assessment (EIA) Notification had first come into existence. The objective of the notification was to push for more sustainable industrialization process in the country after giving due consideration to environmental and social impacts. For doing so, the notification imposed restrictions on setting up, modernising or expanding any new project or proposal without getting an environmental clearance from the government. The notification specified the type of project/proposal that needed environmental clearance and thus would have to conduct the EIA. The act also made it mandatory for all projects listed in Schedule 1 to get an environmental clearance directly from the Central government for setting or expanding any plant in any state in the country. It also listed a number of projects /proposals, which were expected from the environmental clearance process or public hearing. The notification had also made provisions for formation of an Impact Assessment Agency (IAA) to comprise experts for review of the documents submitted to the MoEF for clearance. It defined the roles and responsibilities of the IAA and fixed time frames for various stages of the environmental clearance process. The notification also made the provision for the proponent to reapply in the case its EIA report was rejected due to lack of data. It, however, placed a penalty of automatic rejection in case of misrepresentation and concealing of factual data. However, still the notification was largely thought to be cumbersome and time consuming. To investigate such drawbacks in the 1994 EIA notification, MoEF conducted a comprehensive review of the EC process laid down in the said notification, under the Environmental Management Capacity Building Project in 2001. This study by the MoEF brought out the need for immediate reforms.

A committee was also set up by the then Cabinet Secretariat, with Shri V. Govindarajan as convener, to examine extant procedures for investment approvals and implementation of the projects and to suggest measures to simplify and expedite the process of both public and private projects. The committee pointed that the then Environmental Clearance perhaps takes the longest time and causes the maximum delay to the projects. Some of the constraints identified in the EC process under the EIA Notification, 1994 by the Govindarajan Committee are as under:

- Cumbersome process

- Disproportionate details sought with applications
- Time consuming and requiring undue efforts
- Poor quality of EIA studies by consultants

As against the EIA notification of 1994, the objectives of the proposed Notifications were to formulate a transparent, decentralised and efficient regulatory mechanism which would further

- Incorporate necessary environmental safeguards at planning stage
- Involve stakeholders in the public consultation process
- Identify developmental projects based on impact potential instead of the investment criteria

Amendments in the EIA Notification, 1994

Even before it was thought to completely revise the EIA Notification of 1994, the latter was amended 12 times in eleven years of its existence. While most of the amendments were blamed to have diluted the process of environmental clearance, there were some, which also strengthened the process. Some of the key amendments are discussed as follows

- *Amendment on April 10, 1997:* The process of environmental public hearing (EPH) was introduced in the environmental clearance process. The SPCBs were entrusted to conduct public hearing to get the views and concerns of the affected community and interested parties for the proposed project. The SPCBs were entrusted with forming an EPH committee to ensure fair representation in the public hearing process. This amendment also made some changes with reference to the environmental clearance required for power plants.
- *Amendment on June 13, 2002:* This amendment diluted the purpose of the notification exempting many industries from the EIA process or from the entire environment clearance process on the basis of level of investment.
 - It exempted pipeline and highway projects from preparing the EIA report, but these projects would have to conduct public hearings in all the districts through which the pipeline or highway passes.
 - A number of projects were totally exempted from the Notification if the investment was less than Rs. 100 crore for new projects and less than Rs. 50 crore for expansion/modernization projects.
 - Most of the industries exempted from the clearance process had a very high social and

environmental impact even if the investment was less than Rs 100 crore

- *Amendment on 28th February, 2003:* This amendment added a little tooth to the notification. It took into consideration location-sensitivity into the environment clearance process. This amendment prohibited certain processes and operations in specified areas of the Aravalli Range.
- *Amendment on 7th May 2003:* The notification was amended to expand the lists of activities involving risk or hazard. In this list, river valley projects including hydel power projects, major irrigation projects and their combination including flood control project except projects relating to improvement work including widening and strengthening of existing canals with land acquisition up to a maximum of 20 meters, (both sides put together) along the existing alignments, provided such canals does not pass through ecologically sensitive areas such as national parks, sanctuaries, tiger reserves and reserve forests.
- *Amendment on August 4th 2003:* This amendment was similar to the one in February 2003 that tried bringing in location-sensitivity in the entire environmental clearance process. Any project located in a critically polluted area, within a radius of 15 kilometers of the boundary of reserved forests, ecologically sensitive areas, which include national parks, sanctuaries, biosphere reserves; and any State, had to obtain environmental clearance from the Central Government.
- *Amendment on September 2003:* Site clearance was made mandatory for green field airport, petrochemical complexes and refineries. Moreover, the amendment added that no public hearing was required for offshore exploration activities, beyond 10 km from the nearest habitation, village boundary and ecologically sensitive areas such as, mangroves (with a minimum area of 1,000 sq. m.), corals, coral reefs, national parks, marine parks, sanctuaries, reserve forests and breeding and spawning grounds of fish and other marine life.
- *Amendment on July 7th, 2004:* It made EIA mandatory for construction and industrial estate
- *13th Amendment on 4th July 2005:* The amendment provided that projects related to expansion or modernization of nuclear power and related project, river valley project, ports, harbors and airports, thermal power plants and mining projects with a lease area of more than five hectares could be taken up without prior environmental clearance. The Central Government in the Ministry of Environment and Forests may, on case to case basis, in public interest, relax the requirement of obtaining prior environmental clearance and may, after satisfying itself, grant temporary working permission on receipt of application in the prescribed format for a period not exceeding two years, during which the proponent shall obtain the requisite environmental clearance as per the procedure laid down in the notification. The grant of temporary working permission would not necessarily imply that the environmental clearance would be granted for the said project.

Despite these amendments from time to time, there was a wide spread opinion that the EIA notification (1994) was not able to address all the concerns and had several weaknesses which was making the entire clearance process weak. Therefore, the Union Ministry of Environment and Forests (MoEF) initiated the process of bringing in some significant modifications in the environment clearance process. A draft notification was published on September 15, 2005 and was put up for public comment for a year and has recently been notified in September 2006.

ii) *Environmental Impact Assessment Notification, 2006*: India, as already stated is on the expressway to development. Rapid industrialisation and an upsurge in the number of development projects all over the country is accompanied with massive environmental and social burdens, principally borne by the communities living in the vicinity of project sites. Monitoring tools like Environmental Impact Assessment (EIA), therefore, assume great significance in ensuring sound economic development without compromising on environmental and social costs. It is believed that everybody, from the Prime Minister of the country to a local villager in some remote part of the country is interested in the Environmental Clearance (EC) process, since everyone is directly or indirectly affected by it.

With this at the backdrop, the Planning Commission's approach paper on the 11th Five year plan had stated that 'the country's environmental clearance regulations are beginning to resemble the old license permit raj and were in need of urgent reform'. The concern expressed by this policy formulated body reflected the governmental apathy towards such a critical issue in the last few years. To address this issue and to address the limitations in the old EIA Notification (1994), the Union Ministry of Environment and Forest (MoEF) notified the new EIA Notification in September 2006 after putting up the draft notification for public comment for a year.

The new notification has brought in more number of projects within the purview of the environmental clearance process. As a result, a revised list of those projects and activities has been prepared which require prior environmental clearance. Most importantly, the categorisation of projects requiring EIA is now no longer based on investment. Instead, the size or capacity of the project, according to the new notification, determines whether it is to be cleared by the central or state government.

3. PROCESS AND METHODOLOGY

3.1 Process of EIA

Few steps are followed in the process of EIA and each step is equally important in determination of overall functioning of the project. Screening is generally the first step which ensures time. Generally, the EIA process begins with screening to ensure time and resources.

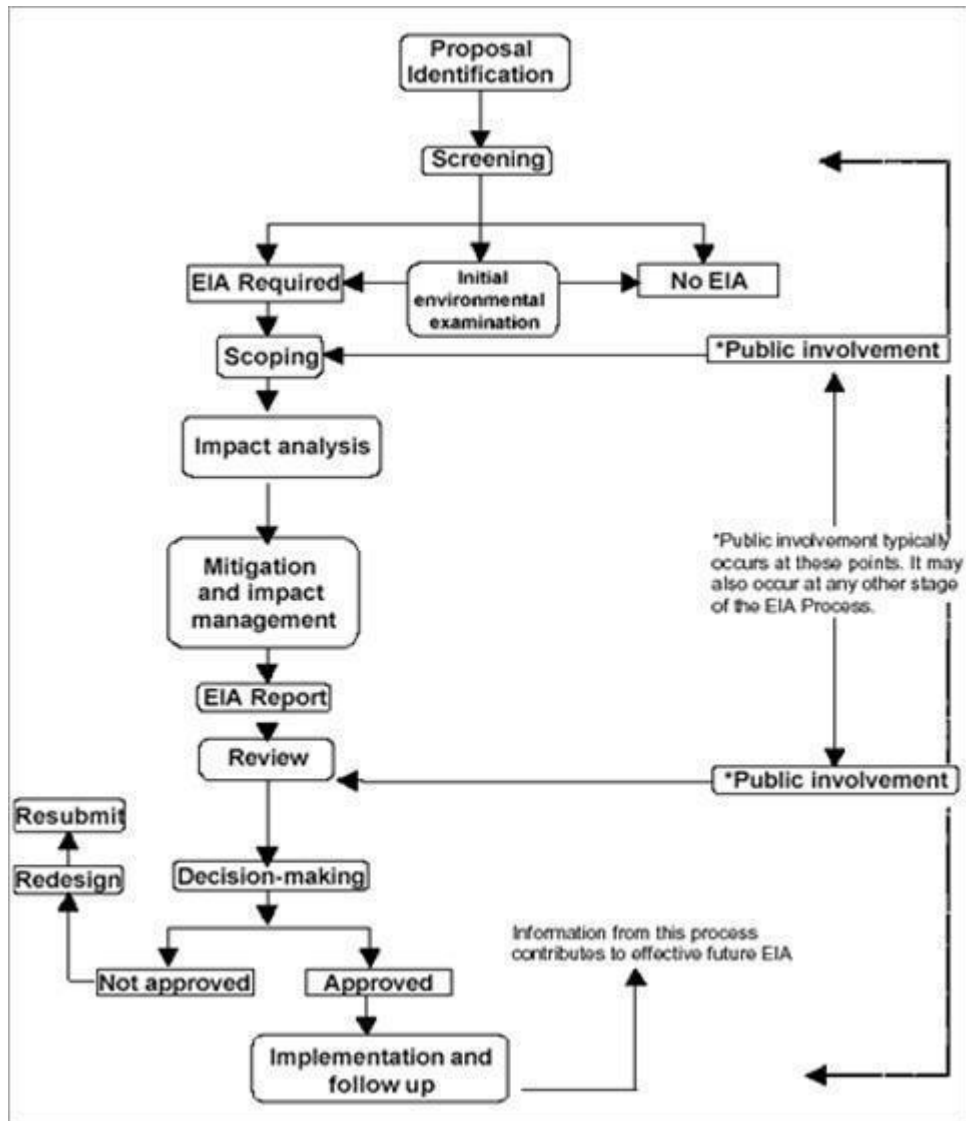


Fig 3.1: Generalised process flow sheet of the EIA process

(Source: *The manual in perspective, EIA Training Resource Manual, United Nations Environment Programme, 2002*)

The following are the major steps in an EIA process:

- Step 1: Perform ES (Environmental Screening)
- Step 2: Perform environmental scoping and IEEs

Step 3: Prepare TOR for EIA

Step 4: Perform EIA study and prepare EIA Report

Step 5: Review and approve EIA Report

Step 6: Formulate EMP and monitor implementation of recommended environmental protection measures

Step 7: Conduct post construction environmental audit and evaluation

3.1.1 Environmental Screening

The extent of environmental review required by a highway is decided by undertaking the Environmental screening step. A recommended list of criteria is used in some countries which help screening to decide whether an EIA is required or not. For most part, there is a relatively well defined screening criteria which determines the level of review. In some cases, there is considerable discretion in analysing whether or not an EIA should be carried out.

There is generally a threefold categorization as follows (**ADB, 1997; WB, 1997**).

i) Project Category A: A full-scale EIA is required for the highway development projects lying in this category. Changes in land use, as well as changes to the social, physical, and biological environment can be induced by the potentially significant environmental issues of these projects. The importance of scope of EIA for compliance with environmental policies is determined with the help of an environmental specialist.

ii) Project Category B: Full-scale EIA is not required for the projects lying in this category. Initial Environment Examination (IEE) is done for such projects. The only difference between projects in this category and those in category A is usually the scale. The environmental impacts lying under this category are less critical than those of projects in category A and also are not located in environmentally sensitive areas. Its easy to describe the mitigation measures for these projects. An environmental specialist will be required to assist in formulating the TOR for the IEE so that the IEE report will comply with the authority's policies.

iii) Project Category C: Projects under this category do not require an EIA. These projects are unlikely to have any adverse environmental and socio-economic impacts.

3.1.2 Environmental Scoping

Environmental scoping is the process which determines the issues to be addressed, the information to be collected and the analysis required to assess the environmental impacts of

highway development projects/activities. The primary output of environmental scoping is the TOR required to conduct an EIA and then to prepare the EIA report.

3.1.3 Initial Environmental Examination (IEE)

In some countries, scoping is done for an EIA process in the context of an IEE. After a highway project has been examined and found to have potentially significant environmental impacts, an IEE is undertaken to analyse the probable environmental impacts associated with the project and analyse whether a full-scale EIA is required. The IEE is usually conducted with a limited budget and is based on existing information and the professional judgment of people, knowledgeable about the impacts of similar highway projects. The primary objectives of the IEE are listed below:

- Identification of the nature and severity of specific, significant environmental issues associated with the project
- Identification of easily implementable mitigating or offsetting measures for the significant environmental issues. The IEE serves as the final impact assessment and no further EIA is required if the IEE shows that there are no significant environmental issues which need further study
- Development of the TOR for the full-scale EIA study in case more detailed impact assessment, or any specific information and data are required.

Conducting an IEE ensures a focused TOR for a full-scale EIA because it identifies and provides background information on the issues requiring resolutions.

3.1.4 Full-scale EIA

A highway project must undergo a full-scale EIA if it is explicitly prescribed by law, regulation or if the IEE results indicate that an EIA is required. A full-scale EIA normally involves a rigorous study whereby new environmental information and data are collected. Number of environmental experts is generally required. A full-scale EIA may involve detailed review procedures and require public consultation. A detailed EIA report is required as part of a full-scale EIA. EIA reports are usually prepared by EIA practitioners. In most cases, EIA consultants follow the guidelines developed by the reviewing agency. These guidelines specify what are to be included in the EIA report.

3.1.5 Term of Reference (TOR)

OECD (1994) has developed procedural guidelines that include a framework TOR for EIA of various development projects. The guidelines were prepared for use by environmental specialists. The framework TOR outlines requires detailed EIA information.

