Initial Environmental Examination

June 2018

NEP: SASEC Highway Improvement Project

Kanchanpur - Kamala Road

Prepared by the Department of Roads, Ministry of Physical Infrastructure and Transport, Government of Nepal for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 23 May 2018)

Currency Unit		Nepalese Rupee (NRs)
$1.00	=	Rs 107.438
Rs 1.00		$0.00914

ABBREVIATIONS

AADT	-	Average Annual Daily Traffic
AC	-	Asphalt Concrete
ADB	-	Asian Development Bank
ADT	-	Average Daily Traffic
AP	--	Affected People
BOD	-	Biological Oxygen Demand
CBOs	-	Community Based Organization
CBS	-	Central Bureau of Statistics
CFUG	-	Community Forest User Group
CITES	-	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	-	carbon monoxide
COI	-	Corridor of Impact
DBH	-	Diameter at Breast Height
DBST	-	Double Bituminous Surface Treatment
DCC	-	District Coordination Committee
DG	-	Diesel Generating
DoHM	-	Department of Hydrology and Meteorology
DIU	-	District Implementation Unit
DNPWC	-	Department of National Parks and Wildlife Conservation
DOA	-	Department of Archaeology
DOF	--	Department of Forest
DoR		Department of Roads
DSC	-	Design and Supervision Consultant
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EMG	-	Environmental Management Guidelines
EMP	-	Environmental Management Plan
EPR	-	Environment Protection Rules
ES	-	Environmental Specialist
EWH	-	East West Highway
FIDIC	-	Federation Internationale des Ingenieurs Conseils
FS	-	Feasibility Study
GESU	-	Geo-Environment and Social Unit
GHG	-	Green House Gas
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
IUCN	-	International Union for Conservation of Nature
LPG	-	Liquefied Petroleum Gas
MoFE	-	Ministry of Forest and Environment
MoSTE	-	Ministry of Science, Technology and Environment
MoPIT	-	Ministry of Physical Infrastructure and Transport
NAAQS	-	Nepal Ambient Air Quality Standard

NEP	-	Nepal
NGO	-	Non-Governmental Organization
NOx	-	Nitrogen Oxide
ODS	-	Ozone Depleting Substances
PD	-	Project Directorate
PPE	-	Personal Protective Equipment
PIP	-	Priority Investment Plan
PIU	-	Project Implementation Unit
REA	-	Rapid Environmental Assessment
RoW	-	Right of Way
RSSDU	-	Road Sector Skills Development Unit
SASEC	-	South Asia Subregional Economic Cooperation
SC	-	Supervision Consultant
SDC	-	Social Development Consultant
SEA	-	Strategic Environmental Assessment
SSEMP	-	Site Specific Environmental Management Plan
SRN	-	Strategic Road Network
TA	-	Technical Assistance
TMO	-	Transport Management Office
TPPF	-	Transport Project Preparation Facility – ADB
VDC	-	Village Development Committee
ZOI	-	Zone of Influence

WEIGHTS AND MEASURES

dBA	-	decibels A
KWH	-	Kilowatt-Hour
K VA	-	Kilo-Volt- Ampere
MLD	-	Millions of Litres Per Day
ppb	-	Parts Per Billion
pph	-	Persons Per Hectare
ppm	-	Parts Per Million

Notes: The Nepalese calendar year (B.S) runs from mid-April to mid-April. Unless otherwise stated, year ranges written in the form 2015/16 denote a single calendar year.

The fiscal year (FY) of the Government ends on 15 July. FY before a calendar year denotes the year in which the fiscal year ends (For example, FY 2018 begins on 16 July 2017 and ends on 15 July 2018).

Acts and Regulations are cited under the name of the ministry from which they originate. The official version of Acts and Regulations is published in the Nepal Gazette (in Nepali). Some Acts and Regulations are published by other Government agencies in English (Unofficial translations).

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

1. This Initial Environmental Examination (IEE) has been prepared for the construction and upgrading of 87-km Kanchanpur – Kamala section of East-West Highway (EWH) from two lanes to four lanes. Construction of the highway includes the construction of 54 bridges and approach roads, 18 of which are considered major[1] bridges.

2. The upgrading of Kanchanpur-Kamala section of EWH and bridges aim to provide ease of access by eliminating traffic congestion and reduction of roadway accidents. Nepal is connected by two Asian Highways: Asian Highway 2 (AH 2) and Asian Highway 42 (AH 42). These Asian Highways are part of the Strategic Road Network. The total length of these two sectors within Nepal is 1324 km. AH 2 originates from Dhaka in Bangladesh and ends in New Delhi in India. AH 2 connects the eastern portion of Nepal at Kakarvitta and passes through Itahari, Dhalkebar, Pathlaiya, Hetauda, Nayanghat, Butwal, Kohalpur, Attaria and Mahendranagar. AH 2 covers a length of 1027 km within Nepal. The portion of AH 2 in Nepal is known as Mahendra Raj Marga (East-West Highway).

3. Out of 54 bridges in Kanchanpur – Kamala section, 18 are considered major. As per GoN Environment Protection Act (EPA 1997) and Environment Protection Rules (EPR '97) 3, schedule 1 (D), (4), the construction of major bridges requires an IEE. These bridges are located in Kanchanrup municipality, Krisna sawaran rural municipality, Rupani Rural municipality, Khadak municipality, Sambhunath municipality, Surunga municipality of Saptari district and Lahan municipality, Dhangadimai municipality, Golbazaar municipality, Mirchaiya municipality and Karjanha municipality of Siraha district.

4. The preparation of this IEE is based on ADB's Safeguards Policy Statement 2009. SPS aims to avoid, minimize, or mitigate harmful environment and social impacts and help the borrower strengthen thein safeguard system. It also provides a platform for participation by affected community in project design and implementation. Both roads and bridges proposed to be constructed and upgraded were screened and categorized using Rapid Environmental Assessment (REA) checklists. The checklists consist of questions related to (i) the sensitivity and vulnerability of environmental resources in the project area, and (ii) the potential for the sub-project to cause significant adverse environmental impacts. This project has been classified as Category "B".

5. The project area lies in eastern Terai region of Nepal. Geologically, the project area lies on the alluvial and colluvial deposits. Land use pattern of the project area includes mostly settlements and agricultural lands. The project area starts from Kanchanpur (Ch. 00+000) in Kanchanrup municipality in Saptari District at an elevation of 108.930 m amsl ends at Kamala Bridge (Ch. 86+823) in Karjanha municipality at an elevation of 113.00 m amsl in Siraha District. Land use pattern of the project area includes mostly settlements and agricultural lands. Major plant species observed in the project area are Khayar (*Acacia catechu*), Sissau (*Dalbergia sissoo*), Masala (*Eucalyptus sp.*), Bar (*Ficus bengalensis*), Pipal (*Ficus religiosa*), Simal (*Bombax ceiba*), Teak (*Tectona grandis*), Jamun (*Syzegium cumini*) etc. Other species include mango (*Mangifera indica*), bamboo (*Bambusa vulgaris*) etc. Wildlife species reported in the project area include Jackal (*Canis aureus*), Mongoose (*Herpestes auropunctatus*), Monkey (*Macacca mulatta*), Dumsi (*Hystrix indica*), Lokharke (*Funambulus sp.*). Bird species found in the project area include Crow (*Corvus splendus*), Koili (*Cuculus micropterus*), Dhukur (*Streptopelia spp.*), Bhangera (*Passer domesticus*), Pigeon (*Columba livia*) etc. The project area is free from any of

[1] Length > 50 m and span > 25 m

the community forest and other forest type of national significance and does not fall under any protected or buffer zone area.

6. For the bridges, the project area starts from Bhedhawa River (Ch. 232+440) in Karjanha Rural municipality (Old Badaharmal VDC) at an elevation of 113.00 m amsl in Siraha District and ends at Sundari – 1 Bridge (Ch. 147+430) in Kanchanrup municipality in Saptari District at an elevation of 113.750 m amsl.

7. The proposed project area passes through nine (9) municipalities and three (3) rural municipalities, namely Kanchanrup, Khadak, Surunga, Shambhunath municipalities and Agnisair Krishnasawaran, Rupani rural municipality in Saptari district and Lahan, Dhangadimai, Golbazar, Naraha rural municipality, Mirchaiya and Karjanha municipality of Siraha district. The concerned municipality and rural municipalities are referred as indirect area of impact and direct impact area are the area occupied by the construction of the project road (i.e. 25 m on either side from centreline, which is also called corridor of impact (COI)). The highway is an already existing national highway where COI is already acquired by GoN. Most of the project area lies in settlements and agriculture land. The upgrading of road and bridges passes through various settlement areas and agricultural land. Total population of project affected municipalities and rural municipalities are 524,142 in 100,225 households with average household size of 5.23. Caste and ethnic groups include the Chaudhary (Tharu), Yadav, Bahun (Brahmin), Magar, Rajput and Muslims. The principal languages are Maithili and Nepali. The major occupation of the households is agriculture, trade and business, private or government service sector, foreign employment etc.

8. Potential adverse impacts due to the proposed project implementation are temporary disruption of public utilities and existing services as electrical poles/line, telephone poles/line, water supply pipelines, existing bus bays, existing cross-drainage structures including canal crossings. The significant impacts during construction stage are temporary disruption of public utilities and existing services as electrical poles/line, telephone poles/line, water supply pipeline etc. These services include: transformer (34), power supplying lines (526 electric poles, 240 lamp posts etc.); 179 telephone poles and water supplying lines and public tubewell (5), and 2 irrigation canal crossing by the road side, drainage structures (cross, side etc.).

9. Laborers and local people will also be prone to adverse health effects and accidents related to construction activities. About 5,627 number of roadside trees along the road alignment will be required to be cleared. Water pollution could result from waste disposal and spoil deposits if not properly managed. The road construction will provoke accident risks if the road safety and safe diversion is not managed for smooth flow of traffic. Air pollution due to dust particles and vehicle emissions, pollution of water, poor sanitation, road and work site accidents, social conflicts and other pressures on the local communities are the possible impacts during construction. During the operation stage, soil erosion and scouring of embanked slopes/siltation on farm land due to monsoon rain could occur. Cross-drains may cause erosion of adjacent agricultural fields if not maintained properly. Labours and local people are prone to adverse health effects and accidents relating to construction activities. No religious structures will require relocation.

10. Construction of road and bridges will have multiple beneficial impacts. During the bridge construction, people will get employment as laborers (approximately 90,000 skilled and 360,000 unskilled person-days). The project will give priority to the poor, ethnic minorities and disadvantaged local people for employment opportunity. Other beneficial impacts include enhancement of local business, development in skills of local people from involvement in the construction activities of the project.

11. During operation stage, an improved road and bridge access will bring an improvement of food security situation and overall economic and social stability. The improved road will also improve accessibility to health and education sectors and provide cheap, safe and fast transport of goods and services from rural areas to urban centers and vice versa. Farmers will also have the capacity to increase agricultural production because of markets' accessibility. This will contribute significantly to increase the productivity in rural areas and eventually improve the overall socio-economic condition of the people.

12. Once this road and bridge is on operation, trade and business activities will be further increased. There is a possibility of increased economic opportunities and significant growth and extension of the local markets along the road alignment. In addition, construction of road and bridge will lead to appreciation of land values particularly near the market and settlement areas.

13. Rehabilitation, extension and construction of adequate drainage and cross-drainage structures are provisioned in the design to avoid alteration of surface water hydrology by maintaining flow and course of stream and irrigation crossings. The mitigation measures such as bio-engineering (seed sowing) for stabilization of embanked slopes and restoration of visual environment, road safety and occupational safety and hazards mitigation will be included in the technical detailed design. Mitigation measures for health and sanitation, pollution control and social and economic impacts are recommended and will be implemented during the project implementation. Strict rules and regulation in the labor and work camp is being provisioned so that any engagement in alcoholic and other bad habits are restricted. Adequate traffic signs and markings, delineators, proper passing bays at bus stops/bus bays, proper junction layout, appropriate entry and exit at access roads and approach to petrol pumps to minimize traffic conflict have been cautiously provisioned in the design for safety of vehicular traffic during operation stage.

14. A number of benefit augmentation measures and adverse impact mitigation measures have been proposed to offset the environmental impacts. Adequate compensation will be provided to affected households for all the lands and properties that need to be acquired temporarily or permanently. Affected families will be given high priority for employment and skill development trainings. Due attention will be given to reduce the adverse impacts that might arise from site clearance, cutting of slopes, disposal of spoils and quarrying activities. Necessary trainings and awareness programs will be conducted. At construction site, the workers will be provided insurance, first aid facilities and safety equipment.

15. Loss of trees will be compensated by planting of about 140,675 trees to replace the 5,627 trees that need to be cut down during construction. Adequate road and bridge safety measures will be provided to minimize road accident.

16. Proper maintenance and proper drainage system will be provided to prevent accumulation of water on the nearby agricultural lands during road operation. Adequate road safety measures will be provided to minimize road accident. A separate Due diligence Resettlement Report has been prepared to address land and property acquisition as well as compensation issues. Based on the report, an estimated amount of NRs.100,000.00 has been allocated for property acquisition. The project proponent will ensure the implementation of mitigation measures during the construction and operation phases.

17. Most of the cost for mitigation measures is included in the in-built design and estimate. However, some of the mitigation costs not included in the project design and construction contract are estimated separately for inclusion in the Civil Works contract. Such costs include the costs for

vegetation and plantation of trees, and reinstatement of public utilities/services etc. and cost for monitoring of air, water and noise during construction and operation stage etc.

18. Suitable measures for the prevention of environmental impacts are recommended in the document. This includes the use of engineering and biological techniques for the mitigation of landslide and associated disasters linked with slope excavation, quarry operation, and spoil management. Similarly, there is a provision for occupational health and safety measures, reduction in air, water and noise pollution, provisioning adequate lighting and signpost to reduce the accidental risk and addresses the impacts resulting from the operation of quarry site and river bed extraction, labor camp etc in the IEE report.

19. The report has proposed for the reconstruction/relocation of 29 electric poles, 1 transformer, 7 telephone poles, 1 tube well and 2 water supply pipelines in appropriate nearby place. Furthermore, the document also has the provision for tree plantation. Altogether, 140,675 saplings of local trees have been proposed for the plantation to replace the 5,627 trees to be cut down. Other mitigation measures include to restrict the extraction of fuel wood from the nearest forest for project use, fishing, and hunting of wildlife, this report recommends the formulation of strict code of conduct. In order to avoid accidental risks around the construction site, this report recommends the installation of sign boards and lighting system.

20. In this way the report includes all possible measures for the enhancement of positive impacts and mitigation of adverse impacts. There is a separate chapter called Environmental Management Plan which guides for the implementation of mitigation measures and monitoring provision to execute the environmental and social safeguard measures. For the successful implementation of Environmental Management Plan, the total budget of NRs. 131,435,419.00 has been allocated.

21. Environmental management plan (EMP) in the IEE report has identified key issues likely to arise from project implementation, and has proposed mitigation measures, including responsibility. A separate Poverty and Social Assessment and Resettlement Studies Report have also been prepared by the Social Development Specialist and the Resettlement Specialist, respectively under the SRCP-PPC. However, the correlated issues such as safety of community and construction crews, safe passages for public, protection of common physical, cultural, religious, historical, archaeological and public utilities/facilities reinstatement are covered under the mitigation plan. Environmental monitoring is an essential component in the implementation of IEE recommendation. The Environmental Monitoring Plan (EMoP) has been prepared to monitor the implementation performance of the EMP.

22. Grievance redress mechanism will be established to resolve grievance from public or stakeholders concerning the project. This mechanism will be made effective by establishing mandatory grievance register book at the site Project office. The grievances in the register book will be assessed in the case of genuine grievance or acceptable suggestion. Accordingly, the response will be given by the concerned PROJECT OFFICE in consultation with supervision consultant or by DoR/Geo-environment and Social Unit (GESU) if the supervision consultants and contractor are unable to resolve the issue. The outcome will also be included in the quarterly report of ADB.

23. Most of the adverse impacts identified and predicted are of minimal scale, temporary, short term and reversible in nature associated with construction stage. The project will be implemented with strict adherence to the mitigation measures as prescribed in the Environmental Management Plan which will be a part of the Bidding Document.

24. The proposed road upgrading works do not exceed any of the prescribed thresholds by EPA, EPR and other relevant Acts and Regulations. Thus, IEE study of the project will be sufficient, and an EIA level study is not recommended.

25. This Initial Environmental Examination of the proposed approach road and 54 bridges, eighteen (18) of which are major, reveal that the benefits from the implementation of the proposed road and bridges are more significant and long term in nature against the adverse impacts most of which could be mitigated. Therefore, this IEE is sufficient for implementation of the proposed Project.

I. INTRODUCTION

A. Project Background

1. Nepal is connected by two Asian Highways which are Asian Highway 2 (AH-2) and Asian Highway 42 (AH-42). The Asian Highways are a part of the Strategic Road Networks. Total length of these two sectors within Nepal is 1324 km. AH-2 originates from Dhaka in Bangladesh and ends in New Delhi in India. It can be further linked with Asian Highway networks. AH-2 connects the eastern portion of Nepal at Kakarvitta and passes through Itahari, Dhalkebar, Pathlaiya, Hetauda, Narayanghat, Butwal, Kohalpur, Attaria and Mahendranagar. AH-2 covers a length of 1027 km within Nepal. The portion of AH 2 in Nepal is known as Mahendra Raj Marga (East West Highway). The government is preparing to upgrade the East-West Highway to four lanes from the existing two lanes to cater to the increased traffic movement. In the first phase, the Ministry of Physical Infrastructure and Transport (MoPIT) has targeted to upgrade sections between Narayanghat-Dhalkebar which is around 215 km. Increased traffic and narrow highways have emerged as a big problem affecting the smooth flow of vehicle for travel and trade.

2. The South Asia Subregional Economic Cooperation (SASEC) Highway Improvement Project (SHIP) proposed to be financed by the Asian Development Bank (ADB) will support the improvement of a section of the East–West Highway (EWH), which is the main domestic and international trade corridor of Nepal and forms part of SAARC and SASEC corridor 4 linking Kathmandu to Dhaka and Chittagong through India. The project will also improve the efficiency and adequacy of the transport system by addressing the deterioration of road asset conditions, the poor safety of the transport network, and the limited cross-border connectivity. The project has two outputs: 1) Rehabilitation and upgradation of about 87 km of road between Kanchanpur and Kamala on the EWH to a 4-lane standard with a design speed of 100 km/h. Civil works contracts will include a performance-based maintenance period of 5 years after completion of construction; and 2) Implementation of activities to improve the planning and management of road safety including capacity enhancement of the Department of Roads (DOR).

B. Project Objectives

3. The objective of the project is to improve connectivity through Kanchanpur to Kamala section of East West Highway as a part of 4-laning and to cater to increased traffic. Further, the upgrading of the road and 54 bridges, 18 of which are major, will increase the effectiveness of AH-2, which is currently under implementation. The AH-2 (EWH is a member road of AH-2) provides connectivity between India, Nepal and Bangladesh.

C. Purpose of the IEE Study

4. The project is categorized as category **'B'** in accordance with ADB's Safeguard Policy Statement (SPS), 2009 warranting an initial environmental examination (IEE). IEE identifies the environmental issues to be considered at project planning and design stage. The IEE report covers the general environmental profile of the study area and includes an overview of the potential environmental impacts and their magnitude on physical, ecological, economic, and social and cultural resources within the project's influence area during design, construction, and operation stages. An Environmental Management Plan (EMP) is also proposed as part of this report which includes mitigation measures for significant environmental impacts during implementation of the project, environmental monitoring program, and the responsible entities for mitigation and monitoring. IEE has four basic objectives; (i) identify the environmental issues that should be taken into account due to project interventions (ii) determine the magnitude of potential

environmental concerns and to ensure that environmental considerations are given adequate weight at planning/design stage (iii) identify need for further environmental studies or Environmental Impact Assessment (EIA) and (iv) suggest enhancement measures, if any.