Detailed EIA information includes:

- (i) description of the highway development project
- (ii) description of the environment
- (iv) positive impacts and negative impacts on natural and human environment
- (v) resettlement and compensation
- (vi) mitigation measures
- (viii) environmental monitoring program or plan.

3.1.6 Preparation of EIA Report

The final EIA report is to be prepared by the project proponent or the EIA practitioners who are responsible for the EIA. An EIA report typically contains the following items:

- executive summary of the EIA findings
- description of the proposed highway development project
- major environmental, socio-economic, and natural resource issues that need clarification and elaboration
- adverse impacts on the natural and socio-economic environment — their identification and prediction
- discussion of options for mitigating adverse impacts and shaping the project to suit its environment
- overview of gaps or uncertainties in the information and data
- summary of the EIA for the general public, especially for the people affected by the project
- conclusions and recommendations

3.1.7 Review and Approval of EIA Report

Different agencies use different methods for the review of the EIA report on highway development projects. The EIA report is reviewed by a reviewing agency or by a special

standing committee or commission established to review projects in a given sector. Generally, a technical evaluation of the EIA report is made by specialists. This technical evaluation provides the basis for the review. The output of the review report is either a rejection or an approval of the project. In case of approval the report outlines the terms and conditions for the project to proceed with. These terms and conditions are attached to any license, permit, or certificate issued by the approving authority. In most cases, the results of an EIA review are provided to the agency responsible for ultimately approving the proposed project. In many jurisdictions, project approval also depends on approval from the EIA agency. One output of the EIA review process is the terms and conditions that are attached to the approval. These terms and conditions define the environmental protection measures that must be integrated into the project. The terms and conditions may also specify environmental monitoring that must be undertaken in conjunction with the project construction and post construction auditing for project evaluation.

3.1.8 EMP and Monitoring

Environmental management is that part of the project management which is responsible for the implementation of the mitigation measures and the environmental monitoring. The EMP contains the following information:

- Details of the mitigation measures that will be undertaken to ensure consent with environmental laws and regulations.
- Objectives and management of the monitoring program, and the specific information and data to be collected.
- Institutional responsibility, reporting requirements, enforcing capability, and resources required in terms of funds, skilled staff, equipment, and training needs.

3.1.9 Postconstruction Environmental Auditing and Evaluation

Postconstruction follow-up is required to analyse whether the conditions of project approval such as the environmental protection measures and monitoring program have been undertaken as required. Further follow-up is required to determine if the environmental protection measures are successful and the monitoring data have been analyzed and acted upon. The postconstruction evaluation reports and project performance audit reports recommended by **ADB, 1997** and **WB, 1996** include a final assessment on the following:

- the degree by which the projects satisfied the EIA recommended environmental requirements
- the effectiveness of mitigating measures and institutional development
- whether any unanticipated impacts occurred as a result of the project implementation activities

3.2 Methodologies of impact assessment

Impact assessment can be done by a large number of methods available, varying according to their levels of technical complexity, the amounts of data required, and the levels of precision and certainty. All these factors should be considered when selecting a method. Improved practices of EIA and advances in information technology have greatly expanded the range of tools available to the EIA practitioner. For example, geographical information systems (GIS), global position system (GPS) and expert systems have been developed to help in environmental screening, environmental scoping, developing TOR, and conducting IEE. The following are some of the more techniques and methods that have evolved to include factors not normally considered in the traditional cost-benefit analysis.

3.2.1 Ad hoc Methods: This is a useful method when time constraints and lack of information require that the EIA must rely exclusively on expert opinion. This method is very easy to use but has a few drawbacks. It may not encompass all the relevant impacts and hence they cannot be compared. Even the relative weightage of various impacts cannot be compared. It is inefficient as it requires considerable effort to identify and assemble an appropriate panel of experts for each impact assessment. It provides minimal guidance for impact analysis while suggesting wide areas of potential impact.

3.2.2 Checklists: Checklists list the types of impacts associated with particular types of highway development project. This method primarily organizes information and ensures that no potential impact is overlooked. This is a more formalized process compared to the ad hoc approach in that specific areas of impacts are listed and instructions are supplied for impact identification and evaluation. Common checklists include:

(a) scaling checklists in which the listed impacts are ranked in order of magnitude or severity

(b) scaling – weighting checklist in which numerous environmental parameters are weighted (using expert judgment), and an index is then calculated to serve as a measure for comparing project alternatives.

3.2.3 Matrices: Matrix methods identify interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities. A matrix of potential interactions is produced by combining these two lists (placing one on the vertical axis and the other on the horizontal axis). One of the earliest matrix methods was developed by **Leopold et al., 1971**. In a Leopold matrix and its variants, the columns of the matrix correspond to project actions while the rows represent environmental conditions. The impact associated with the action columns and the environmental condition row is described in terms of its magnitude and significance. Most matrices were built for specific applications, although the Leopold Matrix itself is quite general.

Matrices can be tailor-made according to the needs of any highway development project that is to be evaluated. They should preferably include both the construction and the operation phases of the highway project, because sometimes, the former causes greater impacts than the latter. Simple matrices are useful for

- (a) Screening
- (b) Scoping or IEE
- (c) Identifying areas that require further research
- (d) Identifying interactions between project activities and specific environmental components.

However, matrices also have their disadvantages:

- they tend to overly simplify impact pathways
- they do not explicitly represent spatial or temporal considerations
- they do not adequately address synergistic impacts.

Matrices require information about both the environmental components and project activities. The cells of the matrix are filled in using subjective (expert) judgment or by using extensive databases.

3.3 Environmental Monitoring Tools and Techniques

The analytical aspects to monitor adverse impacts on the environment involves the methods and the techniques that are required to collect the relevant data, to identify the environmental impacts, to assess the significance proposal of a development of such impacts, to propose impact mitigation measures, etc. Such methods and techniques have been proposed by many academics, experts and practitioners and are described in the scientific literature, and usually collected in various guidelines, handbooks (for instance **Canter 1995, Codorni and Malcevschi 1994**).

3.3.1 Air Environment

a) Meteorological Data

Meteorological data covering maximum and minimum wind speed, wind direction, rainfall, relative humidity and temperature for atleast 10 years should be presented from the nearest meteorological station. Recording velocity and direction of wind along the proposed alignment, where sensitive receptors are located nearby, should be generated by installing continuous and self-recording anemometer. History of cyclones, earth quakes and snowfall data shall be collected from the nearest meteorological station for a period of 50 years.

b) Ambient Air Quality

Baseline data for the parameters - particulate matter size less than 10 μ m or PM10 μ g/m³, particulate matter size less than 2.5 μ m or PM2.5 μ g/m³, sulphur dioxide (μ g/m³), nitrogen dioxide (μ g/m³) and carbon monoxide (μ g/m³) in the study area should be generated for one season except monsoon as per CPCB norms. While selecting the monitoring locations specific importance should be given to the sensitive environmental receptors. The National Ambient Air Quality Standards is given in **Annexure 4**.

Sampling and Analytical Techniques for ambient air quality:

PM10 and PM2.5 have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 part-II, 1969) has been adopted for estimation of SO₂. Jacobs-Hochheiser method (IS-5182 part-IV, 1975) has been adopted for the estimation of NO_x. Samples for Carbon monoxide were collected and analyzed using NDIR method. The techniques adopted for sampling and analysis are described below.

a) *Particulate Matters (PM₁₀ & PM_{2.5})*: PM₁₀ and PM_{2.5} were monitored using a Respirable Dust sampler (RDS) and PM_{2.5} Sampler. A pre-conditioned and weighted glass fiber filter paper is used for PM₁₀ and PTFE filter paper is used for RDS/PM_{2.5} samplers. A known quantity of the air was sucked through the filter paper in a prescribed sampling time. The flow was noted from the manometer. The multiplication of time with rate gave the total quantity of air passed through the filter paper. After sampling, the filter paper was removed, conditioned and weighed finally for getting the concentrations in ambient air.

b) *Sulphur Di-Oxides (SO₂)*: A known quantity of the air was bubbled through impingers containing Tetrachloromercurate. SO₂, formed a Disulfiltomercurate complex, which gave a pinkish blue colour with p-Rosaniline and Formaldehyde solution. The intensity of colour produced was proportional to concentration of Sulphur dioxide. The measurement was made by using spectrophotometer at the wavelength of 560 nm.

c) *Nitrogen Di-Oxides (NO_x)*: A known quantity of air was passed through impingers containing Sodium hydroxide-sodium arsenite solution. The estimation of NO_x was done colorimetrically using Hydrogen peroxide, Sulfanilamide, NEDA, etc. The intensity of the colour was measured at 540 nm using a spectrophotometer.

d) *Carbon Monoxide (CO)*: NDIR based samplers are used to monitor the carbon monoxide levels.

3.3.2 Water Environment

Details of surface water bodies within right of way and within 500mts from the right of way should be considered along with the present usage. Monitoring of surface water and ground water within the study area should be furnished. The samples should be collected and analyzed as per the standard procedures. The flow and other details of the streams crossing the alignment should be furnished. The Central Pollution Control Board has stipulated criteria for raw water usages, use based classification of surface water and these are given in

Annexure 5.

3.3.3 Noise Environment

First of all Baseline data in the study area should be generated. While selecting the monitoring locations specific importance should be given for sensitive environmental receptors like thickly populated areas, hospitals, schools, wildlife corridors etc. Hourly monitoring of noise levels (Leq) should be recorded for 24 hours by using integrated noise

meter. Noise standards designated for different types of land use, i.e. residential, commercial, industrial areas and silence zones as per the Noise Pollution (Regulation and Control) Rules 2000 (**Annexure 6**) should be followed.

3.3.4 Soil Environment

The soil profile of the highway alignment should be analysed based on the soil series maps of National Bureau of Soil Survey and Land Use. The parameters which are suggested for soil analysis are pH, Electrical conductivity, sand (%), silt (%), clay (%), texture, moisture retention capacity (%), infiltration rate (mm/hour), bulk density (gm/cc), porosity (%), organic matter (%), nitrogen (mg/1000g), potassium (mg/1000g), phosphorous (mg/1000g), sulphates and sodium sulphates.

4. DESCRIPTION OF THE PROJECT

It is a highway development project which involves capacity augmentation to 2 lanes with paved shoulders configuration of Pilibhit-Puranpur Section of National Highway-730 in the State of Uttar Pradesh. The Project road under this study is the section of NH-730 starting from Pilibhit at Km 0+000 and ends at Puranpur at Km 38+000 in the state of Uttar Pradesh. The major settlements coming along the project road is Pilibhit, Gajraula, Uday Karanpur and Puranpur. The total length of the project road is 38 km as per Km stones. The Project road falls under Pilibhit district in Uttar Pradesh State.

The Project road falls in the district of Pilibhit.

Location	Latitude	Longitude	Altitude
Km 0+000	28 ^o 36'52''N	79 ^o 46'32''E	190m
Km 38+000	28 ^o 30'55''N	80 ^o 07'20''E	187m

Table 4.1: Latitude and Longitude of both ends of Project Road

4.1 Start and End Point of the Project

4.1.1 Start Point

The Project starts with the start of NH 730 at intersection with NH 74 in the outskirts of Pilibhit.



Figure 4.1 :Start of the Project (Km 0+000)

4.1.2 End Point

The end point of the project road is at Km 38+000 just before Puranpur at the intersection of MDR 39C.



Figure 4.2: The end of the Project (Km 38+000)

4.2 Settlements

The details of settlements along the project road has been presented in Table 4.2

Sl. NO.	Name of village/town/habitation	Existing Chainage (km)	District
1	Pilibhit	2+170	Pilibhit
2	Gaibojh	7+500	Pilibhit
3	Kaag	9+000	Pilibhit
4	Bithoura	12+00	Pilibhit
5	Gajraula-Kala	17+800	Pilibhit
6	Jara T. Madho Tanda	26+500	Pilibhit
7	Zara village	28+200	Pilibhit
8	Uday Karanpur	32+200	Pilibhit

Table 4.2: Details of Settlements along the Project Road

4.3 Terrain Classification

The project road alignment traverses through Plain terrain.

4.4 Soil Types

Since most part of the road falls in the Terai region, the soil generally found in this area is sandy loam.

4.5 Analysis of Alternative

Sound and sustainable highway project involve the consideration of two types of alternatives. These are usually referred to as alternative solutions to the transportation problem and alternative designs for a selected project. The first is an early planning period where general environmental impact from alternative solutions to a road transportation problem are identified and compared, which results in the selection of an environmentally acceptable project option. This analysis should identify the preferred solution to the transportation problem for which the planning activity was initiated.

The project road is an already existing National Highway and the project proposed to capacity augmentation to 2 lanes with paved shoulders configuration of Pilibhit to Puranpur section of NH-730. There is no other alternative solution for fulfilling the transportation & future traffic needs between Pilibhit to Puranpur. There will be non-significant impact on environment due to road widening, as it is an existing road and widening will be done within the existing RoW at most of the stretch.

Considering the possible positive impacts to the economic and social infrastructure of the region, the proposed road development is imperative; however with such development the impacts on the regional environment are also unavoidable. Hence to understand the significance of the proposed project better “With” and “Without” Project scenarios are compared and presented below in Table 4.3.

Component	“With” Project Scenario	“Without” Project Scenario
Carriageway	It is proposed to upgrade the carriageway to 2 lane standard configuration with 7 m carriageway width and 1.5 m paved shoulders on either side.	The project road has carriageway of 7.0 m width except some stretches having 5.5 m width.

Component	“With” Project Scenario	“Without” Project Scenario
Traffic Congestion	Traffic movement will improve and congestion will be reduced once the road is widened. Substandard curves, bottlenecks along the road will be removed.	The project alignment has towns and intersections enrooted. Traffic congestion occurs within towns and at junctions.
Road Safety	There will be a decrease in the number of road accidents after widening of the highways, as there will be adequate space for plying vehicles to cross and overtake. Also, proper road signage will be provided for safety and convenience of people.	With increase in traffic the traffic situation may worsen and will lead to frequent occurrence of accidents. There are number of traffic black spots on the alignment
Environmental Quality	The free flow of traffic on the improved highway will improve the environmental quality as the emissions from the plying vehicles will reduce. There will be temporary increase in dust and emissions during the construction phase only and is reversible.	Environmental quality will further deteriorate due to pollution and high emission from slow traffic movement and congestions. With increase in traffic, the pace of degradation of environment will only hasten
Transportation Facilities	Improvement of existing and new bus bays have been proposed along the project road for convenience of people and to provide better transportation infrastructure to local communities. Improved travel quality in less time will be achieved. In the event of accidents, emergency services will reach quickly.	There will be slow improvement in the transportation facilities.

Component	“With” Project Scenario	“Without” Project Scenario
Economic Development	The project road section connects Pilibhit, Gajraula to Puranpur. Economic activities will automatically improve once the road is widened. It will also benefit the farmers as they will be able to sell their produce in distant markets in less travel time due to the improved transportation. Eventually, the project will lead to economic as well as cultural exchange in the communities.	The economic activity will remain static and local and will improve only at a laggard pace.
Development Potential	There will be higher potential for development in this area due to improvement in access and consequent increase in economic activity. Essential community infrastructures like drainage system, water supply, electricity, transportation etc. will come as consequence of current development.	Development activity will be greatly hampered due to inadequate connectivity.

Table 4.3: Comparison between ‘With’ and ‘Without Project’ Scenarios

It can be concluded that “With” project scenario having positive/ beneficial impacts will significantly enhance social & economic development of the region when compared to the “Without” project scenario. Hence, the “With” project scenario with some reversible impacts is a preferred and acceptable option rather than the “Without” project scenario. The implementation of the project, therefore, will definitely be beneficial for overall socio-economic environment of the impacted region.

5. BASELINE ENVIRONMENTAL CONDITIONS OF PROJECT AREA

The primary baseline data has been collected within the right of way as well as area falling within 500 m on either side of existing right of way and secondary data has been collected within 15 km aerial distance from project road as per guidelines of MoEF Environmental Impact Assessment Guidance Manual for Highways. Map of the study area showing the location of various monitoring stations for air (A1, A2,A3), ground water (GW1,GW2), surface water (SW1, SW2), soil (S1, S2) and noise (N1, N2, N3) quality are shown in Figure-5.1.

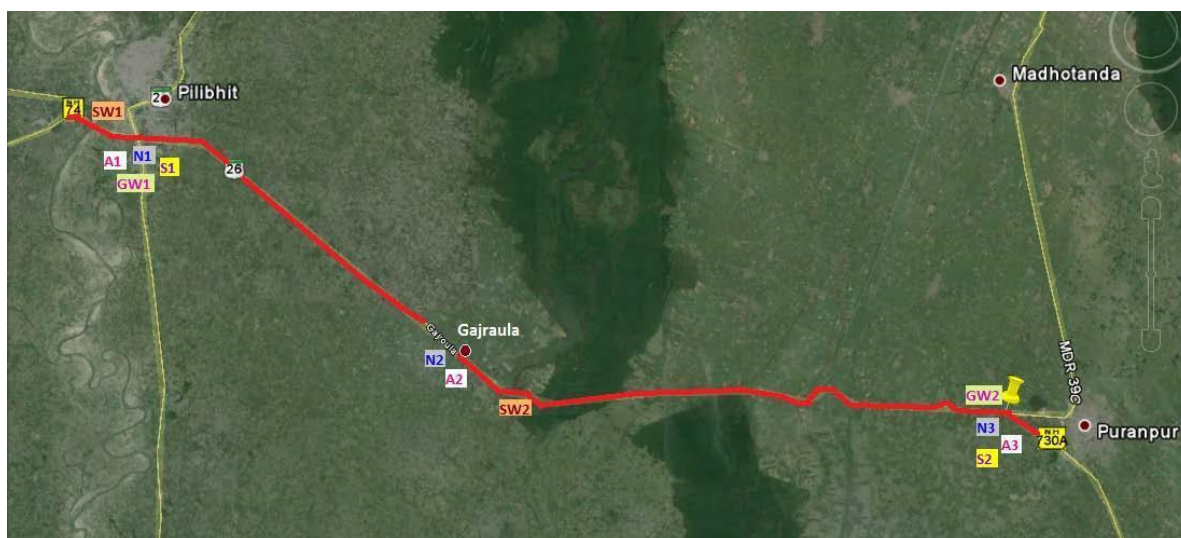


Fig 5.1: Areas of various monitoring stations

The entire stretch of present section was surveyed and screened. The collection of water samples, soil samples and other data pertaining to air quality and noise were done within the right of way as well as area falling within 500 m on either side of existing right of way. Monitoring has been done as per the CPCB guidelines.

5.1 Physical Environment

5.1.1 Topography and Physiography

The state Uttar Pradesh can be divided into three distinct hypsographical regions:

- a) *The sub-Himalayan Terai region in the North* - Highly fertile soil, thick forests with rich flora and fauna.

- b) *The Gangetic Plain in the Centre* - Highly fertile alluvial soils; flat topography broken by numerous ponds, lakes and rivers; slope 2 m/km.
- c) *The Vindhya Hills and plateau in the south* - Hard rock Strata; varied topography of hills, plains, valleys and plateau; limited water availability.

The entire project road traverses through the Terai region in the plain terrain.

Terai: The transitional belt running along the entire length of the State is called the Terai and Bhabhar area. It has rich forests, cutting across it are innumerable streams which swell into raging torrents during the monsoon. The Bhabhar tract gives place to the Terai area which is covered with tall elephant grass and thick forests interspersed with marshes and swamps. The sluggish rivers of the Bhabhar deepen in this area, their course running through a tangled mass of thick under growth. The main crops are wheat, rice, and sugar cane. Jute also is grown.

5.1.2 Land Use and Terrain

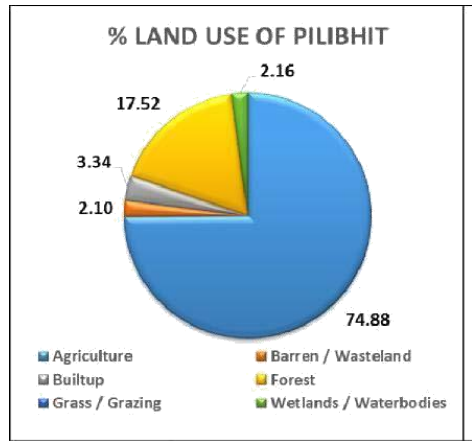
The land use along the project road is agricultural land except at built up areas. Land use pattern of the project area is given in the Table-4.3 and shown in Figure-5.2.

S.no	Land Use Pattern	Pilibhit	
		Area (SqKM)	%LU
1	Agriculture	2522.69	74.88
2	Barren / Wasteland	70.661	2.10
3	Builtup	112.46	3.34
4	Forest	590.21	17.52
5	Grass / Grazing	0.00	0.00
6	Wetlands /	72.8	2.16
	Total	3368.821	100

(Source: *upenvis.nic.in*)

Table 5.2: Land Use Pattern of the Project Area

The land use pattern also highlights adequately the dependence on agriculture with net area sown being around 75% of the total reporting area. 17.52% of land area is covered with forest.



(Source: upenvis.nic.in)

Figure 5.2: Land Use of project area

5.1.3 Natural Hazards and Vulnerability of the sub project area

The Bureau of Indian Standards (BIS) updated the seismic hazard map of India in 2007.

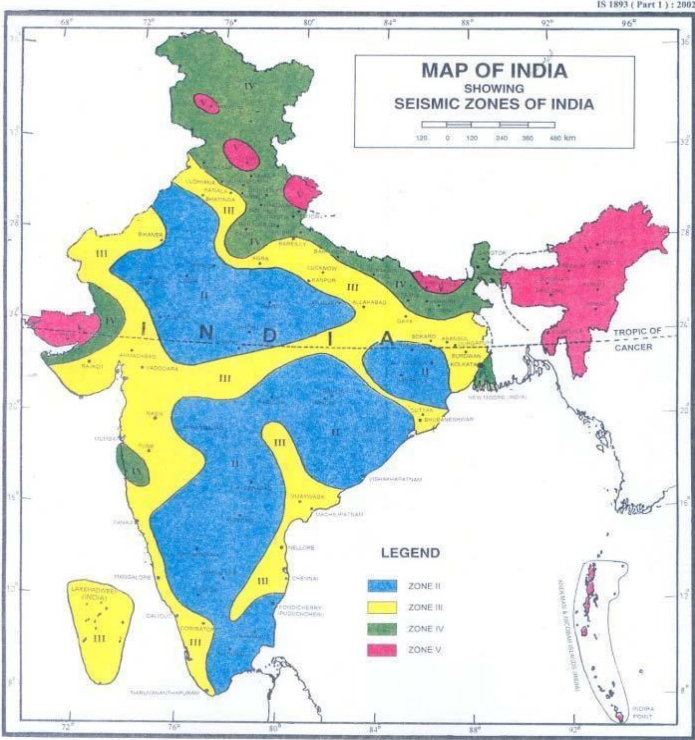
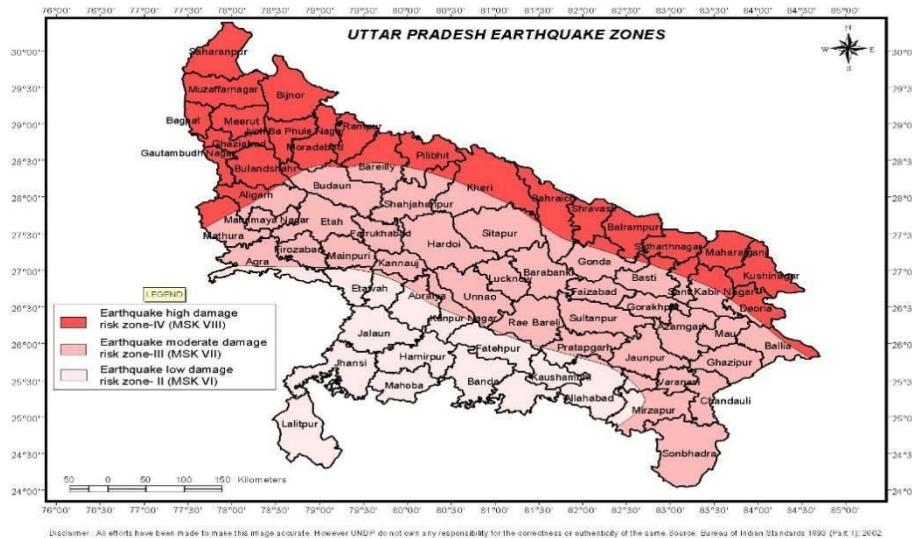


Figure 5.3: Seismic Zones of India

The project affected districts Pilibhit partly falls in Earthquake Damage Risk Zones IV (High Damage Risk Zone) & III (Moderate Damage Risk Zone). However most of the stretch of the project road falls within the Earthquake High Damage Risk Zone IV.



(Source: upenvis.nic.in)

Figure 5.4: Map showing Earth quake risk zones of Uttar Pradesh

5.2 Climate and Micro-Meteorological Parameters

5.2.1 Temperature: State climate is subtropical and congenial for agriculture. In winter the average minimum temperature ranges from 25°C in northern part of the plains to 15°C in eastern part of the state. The maximum temperature during hot season varies from 32°C in Northern part to 46°C in South Western part of the state. In the study area min., max. & avg. temperature was observed 15.11°C , 20°C & 17.55°C respectively in November 2015.

5.2.2 Humidity: Annual relative humidity ranges from 30 to 40% in North Eastern Terai region to 20 – 30% in South Western areas. In the study area min., max. & avg. humidity were observed 12.06%, 35% & 23.53% respectively in November 2015.

5.2.3 Rainfall: The normal annual rainfall of the state is 947.4 mm and it ranges from 710 mm to 1750 mm during last 40 years. The Terai foot hill receives heavy rainfall while in south part rainfall decreases. The large percentage of the annual rainfall over the state is received during June to September. The winter rainfall is received during December to February that is more in North-West part of the Uttar Pradesh. As regards the precipitation trend in the South West and South Eastern part of the state, it ranges from 672 to 1381 mm. In the study area total rainfall was observed 10.11 mm during study period.

5.2.4 Wind speed: In the study area generally the wind blows to West direction and the average wind speed was observed 2.74 m/sec in the month of November. Calm winds were found in 15.84% in the month. The min., & max., wind speed were observed 1.49 m/s & 5.50 m/s respectively.

The windrose diagram for the metrological parameters is shown in Figure 5.5

5.3 Air Quality

The ambient air quality with respect to the study area along the project road form baseline information. There is no major air pollution source along the project road. Air quality of the area is good, only critical at town areas due to traffic. Main sources of air pollution in the region is traffic & burning of domestic fuels as no significant air polluting industries located along the project highway. There are numbers of religious structure, school and Institute along the project road. Proper consideration will be given to minimize the impact of air pollution and noise on these sensitive location.

The ambient air quality monitoring has been carried out as per new notification, issued on 16th November 2009. This section describes the identification of sampling locations, methodology adopted for monitoring and frequency of sampling. The results of monitoring during the study period are also presented in this section.

5.3.1 Selection of Sampling Locations

The sampling of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network and is based on the following considerations:

- Meteorological conditions on synoptic scale;
- Topography of the study area;
- Representatives of likely impact areas along the project road.

Sr. No.	Location Code	Location	Chainage/km
1	A1	Pilibhit	1.9
2	A2	Gajraula	24.7
3	A3	Puranpur	40.5

Table 5.2: Details of Ambient Air Quality Monitoring Locations

5.3.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of twice a week for one month continuously at each site during Nov 2015. The baseline data of ambient air quality is monitored for mentioned below parameters:

- Particulate Matter (PM10)
- Particulate Matter (PM2.5)
- Sulphur dioxide (SO2)
- Oxides of Nitrogen (NO2)
- Carbon monoxides (CO)

Sl.N.	Parameter	Technical Protocol	Instrument Used
1.	PM ₁₀	IS-5182 (Part-23)	Respirable Dust Sampler
2.	PM _{2.5}	CPCB Guidelines	Fine Particulate Sampler
3.	Sulphur Di Oxide	IS-5182 (Part-2)	Respirable Dust Sampler
4.	Nitrogen Oxide	IS-5182 (Part-6)	Respirable Dust Sampler
5.	Carbon Monoxide	IS-5182 (Part-10)	Non dispersive Infra-Red Spectroscope

Table-5.3: Technical Protocol Used For Ambient Air Quality Monitoring
{For protocol refer 3.3.1(b)}

5.3.3 Results and Discussion

Statistical representation of ambient air quality monitoring results for PM₁₀, PM_{2.5}, SO₂, NO_x and CO concentrations are given in Table 5.4. Graphical presentation of maximum, minimum and average values of air quality monitoring along the project road are shown in following Figure 5.5 -5.9. Monitored values are compared with National Ambient Air Quality Standards, 2009. On the basis of tabulated results following observations have been made:

Particulate Matter (PM₁₀)

The average PM₁₀ concentration of ambient air quality at Pilibhit, Gajraula and Puranpur locations were found, 65.3µg/m³, 68.8µg/m³ and 73.8µg/m³ respectively. The maximum and minimum PM₁₀ concentrations measured among all AAQM stations are 82.9µg/m³ at Puranpur and 60.4µg/m³ at Pilibhit respectively.