5. As per EPR 1997, construction of major bridges requires Initial Environmental Examination and its subsequent approval from its concerned ministry (Clause 4 of Road Sector, Schedule-1 Pertaining to Rule-3 of EPR). Nepal Bridge Standard 2010 classifies a bridge as a major bridge when its span is more than 25 m long or the total length of the bridge is more than 50 m. The project area does not fall under any national park, conservation area or wildlife reserve areas and does not require clearance of any forest area. Hence, the proposed construction work requires lEE. This IEE covers both the upgrading and construction of road and bridges within the 87-km Kanchanpur – Kamala road.

D. Extent of IEE Study

6. This IEE covers the proposed road, bridges and approaches construction, including ancillary facilities like camp, quarry, material storage, and plant operations. This report has been prepared based on the information and data available through the engineering design studies, including socio-economic and resettlement studies; and field visits, public consultations and discussions, collection of primary and secondary information and data. The study has established a core zone of impact for 100 meters on either side of the alignment for direct area of influence and 10 km on either side for the indirect area of influence.

- Consultations with Department of Roads (Government of Nepal), Forest Department of Government of Nepal, and concerned local government bodies
- Review of ADB, Government of Nepal policies including legal requirements
- Project site visits and consultations with affected people and stakeholders
- Collection of primary and secondary baseline data for the IEE report
- Review of relevant documents for secondary information and data collection
- Preparation of IEE Draft Report and submit to ADB and DoR GoN, for comments and feedback
- Preparation of Final IEE Report incorporating ADB and DoR GoN, comments and feedbacks

E. IEE Report Content

7. The IEE has been prepared based on the requirements of the Environment Protection Act (EPA), 1996 and Environment Protection Rules (EPR), 1997 of the Government of Nepal (GoN), and the ADB Safeguard Policy Statement (SPS), 2009. The content covers the following nine chapters:

Chapter – 1: Introduction
Chapter – 2: Policy, Legal and Administrative Framework
Chapter – 3: Description of the Project
Chapter – 4: Description of Environment
Chapter – 5: Anticipated Environmental Impacts and Mitigation Measures
Chapter – 6: Project Alternatives
Chapter - 7: Public Consultation and Information Disclosure
Chapter – 8: Environmental Management Plan
Chapter – 9: Grievance Redress Mechanism
Chapter – 10: Conclusion and Recommendation

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

8. This chapter presents a review of the international agreements and commitments, existing institutions and legislations relevant to the project in Nepal and at the National and State levels in India. The environmental assessment processes are based on environmental regulations and guidelines of Government of Nepal and ADB SPS 2009 requirements.

A. International Agreements and Commitments of Government of Nepal

9. Nepal is party to various international agreements / conventions / treaties for conservation of environment at global level. Important agreements and commitments have been briefly described and analyzed vis-a-vis the project development**.**

10. **Ramsar Convention on Wetlands, 1971:** The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty, which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The convention entered into force in Nepal on 17 April 1988. Nepal currently has 10 sites designated as Wetlands of International Importance (Ramsar sites). Out of 10 designated wetlands of International Importance in Nepal, none of them is located in project influence area.

11. **Convention on Protection of the World Cultural and Natural Heritage, 1972:** The United Nations Educational, Scientific and Cultural Organization (UNESCO), which seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity has embodied these objectives in an international treaty called the Convention concerning the Protection of the World Cultural and Natural Heritage in 1972. In Nepal, there are 2 cultural and 2 natural mixed sites. None of them is located in project influence area.

12. **Vienna Convention for Protection of the Ozone layer, 1985 and Montreal Protocol on Substances Depleting the Ozone layer, 1987:** The Vienna Convention outlines state's responsibilities for protecting human health and the environment against the adverse effects of ozone depletion and established the framework under which the Montreal Protocol was negotiated. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform) are to be phased out by 2010. The project does not envisage production and consumption of ozone depleting substances (ODS).

13. **United Nations Framework Convention on Climate Change (UNFCC), 1994:** As per the convention the reduction/limitation requirements of greenhouse gases (GHG) apply only to developed countries. The only reporting obligation for developing countries relates to the construction of a GHG inventory (GHG sources and sinks, potential vulnerability to climate change, adaptation measures and other steps being taken to address climate change). Nepal ratified the protocol on September 16, 2005 and became the signatory of the protocol on 14 December, 2005. Nepal is categorized as non-annex countries. Hence the country is not obliged to set a reduction target like the Annex I countries and it can only participate in the Clean Development Mechanism (CDM) of the protocol. However, Nepal can raise its voice to receive resources for adaptation and mitigation through the Conference of Parties, as individual country or via group of countries.

14. **Convention on Biological Diversity (CBD) 1992:** The Convention on Biological Diversity (CBD) is dedicated to promoting sustainable development and came into force in 1992 Rio Earth Summit. India signed the CBD in 1994. Member Parties have committed themselves to achieve by 2010, a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth.

15. **The Convention on International Trade in Endangered Species of Wild Fauna and Flora, (CITES), 1973:** Nepal became a party to CITES in 1975. CITES has facilitated international cooperation to regulate international trade in endangered wild flora and fauna with the aim of reducing or eliminating trade in species whose numbers or conditions suggest that further removal from their natural habitat would lead to their extinction. The National Parks and Wildlife Conservation (NPWC) Act, 1973 regulates the trade of species listed in CITES appendices. The Government has designated the Natural History Museum (Tribhuvan University) and the Department of Plant Resources as the scientific authorities for wild fauna and wild flora respectively. Similarly, the Government has designated the Department of National Parks and Wildlife Conservation and the Department of Forest as the management authorities for wild fauna and flora respectively. The Convention urges Parties not to allow trade in specimens of species included in the CITES Appendices I, II and III except in accordance with the provisions of the Convention.

A. Nepal's Legal Framework and Regulatory Requirements for the Project

16. In Nepal, various legal instruments are in place to ease the integration of environmental aspects in development proposals. Nepal's legal provisions and guidelines relevant to the road and bridges project include:

1. Plan and Policies

17. **Constitution of Nepal.** Article 25 (2) has mentioned that the state shall acquire legal private property only for public interest, and Article 25 (3) has mentioned that compensation shall be provided for such acquired property on the basis of compensation as prescribed by law. Article 30 (1) has mentioned that every citizen has the right to live in a clean and healthy environment. Under state policy, Article 51 (f) clause (2) has mentioned that state is to develop balanced, environment friendly, quality and sustainable physical infrastructures, while providing priority to the regions lagging behind from development perspective, and clause (3) mentions that state is to enhance local public participation in the process of development works. Article 51 (g) explains about applying appropriate minimization or mitigation measures for negative impact on nature, environment or biodiversity.

18. **Fourteenth Plan (2073/74–2075/76 BS), 2017 AD.** The Fourteenth Plan (2016/17-2018/19) has identified EIA as a priority area, and it emphasizes on environmental monitoring of projects that are covered by the GoN EIA process. The Plan focuses on the need for setting-up national environmental standards with the strategy of internalizing environmental management into the development programmes. The Plan has also realized to carry out Strategic Environmental Assessment (SEA) with the long-term policy of promoting environmental governance. The Plan emphasized on the local participation in environment conservation, according to the Local Self Governance Act 2055, through the local bodies and making them responsible and capable to manage local natural resources.

19. The objective of Nepal's Three-Year Plan (FY2014–FY2016) is to achieve sustainable, broad-based, inclusive economic growth. It has five priority areas. The plan aims to develop energy, transport, and urban services infrastructure as a means to underpin growth and inclusion. The plan aims to expand the strategic and rural road networks and air transport capacity to increase connectivity, provide greater access to basic services and markets, and promote tourism and trade. The plan addresses climate change adaptation and mitigation and overall environmental protection.

20. The environmental strategies of the Interim Plan are to launch development programs by internalizing environmental management; mobilize non-government private sector, local agencies and the public in increasing public awareness on environment; determine and implement additional bylaws on air, water, soil and sound pollution; and make action plans that prioritize and implement Treaties and Conventions on environment, which Nepal has endorsed.