Particulate Matter (PM_{2.5})

The average PM_{2.5} concentration of ambient air quality at Pilibhit, Gajraula and Puranpur locations were found 39.0µg/m³, 38.0µg/m³ and 41.6µg/m³ respectively. The maximum and minimum PM_{2.5} concentrations measured among all AAQM stations are 48.9µg/m³ at Puranpur and 32.6µg/m³ at Gajraula respectively.

Sulphur Dioxide (SO₂)

The average SO₂ concentration of ambient air quality at Pilibhit, Gajraula and Puranpur locations were found 8.4µg/m³, 6.9µg/m³ and 8.2µg/m³ respectively. The maximum and minimum SO₂ concentrations measured among all AAQM stations are 9.6µg/m³ at Pilibhit and 6.2µg/m³ at Gajraula respectively.

Oxides of Nitrogen (NO_x)

The average NO_x concentration of ambient air quality at Pilibhit, Gajraula and Puranpur locations were found 22.2µg/m³, 12.2µg/m³ and 16.6µg/m³ respectively. The maximum and minimum NO_x concentrations measured among all AAQM stations are 22.8µg/m³ at Pilibhit and 10.8 µg/m³ at Gajraula respectively.

Carbon Monoxide (CO)

The average CO concentration of ambient air quality at Pilibhit, Gajraula and Puranpur locations were found 723.75µg/m³, 736.25µg/m³ and 757.50µg/m³ respectively. The maximum and minimum CO concentrations measured among all AAQM stations are 830µg/m³ both at Gajraula and Puranpur and 620.0 µg/m³ at Pilibhit respectively.

It is observed from the data analysis that the highest values for most of the monitored parameters were recorded at Puranpur and lowest at Pilibhit. It may be due to poor condition of roads and huge traffic at Puranpur. There were not much variation in SO₂ and NO_x as no major industry is located along the road. The Results show that all the parameters are well below the National Ambient Air Quality Standard, 2009.

Table-5.4: Value of the AAQ along the project location

Location*	PM10				PM2.5				SO2				NOx				CO			
	08	60.4-70.8	65.3	70.7	08	36.3-42.3	39.0	42.1	08	6.8-9.6	8.4	9.5	08	21.7-22.8	22.2	22.8	08	620-800	723.75	794.4
Pilibhit (A1)	08	60.4-70.8	65.3	70.7	08	36.3-42.3	39.0	42.1	08	6.8-9.6	8.4	9.5	08	21.7-22.8	22.2	22.8	08	620-800	723.75	794.4
Gajraula (A2)	08	64.0-72.7	68.8	72.5	08	32.6-43.7	38.0	43.6	08	6.2-7.6	6.9	7.6	08	10.8-13.1	12.2	13.1	08	650-830	736.25	825.8
Puranpur (A3)	08	65.4-82.9	73.8	82.3	08	35.7-48.9	41.6	48.6	08	6.3-8.8	8.2	8.8	08	15.5-18.4	16.6	18.3	08	650-830	757.50	830.0
Stds. for 24 hrs monitoring except for CO (8Hrs)	100				60				80				80				2000			

1. Note: All values are in µg/cubic meter.

2. The monitoring locations come under category of industrial, residential, rural and other areas as per NAAQS, 2009.

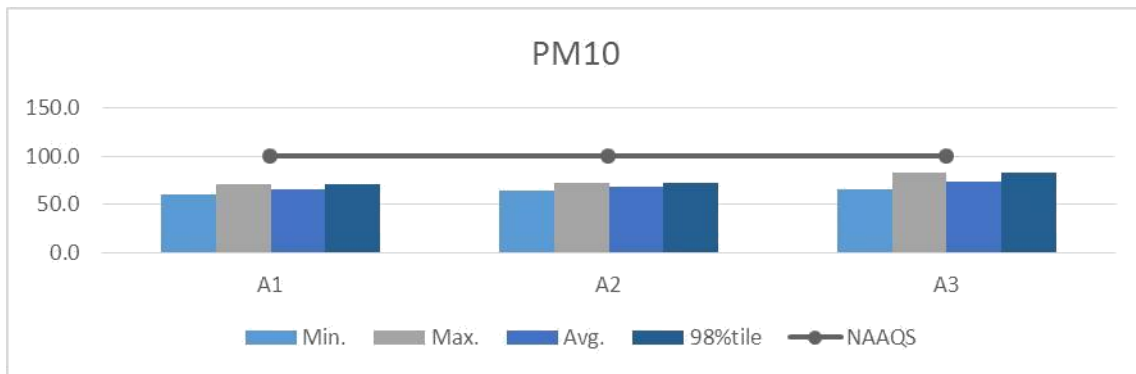


Figure-5.5: Chart Showing Concentration of PM10 on various Monitoring Locations

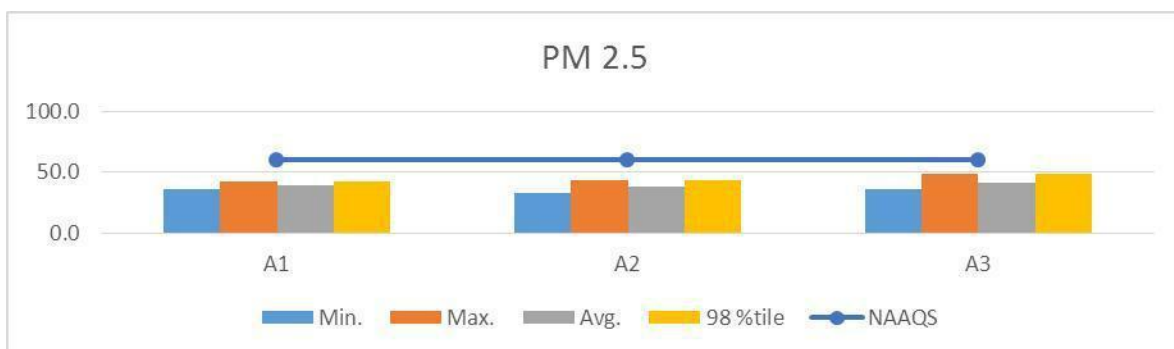


Figure-5.6: Chart Showing Concentration of PM 2.5 on various Monitoring Locations

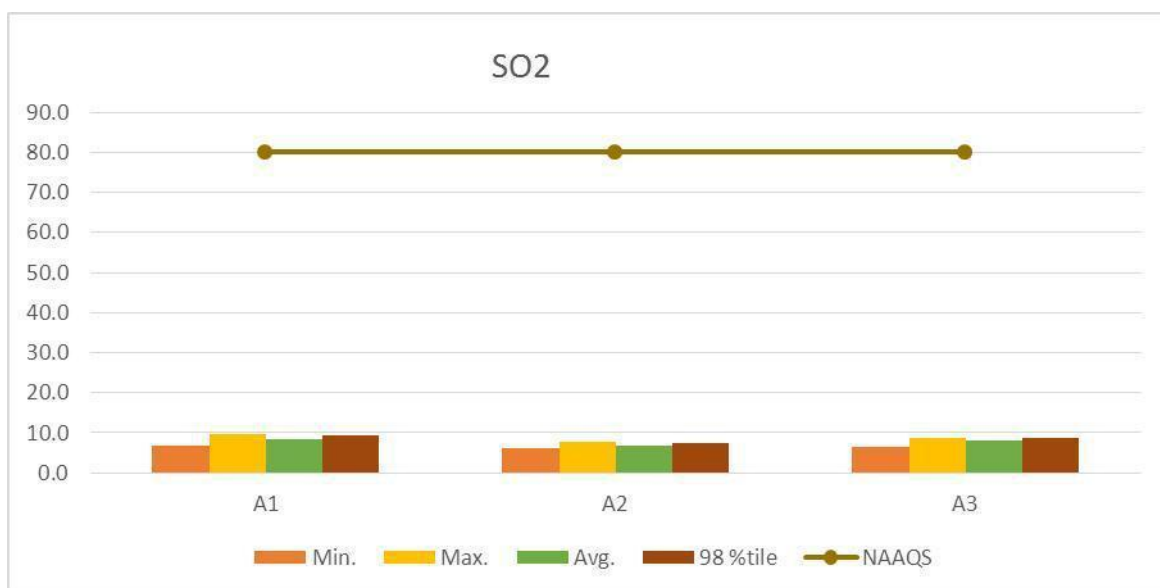


Figure-5.7: Chart Showing Concentration of SO2 on various Monitoring Location

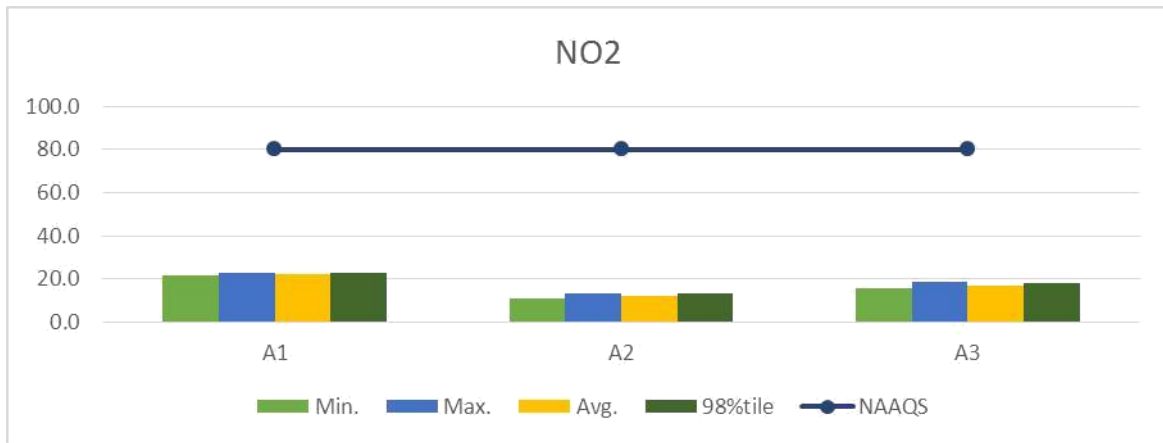


Figure-5.8: Chart Showing Concentration of NO₂ on various Monitoring Locations

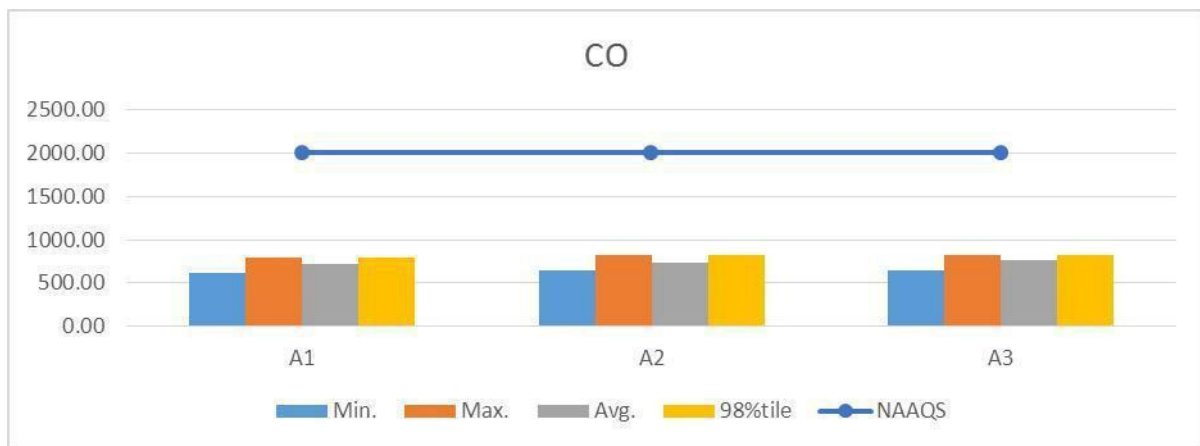


Figure-5.9: Chart Showing Concentration of CO on various Monitoring Locations

5.4 Noise

Noise attributed to roads depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface. High noise levels are a concern for sensitive receptors, *i.e.* hospitals, educational institutions, etc.

5.4.1 Selection of Monitoring Location

The noise levels are monitored at three locations during November, 2015 along the project road to assess the baseline status of noise environment along the project road. Locations for noise monitoring along the project road were identified based on the criteria same as those used for air monitoring but the relative importance of each criterion carries a weightage in arriving at the final set of locations. In case of noise monitoring locations, sensitive receptors such as schools, hospitals and religious places gains more importance due to ill effects of noise. While selecting the noise locations all types of land use (except industrial) in project influence area have been considered.

The noise level (Leq) was measured using Cygnet Make Digital Sound Level Meter (with data logger facility) at various sites along the entire stretch of road for day time (6.00 am to 10 pm) and night time (10 pm to 6.00 am) during the November, 2015.

5.4.2 Results and Discussion

The Noise levels are below the National Ambient Air Quality Standards with respect to Noise. Results for Noise quality are presented in Table-5.5.

Locations	Location Code	Class	Eq. Noise levels dB(A), Day.(Leq)	Eq. Noise levels dB(A), Night.(Leq)	Day time Standard (Leq in dB(A))	Night time Standard (Leq in dB(A))
Pilibhit	N1	Silence	46.1	37.2	50	40
Gajraula	N2	Residential	53.9	44.8	55	45
Puranpur	N3	Commercial	54.3	45.9	65	55

Table-5.5: Value of the Noise along the project location

5.5 Water

5.5.1 Water Resources

The project area is drained by number of rivers, canals and nalla. List of water resources (River, Canal, Pond, Hand Pump, etc.) present within the RoW of the road are depicted in Table-5.6.

S.No.	Chainage	Side (Left/Right/ Across)	Type of water body with Name if any	Offset Distance	Community Use
1	0+900	Across	River	a	
2	1+400	LHS	Hand pump	9.1	Yes
3	2+000	LHS	Pond	7.5	No
4	6+700	RHS	Hand pump	10	Yes
5	7+000	LHS	Hand pump	8	Yes
6	8+000	LHS	Pond	7	No

7	9+000	Across	Canal	a	Yes
8	12+200	RHS	Hand pump	10	Yes
9	13+100	Across	Canal	a	Yes
10	16+500	Across	River	a	Yes
11	21+400	RHS	Hand pump	7	Yes
12	24+600	RHS	Pond	7	No
13	24+700	Across	Canal	a	Yes
14	25+600	RHS	Pond	8	No
15	28+300	RHS	Hand pump	7	Yes
16	29+700	Across	Canal	a	Yes
17	31+000	Across	River	a	No
18	32+000	Across	Canal	a	Yes
19	34+900	RHS	Hand pump	a	Yes

Table-5.6: List of Water Resources in the Project Area

5.5.2 Water Quality

Water quality of the project area is generally good. Construction activities may have impact on water bodies due to disposal of waste and soil erosion at river /water body crossing area. The waste could be due to the spillage of construction materials, dumping of used water from the stone crusher, oils and greases, and labour camp. Proper mitigation measures will be required to minimize the impact of water pollution.