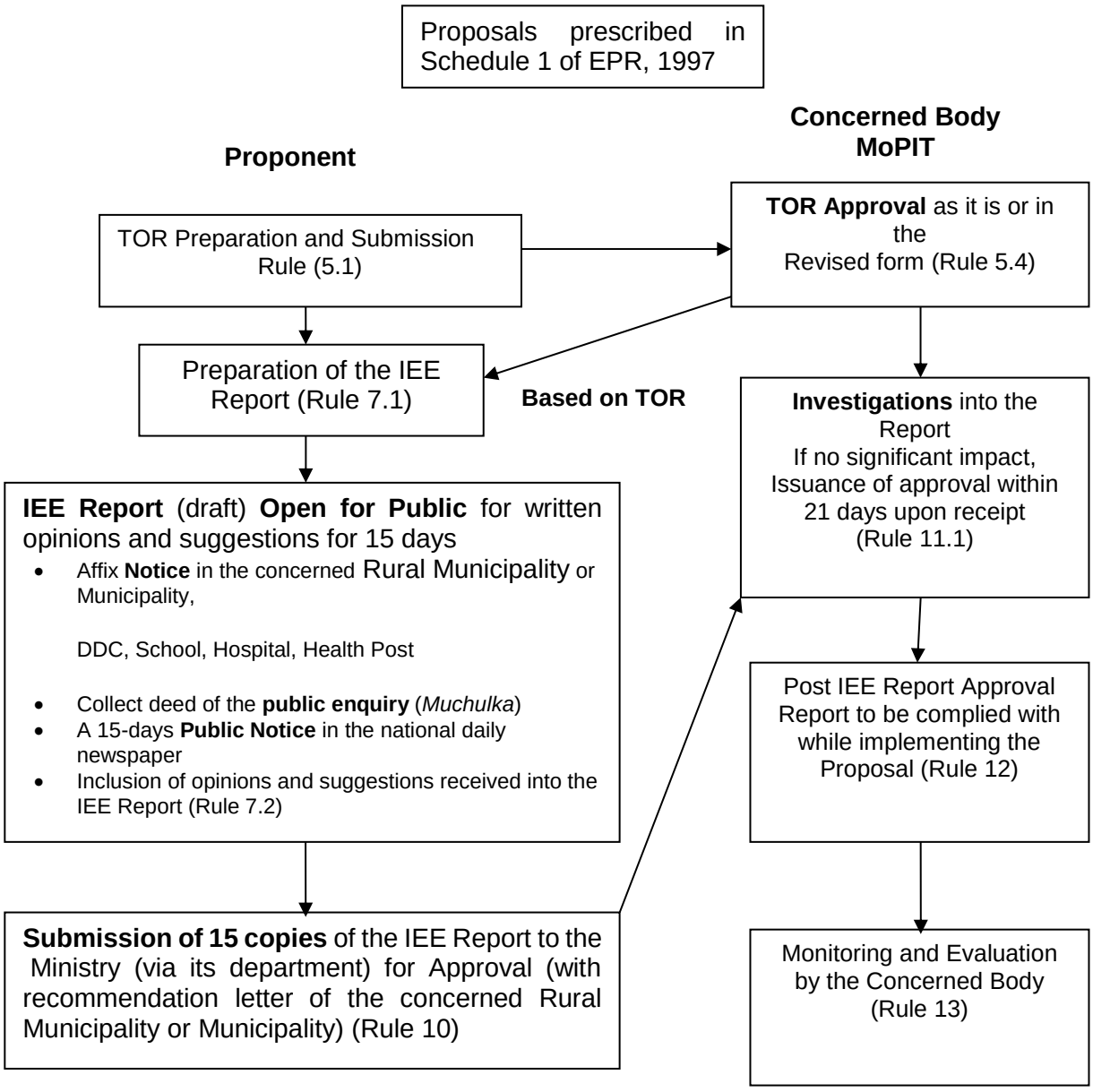
2. Acts and Rules

21. **Environment Protection Act, 1997.** The Environment Protection Act, 1997 contains several provisions to institutionalize the integration of environmental aspects in development projects including road sector, and empowers Ministry of Environment approve EIA report. Similarly, in case of IEE level study, line Ministry, which is Ministry of Physical Infrastructure and Transport is authorized to approve the Final IEE Report. The following are the highlights of the EPA, 1997.

22. The Act recognizes the interdependence between development and the environment and shows the concerns for minimizing the impacts of environmental degradation on people, animal, and plant species and their physical surroundings. The Act obliges the proponent to undertake IEE and EIA of proposal, plans or projects which may cause changes in existing environmental condition and authorizes Ministry of Environment to clear all EIA and line Ministry for IEE study.

23. Empowers Ministry of Population and Environment to prohibit the use of any matter, fuel, equipment or plant, which has adverse effects on the environment. The Act has provisions for polluters to compensate affected persons from polluting activities and empowers government to provide additional incentives to any industry, occupation, technology or process, which has positive impacts on environmental conservation. It provisions to establish an Environmental Protection Fund to be used for environmental protection, pollution control and heritage conservation, and it gives the government authority to declare specific area as environmentally protected areas.

Figure 1: Environmental Clearance Procedure in Nepal



24. **Environment Protection Rules, 1997 (with amendments).** In the process of implementing EPA (1997) effectively the Environment Protection Rule (EPR) came into force in 1997 and was amended in 1999. The EPR contains elaborate provisions for the process to be followed during the preparation and approval of projects requiring EIAs and IEEs including scoping documents, terms of reference, public consultations and hearings, and environmental monitoring and auditing. The environmental legislation empowers the concerned Ministry to monitor the environmental activities including mitigation measures and Ministry of Environment for environmental auditing. For IEE, the concerned Ministry, which is the Ministry of Physical Infrastructure and Transport in case of the road projects, is authorized to approve the Final IEE

Report. The EPR also lists the types of development activities requiring IEE or EIA level Study. It also gives an outline of content of the terms of reference document, IEE and EIA report.

25. **Public Roads Act, 1974.** The Department of Roads may temporarily acquire the land and other property adopting compensatory measures during the construction, rehabilitation and maintenance of the public roads according to the Act (Article 14 &15). The Act also empowers the DoR to operate quarries, borrow pits and other facilities during the road construction (Article 17). In sum, the Act facilitates the acquisition of land and property for the extraction of construction materials and development of other facilities as well as to maintain greenery along the roadside with adoption of compensatory measures.

26. **Forest Act, 1993 (with amendments).** The Forest Act, 1993 recognizes the importance of forests in maintaining a healthy environment. The Act requires decision makers to take account of all forest values, including environment services and biodiversity, not just production of timber and other commodities. The basis of Act is resource oriented rather than use oriented.

27. The Forest Act, 1993, (with amendment) contains several provisions to ensure the development, conservation, management and sustainable use of forest resources, based on approved work plan. The work plan should contain a list of activities that should be implemented in the different forest categories - national forests, community forests, leasehold forests, private forests, and religious forests. Section 23 of the Act empowers the government to delineate any part of the national forest, which has 'special environmental, scientific or cultural importance', as a protected forest. Section 49 of the Act prohibits reclaiming lands, setting fires, grazing cattle, removing and damaging forest products, felling trees of plants, wildlife hunting and extracting boulders sand and soil from the National forest without the prior approval. However, the government may enforce Section 68 of the Forest Act to provide parts of any type of forest for the implementation of a national priority plan with the assurance that it does not adversely affect the environment significantly. As provisioned under the Act, while clearing the forest on the RoW of road, the implementing authority will co-ordinate with the District Forest Office. If necessary, the compensatory re-plantation will also be carried out at the rate of 1:25 under the provision of the Act.

28. **Forest Rule, 1995.** The Forest Rules 1995 (with amendment) further elaborate legal measures for the conservation of forests and wildlife. Based on forest legislation, thirteen plant species are included in the level protection list. Of them, GoN has banned the felling, transportation and export of Champ (*Michelia champaca*), Khayer (*Acacia catechu*) and Sal (*Shorea robusta*). The Rule also stipulates that the entire expenses for cutting and transporting the forest products in a forest area to be used by the approved project shall be borne by the proponents of the project.

29. **Forest Products Collection and Sales Distribution Guidelines, 2001.** Clause 3 to 10 of the Guideline have specified various procedure and formats for getting approvals for vegetation clearance, delineation of lands for vegetation clearance, evaluation of the wood volume etc. and government offices and officials responsible for the approval, delineation and valuation.

30. **Local Government Operation Act, 2017.** The Local Government Operation Act describes the criteria to divide a state into municipalities or rural municipalities and respective rights, duties and responsibilities in various development and conservation sectors. It clarifies the rights of municipalities/rural municipalities to form local laws, regulations and criteria for conservation of environment protected areas and species; for environmental pollution and hazard control; solid waste management etc.

31. **Land Acquisition Act, 1977.** The Land Acquisition Act (1977, as amended 1993) guides the compulsory acquisition of land. GoN can acquire land at any place and in any quantity by giving compensation pursuant to the Act for the land acquired for any public purpose(s) or for operation of any development project initiated by GoN institutions.

32. **Child Labour Prohibition and Regulation Act 2001.** Section 3 of the act prohibits a child from engaging in work, sub clause 1 of the clause 3 states “Nobody shall engage in work a child who has not completed fourteen years of age as a labour and sub clause 2 states “Nobody shall engage a child in a risk full occupation or work set forth in the Schedule”. The section 4 states “Child not to be engaged in work against his will by temptation or fear or pressure or by any other means”. Child labor will be strictly prohibited in the project work under SRCP.

33. **Soil and Watershed Conservation Act, 1982.** Soil and Watershed Conservation Act makes provision to control floods landslides (watershed conservation rules, 1985). The watershed conservation office is authority and district watershed conservation committee must implement watershed conservation practices and public participation for soil and land protection.

34. **Water Resources Act, 1992.** Water Resources Act (1992) makes provision for the rational use of surface and underground water. The act seeks to prevent environment and hazardous effects from the use of water and prohibit water pollution by chemicals, industries waste. Water may only be used in manner that does not permit soil erosion, landslide or flood. Pollution of drinking water is prohibited under the Nepal drinking water corporation act (1989).

35. **Aquatic Animal Protection Act, 1961 (with amendment).** This Act indicates an early recognition of the value of wetlands and aquatic animals. Section 3 renders punishment to any party introducing poisonous, noxious or explosive materials into a water source, or destroying any dam, bridge or water system with the intent of catching or killing aquatic life. Under Section 4 of the Act, Government is empowered to prohibit catching, killing and harming of certain kinds of aquatic animals by notification in Nepal Gazette.

36. **Motor Vehicle and Transportation Management Act, 1993.** This act sets standard for vehicles emission and mechanical condition for vehicle registration by the Transport Management Office (TMO) and the TMO can deny a permit based on environmental factor. Standards are set for petrol and diesel engines under the Nepal vehicle mass emission standard 1999.

3. Guidelines for the Road Sector

37. Guidelines, including the draft EIA Guidelines for Road Sector, 1996, facilitate the proponents to prepare environmental assessment reports. These guidelines have been thoroughly reviewed and all pertinent issues have been incorporated during the preparation of this Report. The DoR Environmental Management Guidelines (EMG), 1997 provides guidance to the Proponent to integrate environmental mitigation measures, particularly on the management of quarries, borrow pits, stockpiling of materials and spoil disposal, earthworks and slope stabilization, location of stone crushing plants, etc. The Environmental Guidelines for Local Development also encourages the Proponent to incorporate environmental issues during project design and implementation.

38. Environmental Management Guidelines, GESU / DoR. Environmental Management Guidelines, GESU/DoR, July 1999 have been prepared as part of the program undertaken jointly by GoN and the World Bank under the Road Maintenance and Rehabilitation Project. These Guidelines are formally approved by Minister level decision on Kartik 22, 2053 BS (1997). The

Guidelines are the part of operational practices for all road maintenance, rehabilitation and construction activities under DoR. The guideline consists of environmental mitigation measures to be incorporated into DOR Subprojects, procedures for public participation, and socioeconomic considerations. The environmental mitigation measures are broken down into twelve categories including (i) quarries; (II) borrow pits; (iii) spoil and construction waste disposal; (iv) work camp location and operation; (v) labour camp location and operation (vi) earthwork/slope stabilization (vii) use of bitumen (viii) stockpiling of materials (ix) explosive, combustible and toxic materials management (x) setting up and operation of stone crushing plants (xi) water management (xii) air and water pollution.