Sl. No.	Parameters	IS: 10500 Standard for Drinking Water		Pilibhit	Puranpur	Devha River	Mala River
		Desirable limit	Permissible Limit	GW1	GW2	SW1	SW2
1.	Colour, hazen units	5	15	<1	<1	<1	<1
2	Odour	agreeable	Agreeable	Odourless	Odourless	Odourless	Odourless
3	pH	6.5-8.5	NR	8.01	8.14	7.77	7.59
4	Turbidity (NTU)	1.0	5.0	0.3	0.3	90.1	62.1
5.	Conductivity(μmhos/cm)	-	-	959.0	468.0	427	701
6.	TSS (mg/l)	-	-	16.2	25.3	156.08	187.8
7.	TDS(mg/l)	500	2000	442.5	224.8	201.2	390
8.	Hardness (CaCO ₃) (mg/l)	200	600	182.0	184.0	220	276
9.	Alkalinity (mg/l)	200	600	156.0	21.6	228	32
10	Chloride as Cl, (mg/l)	250	1000	33.9	33.9	5.9	Nil
11	Sulphate as SO ₄ (mg/l)	200	400	28.0	32.0	14	6.5
12	Calcium as Ca (mg/l)	75	200	64.0	70.0	132	124
13	Magnesium as Mg (mg/l)	30	100	27.7	27.7	21.3	36.9
14	Sodium as Na (mg/l)	-	-	38.0	40.0	11	15

15	Potassium as K (mg/l)	-	-	8.0	10.0	9	7
16	Fluoride (mg/l)	1.0	1.5	0.3	0.4	-	-
17	Nitrate as NO ₃ (mg/l)	45	NR	0.42	1.0	0.34	0.21
18	DO (mg/l)	-	-	5.8	6.7	5.3	6.3
19	Copper as Cu (mg/l)	0.05	1.5	<0.05	<0.05	-	-
20	Chromium as Cr ⁶⁺ (mg/l)	0.05	NR	<0.05	<0.05	-	-
21	Cadmium as Cd (mg/l)	0.003	NR	<0.003	<0.003	-	-
22	Iron as Fe (mg/l)	0.3	NR	0.03	0.02	-	-
23	Arsenic as As (mg/l)	0.01	0.05	<0.01	<0.01	-	-
24	Nickel as Ni (mg/l)	0.02	NR	<0.02	<0.02	-	-
25	Lead as Pb (mg/l)	0.01	NR	<0.01	<0.01	-	-
26	COD	-	-	-	-	6	8
27	BOD	-	-	-	-	3.8	3.1
26	Total Coliform, MPN/100 ml	Absent	Absent	Absent	Absent	150	120
27	Faecal Coliform, MPN/100 ml	Absent	Absent	Absent	Absent	100	70

Table 5.7: Results for Ground water and Surface Water samples in the project area

5.5.3 Results and Discussion

Under natural conditions, surface water quality reflects environmental conditions to a great extent. Hydro-geochemical factors influence color, odour, taste, temperature and the degree of mineralization of water derived from surface run off, springs, etc. Besides, human settlements, overall land use, morphology of the basin area, seasonal distribution of rainfall and winds, disposal of industrial effluents and sewage, etc., contribute a great deal in determining the quality of water. The quality of ground water is influenced by surface and sub-surface environmental conditions. The quantity and quality of water entering the underground regime is another important parameter which influences underground water quality. Rainfall absorbs atmospheric pollutants during its descent through the atmosphere.

In order to represent the true profile of the project area, one sample of ground water and two samples from major surface water bodies were collected in the months of November 2015 and analyzed.

As per the ground water quality analysis of the project region pH and TDS values of the ground water samples ranges from 8.01-8.14 and 224.8-442.5 mg/l, respectively and almost meet the drinking water standards. The concentration of copper are <0.05 for both the samples and sulphate ranges from 28.0 mg/l to 32.0 mg/l and are well within the desirable limits specified for drinking water. Chloride contents in both ground water samples are 33.9 mg/l. and meet the desirable limit. Iron and Fluoride contents ranges from 0.02 mg/l to 0.03 mg/l and 0.3 mg/l to 0.4mg/l respectively and meet the desirable limit. Surface water bodies along the project road have pH and TDS values in the range of 7.59-7.77 and 201.2-390 mg/l respectively. The COD and BOD values these surface water bodies lies within the range of 6-8 mg/l and 3.1-3.8 mg/l respectively. The water quality of the study area is good and meets the IS: 10500 drinking water standards.

5.6 Soil

5.6.1 Soil type

Since most part of the road falls in the Terai region, the soil generally found in this area is loamy.

5.6.2 Soil quality

The soil samples have been collected at two location covering agriculture and forest land. Soil sample was collected from 60 m corridor of the road, at 5-15 cm depth. Besides studying

the texture (sand/silt/clay ratio) it is monitored for physico-chemical parameters to assess the soil quality of the area.



Figure-5.10: Soil map of India

Texture of soil was observed loamy. Water holding capacity of the soil sample ranges from 15.12 to 15.21%. Calcium content in soil samples lies from 5.4 mg/100g to 6.5 mg/100g. Sodium content in soil was found to be in the range of 32 mg/100gm to 50 mg/100g. Potassium content in the sample lies between 0.6 mg/100g to 0.9 mg/100gm. Phosphorous content in soil of the area was found to be in the range of 12kg/hac to 22 kg/ hac. Organic carbon in soil of the area was found in the range of 0.37% to 0.48 %. Results of the soil quality of the area are summarized in Table-5.8.

Sl. No.	Parameters	Pilibhit	Puranpur
1.	pH	9.2	9.08
2.	Bulk density (gm/Cc)	1.58	1.60
3.	Conductivity (mS/cm)	184	169
4.	Water holding capacity (%)	15.21	15.12
5.	Soil color	Brown	Dark brown

6.	Soil texture	Loam	Silt loam
7.	Sand (%)	60	30
8.	Clay (%)	10	15
9.	Silt (%)	30	55
10.	Sodium (mg/100g)	50	32
11.	Potassium (mg/100 g)	0.6	0.9
12.	Cation exchange capacity, CEC (Meq/100g)	4.34	3.68
13.	Available phosphorus (kg/ha)	22	12.8
14.	Available nitrogen (kg/ha)	16	15
15.	Calcium as Ca (mg/100g)	6.5	5.4
16.	Magnesium as Mg (mg/100g)	3.2	3.4
16.	Permeability (cm/min)	2.2	2.0
19.	Porosity (%)	2.0	2.4
20.	Sodium absorption ratio	5.98	6.03
21.	Organic carbon (%)	0.48	0.37

Table-5.8: Soil Quality of the Study Area

5.7 Ecological Features

5.7.1 Forest, Flora & Fauna of the Area

Forest Cover

The recorded forest area of the Uttar Pradesh is 16583 km², which constitutes 6.88% of its geographical area. Reserved Forest constitutes, 71.31 %, Protected Forests 8.56% and Unclassified Forests 21.12% of the total forest area. The forest cover of the State is shown in Figure 5.11.



(Source: upenvis.nic.in)

Figure-5.11: Forest cover map of Uttar Pradesh

The forest cover details of the project district is given in Table-5.9.

District	Geographical Area	Very Dense	Mod. Dense Forest	Open Forest	Total	% of GA	Scrub
Pilibhit	3499	340	157	200	697	19.92	0

Note: All Values are in Km². (Source: upenvis.nic.in)

Table-4.13: Forest Cover in Project Area

Pilibhit has maximum percentage i.e. 19.92 % forest area of total geographical area having 340 Km² very dense forest.

Flora of the Project Area

Floristic survey serves to understand species distribution pattern along the range of complex environmental variables and as such are of immense significance in understanding the biodiversity of the region. The relationship is likely to be stronger within smaller geographical boundaries where environmental variables are relatively uniform compared to larger areas experiencing greater diversity. The initial survey of the proposed area have been conducted to assess the ecological status of the existing flora to generate baseline information and to assess the probable impacts due to proposed activity on the biological environment. Project area has very rich floral

diversity as very dense forest patches present in the area. The important tree species which are present along the project road are given in the Table below.

S.N.	Local	Scientific	S.N.	Local Name	Scientific
1	Aam	Mangifera indica	24	Kala Siras	Albiasia doratissima
2	Aamla	Emblica officinalis	25	Kanju	holoptelia integrifolia
3	Amda/Ambar	Spondias pinnata	26	Kanji	Pongamia pinnata
4	Akohar	Alangium	27	Katahal	Artocarpus
5	Amaltash	Cassia Fistula	28	Kaitha	Feronia linonia
6	Aru	Ailanthus excelsa	29	Khair	Acacia catechu
7	Arjun	Terminalia arjuna	30	Khajur	Phoenix dactylifera
8	Babool	Acacia arabica	31	Lisoda	Cordia dichotoma
9	Baheda	Terminalia bellirica	32	Madar	Calotropis
10	Bakain	Melia azadirachta	33	Mahua	Madhuca indica
11	Bargad	Ficus bangalensis	34	Neem	Azadirachta indica
12	Bel	Aegle marmelos	35	Pakad	Ficus lacor
13	Ber	Ziziphus	36	Pipal	Ficus religiosa
14	Chitvan	Alstonia Scholaris	37	Sagaun	Tectona grandis
15	Eucalyptus	Eucalyptus	38	Sall / Shakhu	Shorea robusta
16	Gambhar	Gmelina arborea	39	Saijana	Moringa oleifera
17	Gular	Ficus Racemosa	40	Sehtoot	Morus Laevigata
18	Gutel	Trewia nudiflora	41	Semal	Bombax ceiba
19	Haldu	Adina cordifolia	42	Safed Siras	Albizzia procera
20	Imli	Tamarindus indica	43	Shisam	Dalburgia sisoo
21	Jamun	Syzigium cumini	44	Sihor	Streblus asper
22	Jigna	Lanea	45	Tendu	Diospyrus tomentosa

Table 5.10: List of important tree species present along the project road

Fauna of the Project Area

The faunal study of the proposed site was done, keeping in view the following objectives:

- To prepare an inventory of the terrestrial fauna present in the study area.

- To assess general status of the terrestrial faunal species present in the study area.
- To assess the impact of the proposed activities on the terrestrial faunal species present in the study area.

A general faunal study was carried out for the project site and surrounding area. No endangered species of fauna was observed during field survey within and surrounding area of project. The Monkey (*Macaca mulata*) & Nilgai (blue bull, *Boselaphus tragocamelus*) are very common and observe during site visit. Table-5.11 provides the list of main species of Mammals found in the Project area.

Sl. No.	Common Name	Biological Name
1	Bandar (Monkey)	<i>Macaca mulata</i>
2	Langoor	<i>Presbytis entellus.</i>
3	Guldar / Bagh / Tendua	<i>Panthera pardus</i>
4	Chita Billi	<i>Phelish bengalensis</i>
5	Jungali Billi / Van bilav	<i>Phelish Chos</i>
6	Sher / Tiger	<i>Panthera tigris</i>
7	Nevala	<i>Herpestes edwardsil</i>
8	Gidar / Siyar(Jackal)	<i>Canis aureus</i>
9	Bheria (Indian wolf)	<i>Canis lupus</i>
10	Lomdi	<i>Vulpes bengalensis</i>
11	Bhalu (Sloth Bear)	<i>Melursus ursinus</i>
12	Bijju (India ratale)	<i>Mellivora capensis</i>
13	Mirg / Kala Hiran (Black Buck)	<i>Antelope cervicapra</i>
14	Chausingha	<i>Tetracerus quadricornis</i>
15	Nilgai	<i>Boselaphus tragocamelus</i>
16	Padha (Hog Deer)	<i>Succis poricimus</i>
17	Sambar	<i>Cervus unicolor</i>
18	Jungli Suar (Wide pig)	<i>Sus scrota</i>
19	Gilahri	<i>Funambulus pennati</i>
20	Chuha (Common house rat)	<i>Rattus rattus</i>
21	Mus (India field mouse)	<i>Mus booduga</i>
22	Sahi / Sehi	<i>Histrix Indica</i>
23	Khargosh	<i>Lepus nigricollis</i>
24	Vazra Keet (Indian Pungolin)	<i>Manis crassicaudataa</i>

Table-5.11: List of important Mammals found in the Project Area

5.7.2 Wild Life Sanctuary/ National Park/Reserved Forest:

The project road from km 20 to km 24 traverses through **Pilibhit Tiger Reserve** and the stretch of about 500 m length between km 27 to km 28 touches the boundary of the **Tiger Reserve** from the Right Hand Side (RHS). The tiger reserve is a newly notified tiger reserve spread in total 72689.48 ha forest area consisting core area of 60279.80 ha in Pilibhit district.

Details of the reserved forest locations are given in Table-5.12.

S. No.	Existing Chainage		Length (km)	Forest Range & Division	Remarks
	From (Km)	To (Km)			
1	20	24	4	Mala Range, Pilibhit	Garha RF, part of Pilibhit Tiger

Table 5.12: Reserved forest locations in the project area

5.7.3 Tree Cutting

Felling of roadside trees is inevitable in road widening project. As per initial survey large numbers of trees are located along the project road, which are likely to be impacted. However effort will be made to minimize the tree cutting by appropriate selection of alignment depending technical feasibility. Compensatory afforestation will be carried out to compensate the losses as per the Forest (Conservation) Act, 1980 and Department of Forest, GoUP. Greenbelt development along the highway section will also help in enhancing the aesthetics as well as overall environmental condition of the area.

5.8 Public Participation

During a public consultation Programme a questionnaire was prepared regarding present & future state of highway. The information is present below.

1.) 62% people are unsatisfied with the drainage system of rain water along the road side, 47% people said that there is no proper rain water drainage on and along the road side.

2.) Traffic congestion emerged as a big concern as 73% people said that the problem of traffic congestion persists in the present highway & 83% people said that widening of road would be appropriate for reducing traffic congestions. 60% people also felt that the road safety was not up to the mark. 76% people are affected on the highway due to the noise level of the traffic in day time as well as night time.

3.) 36% people said that due to smoke of vehicles it causes asthma and many health

diseases. 55% people said there is as such no problem. 9% people said they have not

experienced any health and psychological problem due to pollution.

4.) Only 15% people believed that their business will affects from the construction of highway 58% people can't say anything about that and 26% people said it may be or may not be.

5.) 51% people satisfied from the present condition of the highway.

5. ANTICIPATED ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project. The analysis predicts the nature and significance of the expected impacts. The magnitude and duration (short-term or long-term) of impacts are also discussed.

There are no significant adverse environmental impacts during the planning and design phase based on the environmental screening. Off-site impacts associated with the road upgrading related to material sourcing from quarries, hot mix plant, and stone crushers will be minimized by relying solely on existing and licensed quarries. All hot mix plant or stone crushers to be utilized will have prior consent from the UPPCB. Majority of the significant impacts will occur during the construction phase.

6.1 Impacts on Soil

As the project road is an existing road, there will be no significant changes in present physiography of the region. The most important impact on land environment in road construction or improvement project is the soil erosion. The construction activities require excavation of soil and removal of vegetation, which leads to loss of topsoil leading to localized ecological degradation. The soil erosion also adds to air and water pollution. Land is also impacted from oil residues, lead and other hazardous materials produced from vehicles and construction machineries. Excavation of borrows pits and quarrying is another important activity, which have impact on land environment. Extraction of fill materials from riverbed can cause significant environmental impacts due to erosion.

During the construction phase, erosion is expected to intensify due to vegetation removal, soil disturbance and exposure of bare soil surface. Soil erosion is anticipated at bridge and culvert construction sites. Problem will be more pronounced if the construction is taken up in rainy season. Construction activities such as cuttings and fillings will initiate soil erosion within road alignment, quarries and access roads to these areas.

6.2 Impacts on Water Resources

Seven hand pumps are coming within Right of Way (RoW) and two Rivers & six canals crossing the project road. These water resources will be impacted due to widening of the existing road.

Road construction decreases available water to the host community in terms of its substantial requirement for processing, dust suppression, and domestic use of camps, and to a certain extent decrease the water availability by reducing groundwater recharge due to pavement of road surface. The risk of contaminating both surface and groundwater from untreated camp sewage also impacts availability of water to its most beneficial users. Although the construction requirement is temporary, mitigation measures must ensure the additional water demand will not burden existing water supply and sanitation systems. All road construction water requirements shall be exclusively extracted from government permitted sources. All bore wells will secure permission from the state groundwater authorities to ensure no disruption to customary users. Contractor may draw water from the irrigation canal provided written consent is issued by the Irrigation Department.

Construction of minor bridges on streams and distributaries and road embankment will have potential impact on the quality of surface water bodies. The sources of water pollution from the construction activities include the following:

- Leachates from stored bitumen and emulsion may pollute the nearby surface water source.
- Oil spill from the operation of the mechanical workshop, diesel pumps, diesel storage, transportation and transfer
- Operation of construction camps will require a well-developed drainage system to manage the sewage generated and avoiding its mixing with nearby surface water.
- The camp site will require sanitary facilities for the labours living there. Most of the project area has no water borne sanitation and accompanying sewerage system and need of developing an integrated sewer network with septic tank or effluent collection and management system will be required.

- The camp roofs and pavements shall increase volume and velocity of storm water or run-off flowing across the area covered by the buildings or tents at the contractor's yard or labour camps.
- Water flow from scarified bitumen material.
- Soil erosion during the construction phase of the road embankment and the bridges can contribute large amounts of sediments and silt to run-off waters and this can affect surface water quality adversely.
- Heavy metals, oils, and other toxic substances and debris from construction traffic and spillage can be absorbed by soil at construction site and carried with run-off water to the water courses, which can thus lead to increase in turbidity and alkalinity & impact aquatic flora and fauna adversely.
- Demolition of the project including the road, camps, equipment's and fixtures at contractor's yard and related infrastructure will result in large quantities of solid waste. The waste will contain the materials used in construction including concrete, metal, cement, bitumen, oil, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment. In addition, even the generally non-toxic chemicals such as chloride, sodium, sulphate and ammonia, which may be released as a result of leaching of demolition waste, are known to lead to degradation of groundwater quality.

6.3 Impact on Air Quality

The ambient air quality along the project road is good and within the National Ambient Air Quality Standards, 2009, some important observations on the project roads are:-

- Since no major industry is located along the project corridor, most of the pollution is vehicular.
- The emissions of individual vehicles, their monitoring and regular checks are important. The fuel composition, maintenance of engines, and engine temperature must be properly regulated for improved scenario.
- The parameters of air quality measurements, namely, PM_{2.5}, PM₁₀, NO_x, SO₂ and Carbon Monoxide at all selected sites were recorded to be within the prescribed limits.

- The mitigative measures suggested include the policies, regulation and enforcement programs covering vehicle standards and maintenance requirement, fuel quality and technology, management of traffic efficiency and removing the high-pollution vehicles besides plantation of tall, leafy, and dense vegetation to filter and adsorb some pollutants.
- Sensitive areas will be taken care of especially in this regard.

6.4 Impact on Noise levels

The assessment of potential road noise impacts helps in understanding one of the most significant pollution, the noise pollution. Some salient features related to potential noise impact of a road development include: (i) the road noise impact is greatest where busy road passes through densely populated areas, townships and markets (ii) the range of noise level should be understood in relation to the habitation type also; for example, road noise in industrial area is not likely to be problematic but at sensitive location like schools and hospitals; its impact may be significant, (iii) mitigation of noise in urban areas is rather difficult, especially at the road intersections.

Environmental noise particularly highway traffic noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of vehicles on the road. The impacts of noise due to the project will be of temporary significance locally in the construction phase and slight increase may occur during the operation stages.

Although the baseline day & night time noise levels monitored at two locations along the project road are within permissible limits specified by the MoEFCC. Still, noise is a major area of concern, especially since sensitive receptors (schools, colleges and hospitals) have been located quite close to the road.

6.5 Impact on Flora, Fauna and Ecosystem

Some important positive and negative impacts on flora, fauna and ecosystem of the present road-widening project are: -

- There will be no loss of bio-diversity, since no rare/endangered/threatened (RET) plant or animal species is going to be eliminated due to the proposed restoration / reconstruction.
- There will be no loss of habitat by the road itself, borrow pit areas and quarry sites.

- The proposed road construction will not affect migratory path of animal breeding zone, wetlands or important ecosystems.
- The aquatic habitat will not be damaged.
- The loss of herbal cover, at least during the construction phase, is likely to produce some negative impacts.
- Impact due to burning of fuel: During the construction working labours may utilize the forest wood for cooking as fuel etc., which may lead to biotic pressure on the forests.

6.6 Impact on Protected Monuments and Cultural Heritage Sites

It has been observed that no archaeological site or monument and cultural heritage site exists along the project road. Therefore there would not be any kind of significant impact on the cultural heritage sites.

6.7 Impacts on Road Safety and Human Health

These impacts pertain to those that take place outside the project boundaries, in this case the ROW and camp site, but are related to road construction and operation. Other impact on community health and safety related to road construction pertains to road crashes, structural safety, transport of hazardous materials, communicable and vector borne diseases, and emergency preparedness in case of road failures such as slides rendering villages inaccessible.

Risk of road crashes will increase during construction when a construction related and transport vehicles, and workers are co-located along restricted construction fronts. During operation phase, the projected increase in the number of motorized road users travelling at higher speeds also increases the chances of injuries and fatalities from road crashes. To mitigate these risks, the contractor needs to adopt safety measures for workers and road users particularly those that are more vulnerable to crashes. Accident risks associated with increase in vehicular traffic, leading to accidental spills of toxic materials is also magnified during construction. The construction camps pose risk of communicable and vector-borne diseases not only among its workers but to the host communities through poor camp sanitation and living conditions, migrant workers might carry sexually-transmitted diseases such as HIV/AIDS.

7. MITIGATION MEASURES

The project is likely to bring some negative impacts on the environmental structure of the region. While avoidance and analysis of the alternatives for deciding the alignment from environment point of view were the first priority, some negative potential impacts are unavoidable. In such cases, adoption of mitigation measures is the only solution. A brief description of the approach to mitigation measures on environmental issues is enumerated herewith:

7.1 Soil

The potential impacts, their mitigation, and the phase of implementation to topographic and soil characteristics were assessed and presented below.

Potential Impacts	Mitigation	Implementation Phase
A. Altered embankment	Action confined within ROW Good engineering & construction practices Stabilization and turfing (revegetation)	Pre-constructional phase & constructional phase
B. Borrow pit excavation	IRC: 10-1961 guideline to be followed Borrow areas identified close to road Non-productive land will be used Good engineering & construction practices	Pre-constructional phase & constructional phase

Table-7.1: Impacts on soil, its mitigation and implementation phase

Prior permission of land owners for Borrow areas will be taken and soil will be excavated as per the intended use by the landowner. The location of construction camps and other construction sites shall not be located on productive agricultural land. The topsoil from all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles. The stored topsoil will be utilized for the redevelopment of borrow areas, top dressing of the road embankments, fill slopes and filling up of tree pits proposed as part of compensatory plantation.

7.2 Water Resources

The potential impacts, their mitigation and the phase of implementation regarding water sources were assessed with regard to surface water bodies, like ponds, irrigation channels and underground water tables with reference to wells, tube wells and hand pumps.

Potential Impacts	Mitigation	Implementation Phase
A. Surface water bodies	Provision of proper drainage Construction camps are properly located Good engineering practices to be followed	Pre-constructional, constructional, post-constructional and operational phases
B. Underground water	No appreciable impacts Water to be used for construction should have separate source	Per-construction and constructional phase

Table-7.2: Impact on water sources, its mitigation and implementation phase

7.3 Ambient Air Quality

Potential Impacts	Mitigation	Implementation Phase
Due to additional traffic, especially in market places	Plantation of pollutant adsorbing trees	Operational phase & constructional phase

Table-7.3: Impact on air quality, its mitigation and implementation phase

7.4 Noise Levels

Noise particularly highway traffic noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of vehicles on the road.

Sl. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
1	Sensitive receptors	Direct impact	Increase in noise pollution	Noise barrier should be provided. Traffic calming devices should be used. NO Horn Zone sign Post.
2a	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Man, material & machinery movements Establishment of labor camps onsite offices, stock yards and construction plants	Area specific and for short duration Machinery to be checked & complied with noise pollution regulations. Camps to should be setup away from the settlements, in the down wind direction.

Sl. No.	Item	Impact	Impact (Reason)	Mitigation/Enhancement
2b	Noise Pollution (Construction Stage)	Marginal Impact	stone crushing, asphalt production plant and batching plants, diesel generators etc Community residing near to the work zones	Camps to be setup away from the settlements, in the down wind direction. Noise pollution regulation to be monitored and enforced. Temporary as the work zones will be changing with completion of construction
2c	Noise Pollution (Operation Stage)	Marginal Impact	due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles.
3	Noise Pollution Monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	Measures should be revised & improved to mitigate/ enhance environment due to any unforeseen impact.

Table-7.4. Various factors for noise pollution and its mitigation

7.4.1 Sensitive Receptors – Mitigation

The sensitive receptors such as school and temple have been identified and those that are close to the project roads will require noise barrier to accommodate the long term impact of the improved road. List of sensitive receptors which require noise mitigation measures along the project corridor is presented below in Table-7.5. At these locations horn prohibited sign post and noise barrier shall be provided.

S.No.	Chainage	Side	Type of Property (with Name)	Offset distance	Width of Noise Barrier
1	2+700	RHS	Temple	7.5	10
2	2+800	LHS	Hanuman Temple	10.5	10
3	5+900	RHS	Shiv Temple	8	10
4	7+000	RHS	Temple	15	10
5	7+700	LHS	Shiv Temple	15	10
6	8+500	LHS	Adarsh Inter College	15	20
7	9+000	LHS	Primary School	30	40
8	10+600	LHS	Pooja sthal	10	20
9	11+300	LHS	Shiv Temple	10	10
10	11+300	RHS	Junior school	15	30
11	18+400	RHS	Public School	15	20
12	21+400	RHS	Hanuman Temple	73	10
13	24+200	RHS	Gurudwara	10	20
14	24+600	LHS	Temple	7	10
15	27+400	RHS	Sunny dev temple	10	10
16	28+000	RHS	Gurudwara	10	10
17	28+800	RHS	ISHER Accademy	15	30
18	31+100	LHS	Gurudwara	10	30
19	31+100	LHS	Primary School	15	20
20	32+200	RHS	College	15	30
21	33+500	RHS	Akal Academy	12	100

Table-7.5 Sensitive Receptor which require Noise Mitigation Measures

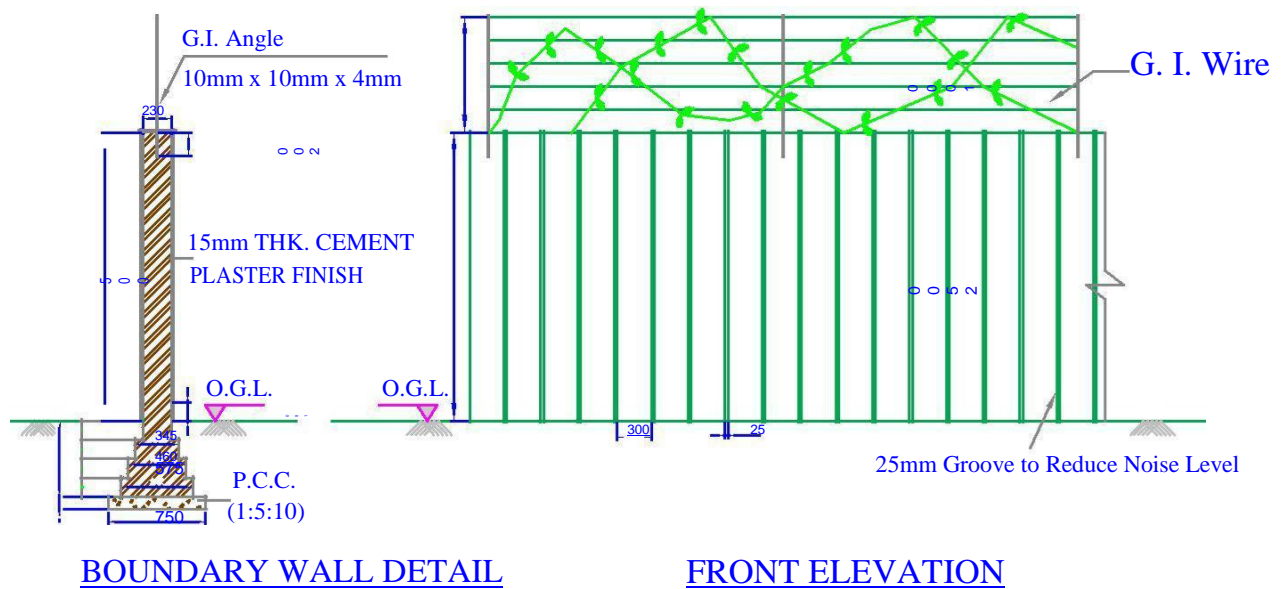


Figure-7.1 Conceptual Drawing for Noise Barrier

7.4.2 Noise Pollution - Mitigation

- Noise standards should be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift should conform to a standard of less than 90dB(A). If ∇ required, high noise producing generators such as concrete mixers, generators, graders, etc. must be provided with noise shields.
- Machinery and vehicles should be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.
- Workers in the vicinity of high noise levels should be provided earplugs, helmets and will be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8 hour shift.
- During construction vibratory compactors should be used sparingly within the urban areas. In case of complaints from roadside residents, the engineer should ask the site engineer to take suitable steps of restricting the work hours even further or use an alternative roller.

- Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage.
- People should be convinced / educated to prevent sensitive land uses from developing up adjacent to the project corridors.

7.5 Mitigation measures for Human Health and Safety

Due to inadequate width of the road, heterogeneous nature of traffic, congested market places, the accidents are not uncommon. Besides this the truck-drivers may carry contagious diseases, which might spread in the area if proper care is not taken.

Potential Impacts	Mitigation	Implementation Phase
Accidental spots can be reduced by correcting the curves, improvement of junctions, new under process, fly-over	Proper provision of service roads, junctions, fly-over, under process to be provided at appropriate places Truck parking places to be identified Medically facility to be provided (an ambulance fitted with all medical equipments and a doctor)	Constructional and operational phases
Sexually transmission diseases (STDs)	Detected diseased person to be carried to the nearest city hospital Preventive measures should be taken to check the spreading of STDs	Operational phases

Table -7.6: Impact on health, its mitigation and implementation phase

7.6 Measures taken for Pedestrian Safety

Following measures should be taken for pedestrian safety in built-up areas:-

- Railing on both sides of the carriageway in built-up areas.
- Pedestrian crossing in built-up area and bus bays.
- Proper signage at appropriate locations.

7.7 Measures for Biological Environment

The most important negative impact that the project will cause is the loss of number of trees, leading to (a) enhanced degree of soil erosion, (b) loss of shade, fruits, timbers and other economic activities, and (c) ecology of the ecosystem. However, if re-plantation management scheme is launched vigorously, the, though slow shall restore the ecological balance.

Potential Impacts	Mitigation	Implementation Phase
Cutting of roadside trees	Ten no. of new trees should be planted at the loss of one tree	Pre-constructional, constructional and operational phases
No loss of bio-diversity	Not needed	
Wildlife	<p>The locations for wildlife crossing should be identified in forest area.</p> <p>Provision of road safety sign at the starting, at every 1km interval and at the end of the forest area.</p> <p>Maximum speed limit of 60 km/hr within the forest area.</p> <p>Parking shall be restricted in the forest area.</p> <p>Road side plantation shall be done under supervision of concerned forest division to reduce night light glare, noise level and air pollution.</p>	Pre-constructional, constructional and operational phases

Table-7.7: Impact on biological environment, its mitigation and implementation phase

7.8 SOCIAL ENVIRONMENT

While preparing the engineering design, the prime consideration has been given to minimise the social negative impacts within the limitations of technical requirements and cost effectiveness and to enhance the benefits. Despite the best efforts to minimise the negative social impact, however, land take and resettlement have been unavoidable. Three broad categories of analysis made to minimize resettlement are (1) design consideration, (2) public consultations and (3) analysis of alternatives and bypasses. The guiding principle with regard to the congested areas has been to limit the road upgrading activities within the available corridor. Where minimising the negative impacts has not been feasible, such as bypasses have been proposed. The purpose of the bypasses is to increase better connectivity while minimising the negative social impacts along the existing alignment, especially the displacement of the affected persons and households.

8. ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is a plan of action for avoidance, mitigation and management of the negative impacts of the project. The Environmental Enhancement is also an important component of Environmental Management Plan. The chapter details out the measures incorporated during the project design stage of proposed widening / up-gradation of existing Puranpur-Khutar section of NH-730 to avoid and mitigate anticipated adverse impacts on the various environmental components. The mitigation measures have been discussed as the impacts identified in Chapter 7, where impacts have been assessed for each of the environmental components.

8.1 Environmental Enhancement

Some additional measures needed to improve the environment are proposed to be undertaken during the project implementation. Such measures are known as environmental enhancements. These relate to improvement of natural, physical and aesthetic environment of roadside. The ‘enhancement measures’, in fact, differ from ‘mitigation measures’. While the former aims at improving the already degraded or mundane ambience, the latter intends to reduce the negative impacts due to the project.

The objective of these measures include:

- To enhance the appeal of the project road,
- To improve the environmental quality, and
- To generate goodwill amongst local community

To achieve these objectives, some suggested measures include:

- Enhancement of roadside facilities (bus stops, rest areas, etc.)
- Improvement of aesthetic qualities along the project road
- Improvement of the local natural resources for local population
- Enhancement of cultural properties and access to them
- Management of some existing problems

8.2 Environment Management Plan

The Environmental Management Plan is the synthesis of all proposed mitigative and monitoring actions, set to a time frame with specific responsibility assigned and follow-up

actions defined. It contains all the information for the proponents, the contractors and the regulatory agency to implement the project within a specified time frame.

The EMP is a plan of action for avoidance, mitigation and management of the negative impacts of the project. The Environmental Enhancement is also an important component of EMP.

The EMP refers to all implementable tasks at different stages of project, namely,

- Design Phase
- Construction Phase, and
- Operation Phase

The EMP includes a list of all project-related activities and impacts and a clear reporting schedule.

The EMP is divided into two broad components,

- (i) dealing with natural environment, and
- (ii) dealing with action plan for resettlement and rehabilitation (RAP).

While the mitigation measures of the natural environment and their management have been incorporated in the present volume, the management of issues related with resettlement and rehabilitation of human communities has been provided in Resettlement Action Plan.

Table 8.1: Environment Management Plan

Environmental Issue/Component	Impact Description	Remedial Measure
PRE-CONSTRUCTION/DESIGN PHASE		
1. ALIGNMENT		
Constricted sections / settlements	<ul style="list-style-type: none"> • The local traffic will mix up with fast moving vehicles leading to accidents • Communities on two sides in market are unable to cross the road easily • Loss of property & income source • Increased traffic jams 	<ul style="list-style-type: none"> • Erecting the service lanes • Developing underpasses in markets • Developing resettlement sites • Modify designs to save settlements trees and other Env. Components • Road widening to remove traffic jams
2. LAND		
Embankment slopes	<ul style="list-style-type: none"> • Some degree of soil erosion on newly constructed embankment • The issue of water logging at adjoining areas will improve due to the raising of the road 	<ul style="list-style-type: none"> • Turfing of the slopes to check soil erosion with grasses, etc. • The raising of slopes of the road ranges between 0.6 to 1.5 m from the existing road in market places to avoid flooding
Borrow areas	<ul style="list-style-type: none"> • Soil and land use will be changed 	<ul style="list-style-type: none"> • Borrow pits shall not be dug continuously. The location, shape and size of the designated borrow areas shall be as approved by the Engineer. No borrow area shall be opened without permission of the engineer. • If borrow pits along the road is permitted by the Engineer, these shall not be dug continuously and shall confirm to MoRTH specifications.

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> Borrow pits shall be redeveloped as per MoEF guidelines. Spoils shall be dumped with an overlay of stockpiled topsoil, in accordance with compliance requirements with respect to MoEF guidelines.
3. WATER		
Water Resources	<ul style="list-style-type: none"> Roadside hand pumps No loss of surface water bodies or canals 	<ul style="list-style-type: none"> Relocation of water sources like wells and hand pumps
Drainage	<ul style="list-style-type: none"> Impact on drainage pattern 	<ul style="list-style-type: none"> Raising the road level Provision for drainage on the side of road & improvement of CD structures
4. FLORA AND FAUNA		
Reserved / Protected forest/sensitive areas / wildlife	<ul style="list-style-type: none"> Loss of reserved/protected forests No sanctuary areas exist in the corridor Wildlife present in reserve forest along the project corridor. 	<ul style="list-style-type: none"> Measures should be taken as stipulated in forest clearance letters. <ul style="list-style-type: none"> The locations for wildlife crossings has been identified through a questionnaire survey and cross drainage sections height will be raised in consultation with design for smooth crossing of wildlife animals. Provision of road safety sign at the starting, at every 1km interval and at the end of the forest area. Maximum speed limit of 40 km/hr within the forest area. Parking shall be restricted in the forest area. <ul style="list-style-type: none"> Road side plantation shall be done under supervision of concerned forest division to reduce night light glare, noise level and air pollution.
Road Side Trees	<ul style="list-style-type: none"> Loss of trees leading to increase in air and noise pollution; the loss of ecological and economic 	<ul style="list-style-type: none"> Minimum trees shall be cut after getting permission from Forest department.

Environmental Issue/Component	Impact Description	Remedial Measure
	activities	<ul style="list-style-type: none"> • Compensatory avenue plantation shall be done.
5. ENVIRONMENTAL QUALITY		
Air quality	<ul style="list-style-type: none"> • There will be slight increase in the pollution level of the air in a few places 	<ul style="list-style-type: none"> • Widening and strengthening of the road will allow optimum speed of fast moving vehicles • Tree plantation scheme to be implemented.
Noise level	<ul style="list-style-type: none"> • The noise level might slightly increase in market places 	<ul style="list-style-type: none"> • Widening and strengthening of the road will allow optimum speed of fast moving vehicles • Tree plantation scheme to be implemented
6. UTILITIES		
Relocation of utility lines/community utilities	<ul style="list-style-type: none"> • Short time negative impact during transitory phase of shifting of utility lines • No impact on shifting wells, hand-pumps etc. 	<ul style="list-style-type: none"> • All utilities to be relocated with prior approval of the concerned agencies • All community utilities such as sources of water to be relocated to suitable places
7. CULTURAL HERITAGE		
Relocation of cultural properties	<ul style="list-style-type: none"> • Few religious properties will be impacted 	<ul style="list-style-type: none"> • Community meetings to be held before relocation or shifting • Provision of enhancement of religious structures, and access road
8. ENVIRONMENTAL SAFETY		
Accidents	<ul style="list-style-type: none"> • Frequency of accidents due to curves in the road 	<ul style="list-style-type: none"> • Improvement in curves in the designs

Environmental Issue/Component	Impact Description	Remedial Measure
	<ul style="list-style-type: none"> • Moving of fast moving & slow moving vehicles in market places will enhance chances of accidents • Poor visibility causes more accidents 	<ul style="list-style-type: none"> • Segregating the slow moving traffic in the market places by developing the service lanes • Provision of wider median in rural stretches and plantation of shrubs/under trees in it to avoid the gear of vehicles moving in opposite direction • Signals to be erected to reduce speed • Proper light arrangement to be made
<p>CONSTRUCTION PHASE</p> <p>1. SOIL</p>		
Soil Erosion	<ul style="list-style-type: none"> • Removal and cleaning of tree line, herbaceous and shrubby covers from embankment will increase soil erosion • Excavations of borrow pits will increase soil erosion 	<ul style="list-style-type: none"> • Turfing of road embankment slopes with herbs, shrubs and grasses • In borrow pits, the depth of the pit should be regulated so that the sides of the excavation will have a slope not steeper than 1 vertical to 4 horizontal from the edge of the final section of bank • The device for checking soil erosion include the formulation of sediment basins, slope drains etc. Such works and maintenance thereof will be deemed as accidental to the earthwork • Cutting of trees in phases
Loss of topsoil	<ul style="list-style-type: none"> • The loss of topsoil is considerable as the proposed bypasses are passing through agricultural field. 	<ul style="list-style-type: none"> • The borrow pit areas could be developed into ponds for fisheries • Land taken for borrow area should be infertile

Environmental Issue/Component	Impact Description	Remedial Measure
Compaction of soil	<ul style="list-style-type: none"> • The excavations in borrow areas may lead to marginal loosening of soil • The compaction of soil may not be affected largely 	<ul style="list-style-type: none"> • It should be ensured that the stability of excavation of fills is maintained • Construction vehicles, machinery and equipment shall move, or be stationed in the designated area • If operating from temporarily hired land, it will be ensured that the topsoil for agriculture remains preserved & not destroyed by storage, material handling or any other construction related activities • The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2 m • Cut and fill should be equalized as per design • Earth, if required, should be dumped in selected & approved area by the engineers.
Borrowing of earth	<ul style="list-style-type: none"> • Large quantities of earth is needed for raising the level of road, its expansion and embankment 	<ul style="list-style-type: none"> • No earth should be borrowed from within the ROW • If new borrow areas are selected, there should be no loss of productive soil, and environmental considerations are met with • If vehicles are passing through some villages, the excavation and carrying of earth will be done during day time only • The borrow areas should not be dug continuously, and the size and shape of borrow pits to be decided by the engineer • Borrow pits should be redeveloped by dumping of spoils; by creating a pond for fisheries, etc. or by leveling an elevated, raised earth mounds.
Contamination of soil from fuel	<ul style="list-style-type: none"> • The impact will be negligible since the chemical 	<ul style="list-style-type: none"> • Vehicles and machines are maintained and refilled in such a fashion that

Environmental Issue/Component	Impact Description	Remedial Measure
and lubricants	<p>nature of the soil will not change much</p> <ul style="list-style-type: none"> • Negligible impact on the growth of vegetation 	<p>old diesel spillage does not contaminate the soil</p> <ul style="list-style-type: none"> • Fuel storage and refilling sites should be kept away from cross drainage structure and important water bodies • At spoils shall be disposed off as desired and the site shall be fully cleaned before handing over
Contamination of soil from construction wastes	<ul style="list-style-type: none"> • The impact will be marginal on the soil quality • The growth of vegetation will be partially disturbed 	<ul style="list-style-type: none"> • The construction wastes should be dumped in selected pits, developed on infertile land • Follow the norms of SPCB • Borrow pits to be filled by such wastes
2. WATER		
Water bodies	<ul style="list-style-type: none"> • Effect on surface water. 	<ul style="list-style-type: none"> • Any source of water for the community such as ponds, wells, tube-wells etc. lost incidentally shall be replaced immediately • All desired measures will be taken to prevent temporary or permanent flooding
Other water sources	<ul style="list-style-type: none"> • The lost sources of water like wells and tube-wells are going to affect the community adversely • Loss of source of irrigation 	<ul style="list-style-type: none"> • Any source of water for the community such as ponds, wells, tube-wells etc. lost incidentally shall be replaced immediately • All desired measures will be taken to prevent temporary or permanent flooding
Drainage and run-off water	<ul style="list-style-type: none"> • The flow of run off water will not be affected largely, excepting certain stretches where the drainage problem already exist 	<ul style="list-style-type: none"> • At cross drainage channels, etc. the earth, stone or any other construction material should be properly disposed of so as not to block the flow of water • All necessary precaution shall be taken to construct temporary or permanent device to prevent water pollution (due to increased situation and