39. Implementation methods for undertaking mitigation measures for each of the activities are also given in the guideline. The Guideline suggests methods for determining how and when the public should be included in the environmental analysis.

40. The guidelines also advise on socioeconomic impacts and strategies for reducing or avoiding the potential negative impacts and for maximizing the beneficial impacts to local residents. The socioeconomic impacts include important issues of land acquisition and compensation and other economic impacts with markets for agriculture production, agriculture inputs, nutrition, extraction of natural resources beyond replenishment, migration and influx of migrants, land speculation, illegal logging and mining, portering, etc. It also includes impacts on cultural heritage.

4. Other Guidelines and Manuals

41. The following guidelines were reviewed and applied during the preparation of the report.

(i) Reference Manual for Environmental and Social Aspects of Integrated Road Development; MPPWD/DoR.HMGN,2003
(ii) Environmental Management Guidelines for Roads and Bridges, GEU/DoR,1997
(iii) Public Work Directives, HMGN,2002
(iv) Guide to Road Slope Protection Works, DoR

B. ADB Safeguard Policy Statement, 2009

42. The Asian Development Bank has defined its environmental safeguard requirements under its "Safeguard Policy Statement, 2009" (SPS 2009). The SPS 2009 key requirements include screening for significant impacts and categorization, consultation, and disclosure. Proposed projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts.

43. Projects are classified into the following categories:

- **Category A**. The proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale environmental impact assessment (EIA), including an environmental management plan (EMP) is required
- **Category B**. The proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed

through mitigation measures. An initial environmental examination (IEE), including an EMP, is required.

- **Category C**. The proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
- **Category FI**. The proposed project involves the investment of ADB funds to, or through, a financial intermediary (see section L of this chapter for additional information on safeguard requirements for FI projects).

44. Project categorization has been done using REA checklist (Appendix A) following the guidance provided above and the project is categorized as B. As per SPS 2009, Category B projects warrants preparation of an IEE.

C. Permissions and Clearances Required for the Project

45. The legal framework of the country consists of several acts, notifications, rules, and regulations to protect environment and wildlife. List of required clearances / permissions related to environment has been summarized in **Table 1**.

Table 1: Permissions and Clearance Required

S.N.	Clearance	Act/Rule/Notification /Guideline	Concerned Agency	Responsibility
A. Pre-construction Stage				
1	Environmental Clearance (categorized as "B" with IEE requirement)	Environment Protection Act 1997 and Environment Protection Rules, 1997 (with amendments).	Ministry of Physical Infrastructure and Transport	Department of Roads / PD, DOR (ADB)
2	Land Acquisition and Compensation	Land Acquisition Act, 1977(with amendments)	Ministry of Physical Infrastructure and Transport	Department of Roads / PD, DOR (ADB)
3	Forestry clearance for felling of Trees	Forest Act, 1993 (with amendment), Forest Rule, 1995, Forest Products Collection and Sales Distribution Guidelines, 2001 and Local Self-Governance Act, 1999	Ministry of Forest and Environment, Department of Forest	Department of Roads / PD, DOR (ADB)
B. Implementation Stage				
4	Permission for construction material quarrying (stone, cobble, sand, gravel, soil etc)	Local Government Operation Act, 2017 and Soil and Watershed Conservation Act, 1982 and Watershed Conservation Rule, 1985. PA,1996 and EPR, 1997 (with amendments)	Concerned Project and concerned DCC and Municipality/ Rural Municipality	Contractor
5	Consent to operate Hot mix plant, Crushers, Batching Plant	Local Government Operation Act, 2017	Concerned Project and concerned DCC and Municipality/Rural Municipality	Contractor

S.N.	Clearance	Act/Rule/Notification /Guideline	Concerned Agency	Responsibility
6	Consent for disposal of sewage from labour camps	Water Resource Act, 1992	Concerned Project	Contractor
7	Pollution Under Control Certificate	Motor Vehicle and Transportation Management Act, 1993	Department of Transport Management	Contractor

III. DESCRIPTION OF THE PROJECT

A. Location of Project

46. The project area is located in Saptari and Siraha districts in Sagarmatha zone in eastern development region of Nepal. The project road section originates at Kanchanpur (Km 00+000), Saptari district from where the feeder road to Phattepur (now Saptakoshi municipality) starts and passes through various settlement areas, agricultural lands, rivers, canals and ends at the start of Kamala bridge (Km 87+000), Siraha district over Kamala river. The project road from Km 00+000 to Km 45+400 lies in the Saptari district and the remaining section of the road lies in the Siraha district. The salient features of the road project improvement are presented in **Table 1** while that of the approach road and bridges are shown in **Table 2.**

Table 2: Salient Features of the Road Project

Name of the Project	Upgrading of Kanchanpur-Kamala Road (87 Km), a section of Mahendra Highway
Province	2
District	Saptari and Siraha
Municipality/Rural Municipality	Kanchanrup municipality, Agmisair Krishna Sabaran rural municipality, Rupani rural municipality, Shambhunath municipality, Khadak municipality, Surunga municipality, Lahan municipality, Dhangadimai municipality, Golbazar municipality, Naraha rural municipality, Mirchaiya municipality, and Karjanha municipality
Start Point	Kanchanpur, Ch. Km (00+000), Kanchanrup Municipality, Saptari
End Point	Kamala Bridge, Ch. Km (87+000), Karjanha Municipality, Siraha
Elevation	Start Point, Elevation: 108.93 m End Point, Elevation: 113.00 m
Climate	Tropical
Total Length	86.823 Km
Road Standard	National Highway (H1) and Asian Highway AH2, Class II
Right of Way	50 m (25 m on either side from center line of the road)
Carriage way Width	14 m
Formation width	24 m, (Median – 3 m), {Shoulder – (2.5-3) m on both sides} - 4 lane; 43 m – 6 lane
Surface Type	Asphalt Concrete
Type of work	Upgrading
Traffic Volume (vpd)	10,093 for 2018

Source: Feasibility Report, Kanchanpur-Kamala Road, 2018

Table 3: Salient Features of the Approach Road and Bridges Project

Name of the Project	Approach Road and Bridges in Kamala to Koshi Section of East-West Highway
Affected Municipalities/Rural municipalities	Kanchanrup municipality, Krishnasawaran rural municipality, Rupani rural municipality, Sambhunath municipality, Khadak municipality, Lahan municipality of Saptari district, Surunga municipality, Golbazar municipality, Dhangadimai municipality, Mirchaiya municipality and Karjanha municipality of Siraha district.
Province	2
Districts	Saptari and Siraha
Total length covered, km	85
Start Point	Bhedhawa River (Ch. 232+440), Karjanha rural municipality, Siraha District
End Point	Sundari – 1 Bridge (Ch. 147+430), Kanchanrup municipality, Saptari District

GEOGRAPHICAL FEATURES	
Terrain	Plain/Terai
Altitude	**Start Point:** 113.00 m at Bhedhawa River (Ch. 232+440), Karjanha rural municipality, Siraha District **End Point:** 113.750 m, Sundari – 1 Bridge (Ch. 147+430), Kanchanrup municipality, Saptari District
Climate	Tropical

Figure 2: Project Location in Google Map

Table 4: Project Bridges Details

Particulars	Name of the Bridge (Ch. 147+430 – Ch. 169+350)					
	Sundari - 1	**Sundari**	**Baghuwa**	**Raikhola**	**Mahuli**	**Dudhela**
Name of the Road	East – West Highway, Koshi – Kamala Section					
Chainage/Bridge Identification Number	Km 147+430/ 15-H001-083	Km 153+990/15-H001-86	Km 157+160/15-H001-088	Km 158+390/ 15-H001-090	Km 160+720/15-H001-94	Km 169+350/ 15-H001-099
Geographical Location:						
Easting	$86^0$54'1.5" E	$86^0$53'06.9" E	$86^0$51'15.9" E	$86^0$50'30" E	$86^0$49'6.3" E	$86^0$44'12.8" E
Northing	$26^0$36'23.1" N	$26^0$38'43.2" N	$26^0$38'38.1" N	$26^0$38'42.4" N	$26^0$38'43.3" N	$26^0$37'29.7" N
Elevation	113.750m	108.930m	106.43 m	110.93 m	102.330m	107.83 m
Classification of the Road	National Highway					
Terrain/Geology	Plain terrain					
Information on Structure:						
Total length of Bridge	64.20 m	375.00 m	64.20 m	64.20 m	660.00 m	85.60 m
Approach Road	40 m (20 m on each bank)					
Span arrangement	3 x 21.40m	25 x 15.00m	3 x 21.40m	3 x 21.40m	44 x 15.00m	4 x 21.40m
Total width	11.66 m					
Carriageway Width	8.0 m (7.5 c/w + 0.5m curb shyness width)					
Footpath(s):	2.75 m one side					
Kerbs:	Crash barriers, bottom width 0.38 m (FHWA, F-shaped parapets)					
Type of superstructure:	Composite deck with precast, pre-tensioned Box Girders and cast in situ RCC deck slab					
Type of bearings:	Elastomeric bearings with preliminary size 350x2750x50 mm					
Type of abutments:	Spill through with RC wing wall					
Type of pier(s):	Pier frame including three circular column and cap beam					
Type and depth of foundations:	**Abutments:** Dia. 1.0 m bored and cast in situ piles, 15.0m **Piers:** Dia. 1.0 m bored and cast in situ piles, 15.0m	**Abutments:** Dia. 0.80 m bored and cast in situ piles, 20.0m **Piers:** Dia. 0.80 m bored and cast in situ piles, 20.0m	**Abutments:** Dia. 1.0 m bored and cast in situ piles, 15.0m **Piers:** Dia. 1.0 m bored and cast in situ piles, 15.0m	**Abutments:** Dia. 1.0 m bored and cast in situ piles, 15.0m; **Piers:** Dia. 1.0 m bored and cast in situ piles, 20.0m	**Abutments:** Dia. 1.0 m bored and cast in situ piles, 16.0m; **Piers:** Dia. Dia. 0.80 m bored and cast in situ piles, 20.0m	**Abutments:** Dia. 1.0 m bored and cast in situ piles, 15.0m **Piers:** Dia. 1.0 m bored and cast in situ piles, 20.0m
Design Parameters:						
Live load:	IRC class A (2 lanes) and class 70R (one lane)					
Net bearing capacity	Abutment: 1792 KN and Pier: 1795 KN	Abutment: 969.00 KN and Pier: 984 KN	Abutment: 939 KN and Pier: 1424 KN	Abutment: 1665 KN and Pier: 1533 KN	Abutment: 1207.00 KN and Pier: 1289.25 KN	Abutment: 1092 KN and Pier: 1634.15 KN
Design discharge	134 m^3/s	195.00 m^3/s	23.00 m^3/s	47.00 m^3/s	523.00 m^3/s	127 m^3/s

Linear waterway	54.99 m	66.33 m	22.78 m	32.56 m	108.63 m	53.53 m
Summary of quantities of materials						
Grade and quantity of concrete:						
Superstructure	M45 – 96.52 m^3 M25 – 59.63 m^3	M25 – 43.00 m^3	M45 – 96.52 m^3 M25 – 59.63 m^3	M45 – 94.88 m^3 M25 – 7.20 m^3	M25 – 43.00 m^3	M45 – 96.52 m^3 M25 – 59.63 m^3
Substructure	M25 – 63 m^3 M30 – 146 m^3	M25 – 63 m^3 M30 – 1,376.00m^3	M25 – 63.00 m^3 M30 – 146.00 m^3	M25 – 8.21 m^3 M30 – 94.11 m^3	M25 – 63.00 m^3 M30 – 1,250.00m^3	M25 – 63.00 m^3 M30 – 177.00 m^3
Foundation	M10 – 7 m^3 M25 – 214 m^3 M30 – 61 m^3	M10 – 198 m^3 M25 – 2,680 m^3 M30 – 2,795 m^3	M10 – 7.00 m^3 M25 – 253 m^3 M30 – 61 m^3	M10 – 4.09 m^3 M25 – 197.50 m^3 M30 – 25.65 m^3	M10 – 61.00 m^3 M25 – 2,252.00 m^3 M30 – 974.00 m^3	M10 – 8.00 m^3 M25 – 332.00 m^3 M30 – 91.00 m^3
Grade and quantity of reinforcing steel:						
Superstructure	Fe 500, 73.34 MT	Fe 500, 962.54MT	Fe 500, 76.68 MT	Fe 500, 65.33 MT	Fe 500, 733.36 MT	Fe 500, 94.64 MT
Substructure	Fe 500, 25.32 MT	Fe 500, 240MT	Fe 500, 25.32 MT	Fe 500,16.83 MT	Fe 500, 217.11 MT	Fe 500, 31.36 MT
Foundation	Fe 500, 30.43 MT	Fe 500, 714MT	Fe 500, 33.77 MT	Fe 500, 28.00 MT	Fe 500, 507.71 MT	Fe 500, 45.69 MT
Quantities of other materials:						
Stone masonry	100 m^3	430 m^3	100 m^3	155 m^3	430 m^3	183 m^3
Gabion works	1020 m^3	1000 m^3	1020 m^3	700 m^3	1000 m^3	760 m^3
Formworks	913 m^2	6035 m^2	710 m^2	731 m^2	5540 m^2	1038 m^2
GI pipe railings	188.28 m	133 m	188.28 m	98 m	133 m	98 m
Summary of cost (NRs.)						
Superstructure:	28,466,361.96	339,238,982.12	28,478,612.72	11,382,690.16	339,238,982.12	38,034,540.48
Substructure:	6,462,247.64	53,402,300.00	6,467,194.20	3,480,991.29	48,429,800.60	7,743,120.32
Foundation:	12,494,457.36	252,688,500.80	14,302,553.20	17,999,539.76	176,955,069.60	19,149,094.53
River training works:	6,955,169.00	10,707,481.00	6,981,359.00	5,339,218.00	10,239,083.40	6,236,373.00
Net Cost	55,149,999.96	659,120,940.92	57,007,055.12	55,792,669.96	577,702,360.72	71,985,403.33
Gross Cost	62,319,499.95	744,806,663.24	64,417,972.29	63,045,717.05	652,803,667.61	81,343,505.76

Particulars	**Name of the Bridge (Ch. 170+260 – Ch. 186+880)**					
	Khando	**Devdhar**	**Lakeshar**	**Khadak**	**Chapin**	**Amaha**
Name of the Road	East – West Highway, Koshi – Kamala Section					
Chainage/Bridge Identification Number	Km 170+260/ 15-H001-100	Km 178+030/ 15-H001-105	Km 179+690/15-H001-106	Km 181+400/15-H001-107	Km 183+740/ 15-H001-109	Km 186+880/ 15-H001-111
Geographical Location:						
Easting	$86^0$43’40.3” E	$86^0$39’3.3” E	$86^0$38’3.8” E	$86^0$37’4.6” E	$86^0$35’47.4” E	$86^0$34’4” E
Northing	$26^0$37’34.5” N	$26^0$38’13” N	$26^0$38’20.22” N	$26^0$38’35.1” N	$26^0$39’5.4” N	$26^0$39’47.1” N
Elevation	106.93 m	109.430m	109.63m	109.63 m	119.730 m	109.63m

Particulars	Name of the Bridge (Ch. 170+260 – Ch. 186+880)					
	Khando	**Devdhar**	**Lakeshar**	**Khadak**	**Chapin**	**Amaha**
Classification of the Road	National Highway					
Terrain/Geology	Plain terrain					
Information on Structure:						
Total length of Bridge	192.60 m	69.40 m	53.16 m	128.40 m	90.80 m	53.16 m
Approach Road	40 m (20 m on each bank)					
Span arrangement	9 x 21.40m	24.0+21.40+24.0 m	2 x 26.58m	6 x 21.40m	24.0+2*21.40+ 24.0 m	2 x 26.58m
Total width	11.66 m					
Carriageway Width	8.0 m (7.5 c/w + 0.5m curb shyness width)					
Footpath(s):	2.75 m one side					
Kerbs:	Crash barriers, bottom width 0.38 m (FHWA, F-shaped parapets)					
Type of superstructure:	Composite deck with precast, pre-tensioned Box Girders and cast in situ RCC deck slab					
Type of bearings:	Elastomeric bearings with preliminary size 350x2750x50 mm (exact dimensions to be determined by the manufacturer)					
Type of abutments	Spill through with RC wing wall					
Type of pier(s):	Pier frame including three circular column and cap beam					
Type and depth of foundations:	Abutments: Dia. 1.0 m bored and cast in situ piles, 16 m Piers: Dia. 1.0 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 20.0m Piers: Dia. 1.00 m bored and cast in situ piles, 21 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 20.0m Piers: Dia. 1.00 m bored and cast in situ piles, 22 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 15.0m; Piers: Dia. 1.0 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 16.0m; Piers: Dia. 1.10 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 20 m Piers: Dia. 1.0 m bored and cast in situ piles, 20 m
Design Parameters						
Live load:	IRC class A (2 lanes) and class 70R (one lane)					
Net bearing capacity	Abutment: 1826 KN; Pier: 1477 KN	Abutment: 1012 KN and Pier: 1015 KN	Abutment: 1213.50 KN and Pier: 1173.00 KN	Abutment: 1255 KN and Pier: 1522.50 KN	Abutment: 982.68 KN and Pier: 1647 KN	Abutment: 911 KN and Pier: 1173 KN
Design discharge	310 m^3/s	93 m^3/s	83 m^3/s	275.00 m^3/s	108.00 m^3/s	76 m^3/s
Linear waterway	83.63 m	45.81 m	43.27 m	78.77 m	49.36 m	41.41 m
Summary of quantities of materials						

Particulars	Name of the Bridge (Ch. 170+260 – Ch. 186+880)					
	Khando	**Devdhar**	**Lakeshar**	**Khadak**	**Chapin**	**Amaha**
Grade and quantity of concrete:						
Superstructure:	M45 – 96.52 m^3 M25 – 59.63 m^3	M45 – 311.00 m^3 M25 – 193.00 m^3	M45 – 117.81 m^3 M25 – 72.80 m^3	M45 – 96.52 m^3 M25 – 59.63 m^3	M45 – 108.00 m^3 M25 – 253.00 m^3	M45 – 117.81 m^3 M25 – 72.80 m^3
Substructure:	M25 – 8.21 m^3 M30 – 94.11 m^3	M25 – 63.00 m^3 M30 – 149.00 m^3	M25 – 63.00 m^3 M30 – 130.00 m^3	M25 – 8.21 m^3 M30 – 94.11 m^3	M25 – 63.00 m^3 M30 – 246.00 m^3	M25 – 63.00 m^3 M30 – 137.00 m^3
Foundation:	M10 – 16.00 m^3 M25 – 734.00 m^3 M30 – 242.00 m^3	M10 –13.00 m^3 M25 – 474.00 m^3 M30 – 177.00 m^3	M10 –8.00 m^3 M25 – 332.00 m^3 M30 – 95.00 m^3	M10 – 12.00 m^3 M25 – 119.00 m^3 M30 – 162.00 m^3	M10 –8.00 m^3 M25 – 412.00 m^3 M30 – 98.00 m^3	M10 –8.00 m^3 M25 – 316.00 m^3 M30 – 95.00 m^3
Grade and quantity of reinforcing steel	Fe 500, 183.13 MT	Fe500, 159.86 MT	Fe500, 93.58 MT	Fe500, 156.33 MT	Fe 500, 213.43 MT	Fe 500, 87.73 MT
Quantities of other materials:						
Stone masonry	265 m^3	100 m^3	100 m^3	155 m^3	210 m^3	100 m^3
Gabion works	1065 m^3	1020 m^3	1020 m^3	750 m^3	750 m^3	1020 m^3
Formworks	1752 m^2	1589 m^2	924 m^2	1479 m^2	3265 m^2	946 m^2
Summary of Cost (NRs.)						
Superstructure	85,442,866.67	29,791,939.00	22,053,640.98	56,873,249.09	39,269,662.00	22,027,540.20
Substructure	14,399,683.60	6,561,861.64	5,676,682.44	12,358,014.18	8,968,216.46	6,040,711.58
Foundation	43,337,581.60	29,487,849.28	19,846,907.81	33,305,883.26	28,515,976.16	18,346,418.82
River training works	8,125,606.00	5,903,014.00	7,116,528.00	5,685,435.00	5,799,382.00	6,969,644.00
Net Cost	152,869,163.87	72,568,684.92	55,466,472.23	109,657,869.53	83,660,531.62	54,153,085.60
Gross Cost	172,742,155.17	82,002,613.96	62,677,113.62	123,913,392.57	94,536,400.73	61,192,986.73