Environmental Issue/Component	Impact Description	Remedial Measure
		turbidity)
Contamination of water from construction waste	<ul style="list-style-type: none"> • The construction wastes may increase the suspended matter and clay in stagnant water bodies • There will be very little increase in toxicity <ul style="list-style-type: none"> • The community dependent on such water used for purposes other than drinking may be affected 	<ul style="list-style-type: none"> • Construction work close to the streams or other water bodies shall be avoided, especially during monsoon period • All waste arising from the project is to be disposed of, as per norms of SPCB • Waste products must be collected., stored and taken to approved disposal site
Contamination of water from fuel and lubricants	<ul style="list-style-type: none"> • The fuel and lubricants may affect the both component of water bodies • The community may be slightly affected 	<ul style="list-style-type: none"> • The slopes of embankment landing to water bodies should be modified and re-channelised so that contaminant may not enter the water body • To avoid contamination from fuel and lubricants the vehicles and equipment shall be properly maintained and refilled
Sanitation and waste disposal in construction camps	<ul style="list-style-type: none"> • The absence of sanitation may lead to many human diseases which are mostly water-borne • No communicable diseases are going to be spread 	<ul style="list-style-type: none"> • The construction laborers camp shall be located away from the habitation • The sewage system for such camps shall be properly designed and built so that no water pollution takes place to any water-body or water course • The workplace shall have proper medical approval by local medical health or municipal authorities
Use of water for construction	<ul style="list-style-type: none"> • The use of water from sources, already in use by local community may cause scarcity of water for community • The easy availability of underground water will not affect the water tube 	<ul style="list-style-type: none"> • Arrangement for supply and storage of water will be made by the contractor in such a way so that the water availability and supply to nearby communities remain unaffected. If a new tube-well is to be bored, proper sanction and approval by Underground Water Department is needed • The waste of water during the construction should be minimized

Environmental Issue/Component	Impact Description	Remedial Measure
3. AIR		
Emission from construction vehicles and machinery	<ul style="list-style-type: none"> • Effect on human health <ul style="list-style-type: none"> • Dust settled on leaves may reduce growth rate of the plants • Crowded market places and construction sites will have higher degree of emission 	<ul style="list-style-type: none"> • All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that the pollution emissions levels are as per norms of SPCB • Monitoring of suspended particulate matter to be conducted at least once a month at the sites where crushers are used • The human settlements should be at least 500 m downward wind direction of asphalt mixing plant
Dust and its treatment	<ul style="list-style-type: none"> • The impact of dust at construction sites is rather adverse, but localized in nature • No serious health problem is likely to be caused 	<ul style="list-style-type: none"> • At precautions to reduce the level of dust emissions from the hot mix plants shall be taken • The hot-mix plants be sited at least 500 m from the nearest habitation. They should be fitted with dust extraction unit • Water should be sprayed in the line and earth mixing sites, asphalt mixing site and service roads. In filling subgrade, water spraying is needed to solidify the material. After the impacting, water should be sprayed regularly to prevent dust • Vehicles delivering material should be covered
4. NOISE LEVELS		
Noise from vehicles, asphalt plants and equipment	<ul style="list-style-type: none"> • The activities of using heavy machinery and equipment are localized and intermittent • No serious impact on human health like loss of hearing ability though some sleep disorders may 	<ul style="list-style-type: none"> • The parts and equipment used in construction shall strictly conform to CPCB noise standards • Vehicles and equipment used should be fitted with silencer • Noise standards or industrial enterprises will be strictly enforced to

Environmental Issue/Component	Impact Description	Remedial Measure
	result	<p>construction workers from damage</p> <ul style="list-style-type: none"> • In construction sites with 150 m where, there are human settlements, noisy construction should be stopped between 10:00 pm and 8:00 am • Noise to be monitored at construction sites
Noise from blasting operations	<ul style="list-style-type: none"> • The sudden and loud noise of blasting is disturbing and irritating • The intense noise may cause partial deafness 	<ul style="list-style-type: none"> • People living near such sites should have prior information of operational hours • Blasting should not be undertaken in midnight or late-night hours • Regulation of material haulage roads • Providing earplugs to workers at site
Loss of damage to vegetation	<ul style="list-style-type: none"> • The loss of trees, shrubs and herbal cover may lead to higher degree of soil erosion • The loss of shade and other benefits due to loss of trees • The air quality especially in market places, will decline • There will be no loss or damage to hydrophytes 	<ul style="list-style-type: none"> • Areas of tree plantation cleared will be replaced according to Compensatory Afforestation Policy under Forest Conservation Act-1980 • Trees clearing with ROW should be avoided • Trees should be removed in phases
Compaction of vegetation	<ul style="list-style-type: none"> • The effect on compaction will not be much severe • There will be no loss of biodiversity 	<ul style="list-style-type: none"> • The removal of vegetation is confirmed along the proposed project. • The saving of trees at the design phase has not reduced compaction much • Replantation of tree species along new ROW • Plantation of shrubs and undertrees in the median

Environmental Issue/Component	Impact Description	Remedial Measure
Loss, damage or disruption to fauna	<ul style="list-style-type: none"> • There will be no loss, damage or disruption to fauna 	<ul style="list-style-type: none"> • Construction workers should be educated not to disrupt or damage the fauna • Hunting is strictly prohibited
Accident risk from construction activities	<ul style="list-style-type: none"> • The type of accidental risks may be due to ill-maintains machines and vehicles, due to poor light conditions at the work place, or due to carelessness and poor management of the work involved 	<ul style="list-style-type: none"> • To ensure safe construction in the temporary accesses during construction, lighting devices and safety signal devices shall be installed. Traffic rules and regulations to be strictly followed • At blasting sites – the blasting time, signal and guarding will be regulated. Prior to blasting the site should be thoroughly inspected. Blasting should not be carried out during rush hours <ul style="list-style-type: none"> • Safety of workers undertaking various operations during construction should be ensured by providing them helmets, masks, safety goggles etc • The electrical equipment should be checked regularly to avoid risks to workers
		<ul style="list-style-type: none"> • At every work place, a ready available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), nursing staff and an attending doctor to be provided • Lighting device and signals at workplace to be installed
Health issues	<ul style="list-style-type: none"> • The previous of unhygienic conditions at work place of construction workers • The non-availability of good drinking water 	<ul style="list-style-type: none"> • At every workplace, the good, and sufficient water supply shall be maintained to avoid waterborne diseases and securing the health of workers • Adequate drainage, sanitation and waste disposal to be provided at workplace

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> • Medical care to be provided to workers if falling ill
Damage or loss of cultural properties	<ul style="list-style-type: none"> • No existence of archaeological relics is likely • No monument exists in the corridor • Few Religious structures will be impacted 	<ul style="list-style-type: none"> • Relocation of cultural properties • All necessary and adequate care should be taken to minimize the impact on cultural properties • If valuable or invaluable articles such as fabrics, coins, artifacts, structures or other geographic or archaeological rare discovered, the excavation should be stopped and archaeology department to be contacted • Archaeologist will supervise the excavation to avoid any damage to the relics
Roadside landscape development	<ul style="list-style-type: none"> • The positive impact will be on bio aesthetics and beauty • Landscaping and beautification of ponds, and access roads will improve aesthetic considerations 	<ul style="list-style-type: none"> • Avenue plantation of foliage shade trees mixed with flowering trees, should and scented plants as per detailed designs • The treatment at ponds as the sites for rests for tourists at specified chainage be developed
Roadside amenities	<ul style="list-style-type: none"> • People will be largely benefited by the comfort and use, provided by these amenities 	<ul style="list-style-type: none"> • Restoration and improvement of bus shelters, bus bays and truck stoppage sites as per detailed design • Road furniture including footpaths, railing, traffic signs, speed zone signs etc. shall be erected as per design
Cultural properties	<ul style="list-style-type: none"> • The enhancement of cultural properties will bring harmony, goodwill and coherence 	<ul style="list-style-type: none"> • Enhancement of all cultural properties and access road shall be completed as per design

Environmental Issue/Component	Impact Description	Remedial Measure
	amongst communities	
Contamination from spills due to traffic and accidents	<ul style="list-style-type: none"> The chances of accidents are likely to be reduced with improved width and quality of the road. The contamination of soil and water due to spills will be minor 	<ul style="list-style-type: none"> Cleaning of the spills at the accidental site by a workforce provided by state PWD The left over spill may be scrapped to a small nearby pit with ROW
Dust generation	<ul style="list-style-type: none"> Though dust is a common feature of tropical climate, yet the situation will improve by develop new vegetation 	<ul style="list-style-type: none"> Roadside tree plantation to be restored and maintained New sites (for example, gram panchayat land etc) near the road to be discovered for afforestation
Air pollution	<ul style="list-style-type: none"> The degree of air pollution is likely to be on a lower scale with improvement in road surface and which maintenance 	<ul style="list-style-type: none"> Vehicular emissions of SPM, RSPM, CO, SO₂, NO_x to be checked Roadside tree plantation to be maintained Atmospheric pollution to be managed and monitored Public awareness programme to be launched
Water	<ul style="list-style-type: none"> Due to improved and elevated road, the water logging during monsoon will not take place Improved drainage on roadside will also better the water flow at of settlement sites 	<ul style="list-style-type: none"> The chainage system should be periodically cleared Public awareness programmes to be launched for maintaining clean drinking water
Flora and Fauna (key stone species)	<ul style="list-style-type: none"> The loss of trees, shrubs and herbs will not affect the keystone species and bio-diversity 	<ul style="list-style-type: none"> The replantation scheme, containing keystone species should be strictly implemented Improvement of density of vegetation by planting such species
Accidents involving hazardous materials	<ul style="list-style-type: none"> The chances of such accidents will minimum, yet not unavoidable 	<ul style="list-style-type: none"> The rules as defined in Environmental (Protection) Act, 1986 should be compiled

Environmental Issue/Component	Impact Description	Remedial Measure
		<ul style="list-style-type: none"> • For delivery of hazardous substances, three certificate issued by transportation department, namely permit license, driving license and guarding license are required • Vehicles delivering hazardous substances will be printed with unified signs <ul style="list-style-type: none"> • Public security, transportation and the fighting departments will designate a special route for these vehicles • The project hazardous substances will be administrated by highway management department registration system • In case of spillage, the report to relevant department is made and instructions followed

8.3 Cost of Environmental Protection Measures

Based upon the environmental issues identified & predicted impact on the environment, EMP cost is estimated to implement the key environmental measures and environmental management & monitoring plan. The cost for Implementation of Environmental Management Plan has been estimated Rs. 220.18 Lacs as details provided in Table-8.2 and Rs. 2.68 Lacs per year for implementation of Environmental Monitoring Plan during operation phase.

S. No.	Component	Items	Quantity	Total Cost (Rs.)
Construction Phase				
1	Tree Plantation	Avenue plantation (Single Row each side) 200 plants/km and their fencing and maintenance for 2 years	38	7600000.00
2	Rain Water Harvesting	Construction Two rainwater harvesting structures at every 5 km for 38 km (both side)	16	400000.00
3	Environmental Enhancement	Enhancement of roadside facilities, improvement of aesthetic qualities near hand pumps & ponds and enhancement of religious places, etc.	Lump sum	1000000.00
4	Air Pollution Control	Dust suppression at site (2 trips / day for 300 days/year for 2 years)	1200	1800000.00
5	Water Pollution Control	Oil Interceptors at vehicles parking areas	10	200000.00
6	Noise Pollution Control	Construction of noise barriers at sensitive receptors (length 460 m. @ Rs. 8000/- per running meter)	460	3680000.00
7		Ear Muff and plugs for laborers	200	100000.00
8		Appropriate signage to inform road users of "NO HORN ZONE"	Lump sum	200000.00
9	Soil Pollution	Preservation of top soil & reuse	Lump sum	100000.00

S. No.	Component	Items	Quantity	Total Cost (Rs.)
Construction Phase				
	Control			
10	Solid waste management	Demolition wastes and bituminous scrap disposal & transportation	Lump sum	500000.00
11	Erosion & Landslide Control	Slop Stabilization Measures, Drains, River Protection, Breast Walls for Slop Stabilization for Slop Stabilization in high embankment and Ghat Section, Slip Treatment, etc	In Civil Cost	-
12	Drainage	Constriction of new culverts and strengthening of existing culverts	In Civil Cost	-
13	Flora	Ornamental Plantation at intersections & near religious properties		1000000.00
14	Wildlife	Crossing locations for wildlife (included in construction cost)	-	-
15		Signage for Wildlife/ Forest	-	100000.00
16	Safety Measures	Demarcating borrow areas clearly, using fencing if needed.	Lump sum	500000.00
17		Provision of Hoarding /Posters and health checks at construction camps	Lump sum	500000.00
18		Provision for helmet, gumboots, jackets, goggles etc. for labours	200	200000.00
19	Safety of Locals	Construction of service roads, underpasses and flyovers	In Civil Cost	-
20	Construction Camps	Sanitary Facilities & their maintenance	Lump sum	500000.00
21	Environmental	Training, workshops, awareness	Lump sum	1000000.00

S. No.	Component	Items	Quantity	Total Cost (Rs.)
Construction Phase				
	Awareness	campaigning etc.		
22	Environmental Monitoring	Monitoring of air, water, soil, noise, ecology and function of environmental management cell	As per environmental monitoring plan	636000
Total				20,016,000.00
Contingency (10%)				2,001,600.00
Total Budget for Implementation of Environmental Management Plan (Rs.)				22,017,600.00
Operation Phase				
Total Cost for implementation of Environmental Monitoring Plan (as per chapter-6) during operation phase per Year (Rs.)				2,68,400

Table-8.2: Budget for Implementation of Environmental Management Plan

9. CONCLUSION AND RECOMMENDATIONS

As per the ground water quality analysis of the project region pH and TDS values of the ground water samples ranges from 8.01-8.14 and 224.8-442.5 mg/l, respectively and almost meet the drinking water standards. Surface water bodies along the project road have pH and TDS values in the range of 7.59-7.77 and 201.2-390 mg/l respectively. The COD and BOD values these surface water bodies lies within the range of 6-8 mg/l and 3.1-3.8 mg/l respectively. The water quality of the study area is good and meets the IS: 10500 drinking water standards.

The values of SO₂, NO₂, & RSPM are below the limits. Noise values at the certain locations are found close to permissible limits but do not exceed it. Hence proper mitigation should be taken during the construction phase to keep the noise values under the permissible limits. There is no contamination with respect to soil, but there are many chances of occurrence of contamination during construction. Traffic congestion is a major problem along the highways. Pavement condition was very vulnerable proper drainage is required, at many places. During the survey, various pot holes and cracking were found on the selected stretch. From the analysis of traffic data it can be concluded that present two lane highway is insufficient to handle the current traffic volume From the public consultation it can be concluded that highway condition is not too much good. For reducing the impacts as described above proper mitigation measures are taken. Some impacts are of short duration it can be reduced by appropriate mitigation measures. Operation phase are also less magnitude can be prevent from mitigation measures. On the basis of existing data evaluation and analysis of the potential impacts, total impacts have been calculated by the matrix method.

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