Particulars	Name of the Bridge (Ch. 193+974 – Ch. 232+440)					
	Balan	**Gagan - 2**	**Mainabati**	**Ghurmi**	**Jiba**	**Bhedhawa**
Name of the Road	East – West Highway, Koshi – Kamala Section					
Chainage/Bridge Identification Number	Km 193+974/ 15-H001-116	Km 183+740/ 15-H001-122	Km 216+720/ 15-H001-124	Km 221+190/ 15-H001-125	Km 222+410/15-H001-127	Km 232+440/15-H001-134
Geographical Location:						
Easting	$86^0$30’41.7” E	$86^0$21’9” E	$86^0$18’57.4” E	$86^0$16’31.1” E	$86^0$14’20.2” E	$86^0$11’5.5” E
Northing	$26^0$42’4.3” N	$26^0$47’4.8” N	$26^0$47’59.8” N	$26^0$48’59.7” N	$26^0$50’0.9” N	$26^0$52’14.3” N
Elevation	97.85m	130.960 m	129.73 m	113.930 m	123.58m	113.00 m
Classification of the Road	National Highway					

Particulars	Name of the Bridge (Ch. 193+974 – Ch. 232+440)					
	Balan	**Gagan - 2**	**Mainabati**	**Ghurmi**	**Jiba**	**Bhedhawa**
Terrain/Geology	Plain terrain					
Information on Structure:						
Total length of Bridge	478.44 m	133.60 m	85.60 m	112.20 m	53.16 m	69.40 m
Approach Road	40 m (20 m on each bank)					
Span arrangement	18 x 26.58m	24.0+4*21.40+24.0 m	4 x 21.40m	24.0+3*21.40+ 24.0 m	2 x 26.58m	24.0+21.40+24.0m
Total width	11.66 m					
Carriageway Width	8.0 m (7.5 c/w + 0.5m curb shyness width)					
Footpath(s):	2.75 m one side					
Kerbs:	Crash barriers, bottom width 0.38 m (FHWA, F-shaped parapets)					
Type of superstructure:	Composite deck with precast, pre-tensioned Box Girders and cast in situ RCC deck slab					
Type of bearings:	Elastomeric bearings with preliminary size 350x2750x50 mm (exact dimensions to be determined by the manufacturer)					
Type of abutments:	Spill through with RC wing wall					
Type of pier(s):	Pier frame including three circular column and cap beam					
Type and depth of foundations:	Abutments: Dia. 1.20 m bored and cast in situ piles, 16 m Piers: Dia. 1.20 m bored and cast in situ piles, 22 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 15 m Piers: Dia. 1.00 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 15 m Piers: Dia. 1.00 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 15 m Piers: Dia. 1.0 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 20 m Piers: Dia. 1.10 m bored and cast in situ piles, 20 m	Abutments: Dia. 1.0 m bored and cast in situ piles, 20 m Piers: Dia. 1.0 m bored and cast in situ piles, 21 m
Design data:						
Live load	IRC class A (2 lanes) and class 70R (one lane)					
Design discharge	2442 m^3/s	276m^3/s	375 m^3/s	259 m^3/s	151 m^3/s	174 m^3/s
Linear waterway	234.73 m	78.91 m	91.98 m	76.44 m	58.35 m	50.72 m
Summary of quantities of materials						
Grade and quantity of concrete:						
Superstructure:	M45 – 117.81 m^3 M25 – 72.80 m^3	M45 – 601.00 m^3 M25 – 372.00 m^3	M45 – 96.52 m^3 M25 – 59.63 m^3	M45 – 504.00 m^3 M25 – 248.00 m^3	M45 – 117.81 m^3 M25 – 72.80 m^3	M25 – 193.00 m^3
Substructure:	M25 – 63.00 m^3 M30 – 872.00 m^3	M25 – 8.21 m^3 M30 – 94.11 m^3	M25 – 63.00 m^3 M30 – 219.00 m^3	M25 – 8.21 m^3 M30 – 94.11 m^3	M25 – 63.00 m^3 M30 – 140.00 m^3	M25 – 63.00 m^3 M30 – 149.00 m^3

Particulars	Name of the Bridge (Ch. 193+974 – Ch. 232+440)					
	Balan	**Gagan - 2**	**Mainabati**	**Ghurmi**	**Jiba**	**Bhedhawa**
Foundation:	M10 –31 m^3 M25 – 2240 m^3 M30 – 555 m^3	M10 –11 m^3 M25 – 594 m^3 M30 – 152 m^3	M10 – 8 m^3 M25 – 119 m^3 M30 – 98 m^3	M10 –10.00 m^3 M25 – 499 m^3 M30 – 122 m^3	M10 –8 m^3 M25 – 324 m^3 M30 – 96 m^3	M10 –13 m^3 M25 – 474 m^3 M30 – 177 m^3
Grade and quantity of reinforcing steel:						
Superstructure:	Fe 500, 20.33 MT	Fe 500, 109 MT	Fe 500, 17.59 MT	Fe 500, 91.00 MT	Fe 500, 20.33 MT	Fe 500, 30.70 MT
Substructure:	Fe 500,154.57MT	Fe 500,48.68 MT	Fe 500,37.57 MT	Fe 500,39.36 MT	Fe 500,23.50 MT	Fe 500,25.30 MT
Foundation:	Fe 500, 351.18 MT	Fe 500, 86.45MT	Fe 500, 63.27 MT	Fe 500, 71.50 MT	Fe 500, 44.93 MT	Fe 500, 64.84 MT
Quantities of other materials:						
Stone masonry	307 m^3	307 m^3	265 m^3	307.00 m^3	307 m^3	183 m^3
Gabion works	800 m^3	836 m^3	750 m^3	800.00 m^3	700 m^3	670 m^3
Formworks	3652 m^2	3257 m^2	1172 m^2	2691 m^2	953 m^2	1588 m^2
GI pipe railings	234 m	1175.00 m	188.28m	987 m	234 m	610.00 m
Summary of Cost (NRs.)						
Superstructure	193,834,876.38	59,828,498.00	39,030,450.16	50,048,162.00	21,616,261.34	32,910,305.16
Substructure	36,313,149.34	12,246,882.00	9,663,427.58	9,868,243.96	6,468,349.00	6,847,017.20
Foundation	124,924,510.16	33,507,417.50	20,008,098.38	26,801,814.00	18,940,994.26	28,118,365.36
River training works	7,163,482.00	6,555,653.00	6,133,761.00	6,748,747.00	6,366,191.00	5,258,120.20
Net Cost	364,435,769.88	113,334,891.50	75,922,463.12	94,607,232.96	54,162,753.60	73,761,536.92
Gross Cost	411,812,419.96	128,068,427.40	85,792,383.33	106,906,173.24	61,203,911.57	83,350,536.72

Source: Detail Design Report, TPPF, 2017

Figure 3: Project Location Map in Saptari and Siraha Districts

B. Need of the Project

47. Nepal is connected by two Asian Highways; which are Asian Highway 2 (AH 2) and Asian Highway 42 (AH 42). The Asian Highways are a part of the Strategic Road Networks. Total length of these two sectors within Nepal is 1324 km. AH 2 originates from Dhaka in Bangladesh and ends in New Delhi in India. It can be further linked with Asian Highway Network. Similarly, AH 42 originates from Barhi in India and ends in Lhasa in People's Republic of China. It is further linked to India by AH 1 and People's Republic of China by AH 5. AH 2 connects the eastern portion of Nepal at Kakarvitta and passes through Itahari, Dhalkebar, Pathlaiya, Hetauda, Nayanghat, Butwal, Kohalpur, Attaria and Mahendranagar.

48. AH 2 covers a length of 1027 km within Nepal. The portion of AH 2 in Nepal is known as Mahendra Raj Marga (East West Highway).. The government is preparing to upgrade the East West Highway to four lanes from the existing two lanes to cater to the increased traffic. In the first phase, the Ministry of Physical Infrastructure and Transport (MoPIT) has targeted to upgrade sections between Narayanghat-Dhalkebar which 215 km. Increased traffic and narrow highways have emerged as a big problem affecting the smooth flow of vehicle for travel and trade. As only the widening of the road will not suffice, a project is already being carried out to upgrade old bridges in different sections of the East West Highway to double lane or replace with new ones. Bridges in Dhalkebar-Pathlaiya section of the highway have been kept in top priority. This feasibility and detail design study of Kanchanpur to Kamala section of East West Highway is a part of the upgrading of East West Highway and being conducted with financial assistance of Asian Development Bank.

49. Therefore, upgrading of Kanchanpur to Kamala Section will significantly contribute in the improvement of the socio-economic condition of the project districts and Nepal at large. This improved access will also attract other development infrastructures and open door to further development opportunities in the area.

C. Environmental Category

50. Project categorization has been done using Rapid Environment Assessment (REA) checklist (**Appendix A**) after screening survey and initial consultations. Project intervention is limited to improvement and widening of existing road, and construction of new bridges

51. The project road and bridges do not pass through or located near wildlife sanctuary, national park, protected area network or any other similar eco-sensitive areas. Majority of impacts are mainly temporary and localized in nature which can be mitigated by effective implementation of Environmental Management Plan (EMP) included with the IEE. Hence, the project has been categorized as **Category 'B'** as per SPS, 2009.

D. Road Component

1. Improvement/Strengthening Components

52. The proposed project involves key upgrading activities including geometry improvement, pavement upgrading, drainage improvement, retaining structures; slope protection/stabilization, other off-road works, and works on traffic management and road safety. Proposed cross-section of the road is given in the **Figure 2.**

53. The upgrading involves widening of existing road width to 43 m in urban section, and 24 m in rural section to meet the design standards. These proposed location and length of widening are shown in **Table 5**.

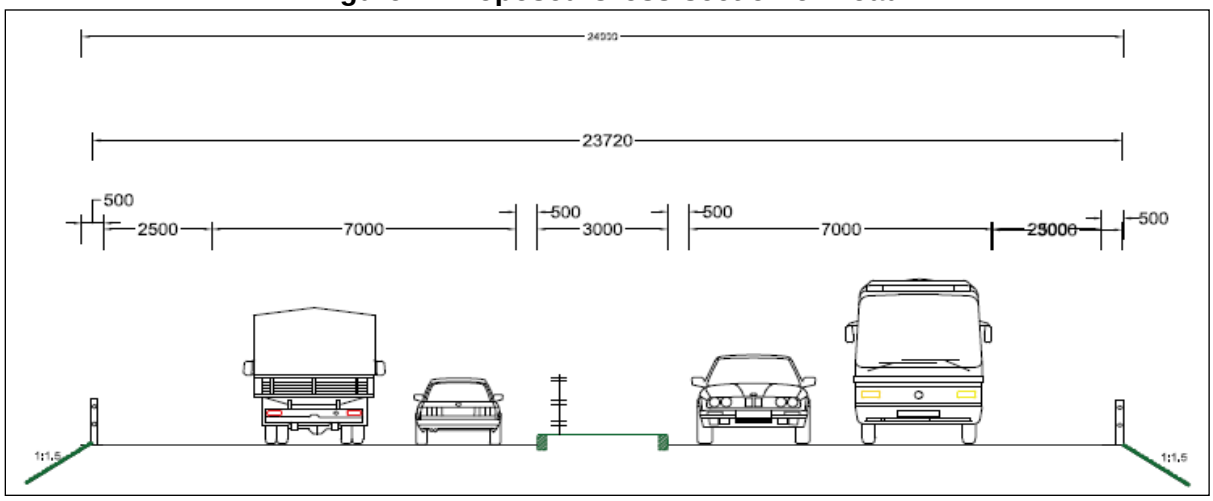
Table 5: Details of Road Section and List of Road Widening

Left Side	From	To	Right Side	Total Lanes	Length (m)
3 Lane	0+000	0+760	3 Lane	6 Lane	760
Transition from 3-L to 2-L	0+760	0+800	Transition from 3-L to 2-L	Transition	40
2 Lane	0+800	11+120	2 Lane	4 Lane	10,320
3 Lane	11+120	11+240	2 Lane	5 Lane	120
3 Lane	11+240	11+270	Transition from 2-L to 3-L	Transition	30
3 Lane	11+270	12+980	3 Lane	6 Lane	1,710
3 Lane	12+980	13+010	Transition from 3-L to 2-L	Transition	30
3 Lane	13+010	13+135	2 Lane	5 Lane	125
Transition from 3-L to 2-L	13+135	13+160	2 Lane	Transition	25
2 Lane	13+160	16+520	2 Lane	4 Lane	3,360
Transition from 2-L to 3-L	16+520	16+540	2 Lane	Transition	20
Transition from 2-L to 3-L	16+540	16+560	Transition from 2-L to 3-L	Transition	20
3 Lane	16+560	16+600	Transition from 2-L to 3-L	Transition	40
3 Lane	16+600	17+800	3 Lane	6 Lane	1,200
Transition from 3-L to 2-L	17+800	17+870	Transition from 3-L to 2-L	Transition	70
2 Lane	17+870	20+470	2 Lane	4 Lane	2,600
2 Lane	20+470	20+530	Transition from 2-L to 3-L	Transition	60
2 Lane	20+530	20+570	3 Lane	5 Lane	40
Transition from 2-L to 3-L	20+570	20+690	3 Lane	Transition	120
3 Lane	20+690	21+800	3 Lane	6 Lane	1,110
2 Lane	21+800	25+840	2 Lane	4 Lane	4,040
Transition from 2-L to 3-L	25+840	25+900	Transition from 2-L to 3-L	Transition	60
3 Lane	25+900	26+100	3 Lane	6 Lane	200
Transition from 3-L to 2-L	26+100	26+700	Transition from 3-L to 2-L	Transition	600
2 Lane	26+700	29+730	2 Lane	4 Lane	3,030
Transition from 2-L to 3-L	29+730	29+760	Transition from 2-L to 3-L	Transition	30
3 Lane	29+760	30+700	3 Lane	6 Lane	940
Transition from 3-L to 2-L	30+700	30+890	Transition from 3-L to 2-L	Transition	190
2 Lane	30+890	44+090	2 Lane	4 Lane	13,200
3 Lane	44+090	48+860	3 Lane	6 Lane	4,770
Transition from 3-L to 2-L	48+860	48+940	Transition from 3-L to 2-L	Transition	80
2 Lane	48+940	63+490	2 Lane	4 Lane	14,550
Transition from 2-L to 3-L	63+490	63+520	Transition from 2-L to 3-L	Transition	30
3 Lane	63+520	65+990	3 Lane	6 Lane	2,470
Transition from 3-L to 2-L	65+990	66+180	Transition from 3-L to 2-L	Transition	190
2 Lane	66+180	72+190	2 Lane	4 Lane	6,010

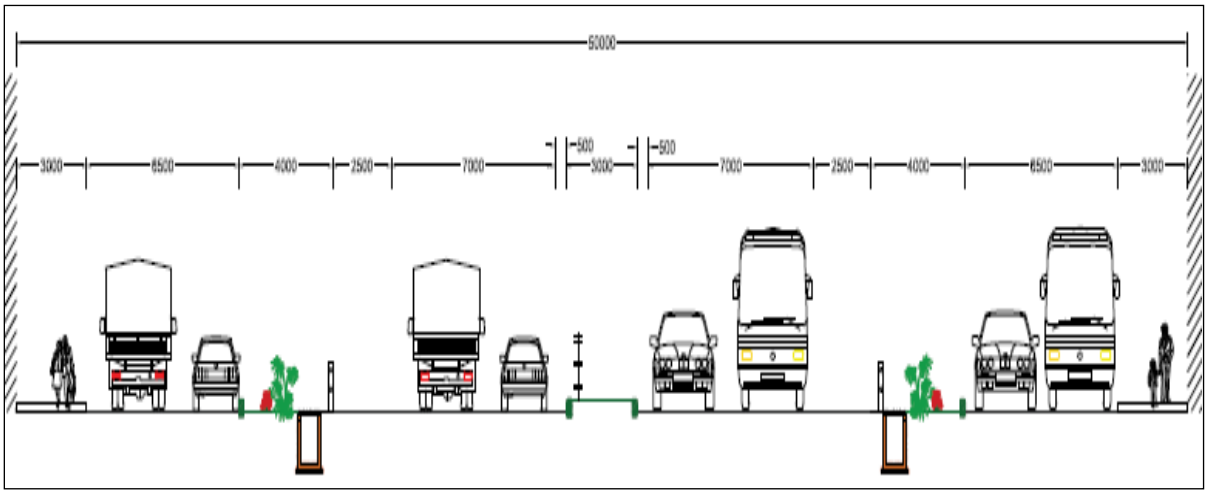
Left Side	From	To	Right Side	Total Lanes	Length (m)
Transition from 2-L to 3-L	72+190	72+250	Transition from 2-L to 3-L	Transition	60
3 Lane	72+250	74+430	3 Lane	6 Lane	2,180
Transition from 3-L to 2-L	74+430	74+610	Transition from 3-L to 2-L	Transition	180
2 Lane	74+610	84+490	2 Lane	4 Lane	9,880
2 Lane	84+490	84+540	Transition from 2-L to 3-L	Transition	50
Transition from 2-L to 3-L	84+540	84+630	Transition from 2-L to 3-L	Transition	90
Transition from 2-L to 3-L	84+630	84+650	3 Lane	Transition	20
3 Lane	84+650	85+620	3 Lane	6 Lane	970
Transition from 3-L to 2-L	85+620	85+700	Transition from 3-L to 2-L	Transition	80
2 Lane	85+700	86+823	2 Lane	4 Lane	1,123
				Total (Km)	**86.823**
				Total 6 lane	16,310 m
				Total 5 lane	285 m
				Total 4 lane	68,113 m
				Total Transition	2,115 m

Source: Detail Design Report, 2018

Figure 4: Proposed Cross-section of Road



(a) Typical cross- section of four lane road



(b) Typical cross- section of six lane road

Note: All dimension in mm.

2. Construction Material and Sourcing

54. Construction materials required for the construction of the proposed project road will be stone, coarse aggregates, sand, sub base, base course, and surface dressing/asphalt concrete chips. The probable sources of materials are Chisan River, Gachhiya River, Ghurmi River, Kamala River, Lama Khola, Gangajali River and Ratu River.

Table 6: Probable Sources of Construction Material

S. N	Source	Location	Estimated Quantity (m^3)	Estimated Extractable Quantities			Equipment used for materials extraction
				Gravel and Boulder for Surface dressing Chips and base course	Natural material for sub base and sub base mix	Sand	
				Qty, m^3	Qty, m^3	Qty, m^3	
1	Chisyan Khola	80 Km away from Ch. Km 0+000	500000	175000	122500	52500	Excavator, Bulldozer, Loader, Tipper, Trucks, Tractors, Shovel and Crusher Plant and Screen plant etc.
2	Gachhiya Khola	66 Km away from Ch. 0+000	360000	138600	75600	37800	
3	Kamala Khola	5 Km away from Ch. 85+000	500000	210000	105000	35000	
4	Ratu khola	20 Km away from Ch. 85+000	800000	308000	168000	84000	
5	Ghurmi khola	3 Km away from Ch. 70+000	100000	-	-	49000	
6	Gangajali Khola	10 Km away from Ch. 0+000	100000	-	-	49000	
7	Lama khola	26 Km away from Ch. 0+000	150000	47250	315000	26250	

Source: Construction material survey, 2017/2018

E. Approach Road and Bridges Component

1. Land Requirements

55. Construction of proposed project requires approximately about 6.385 ha land out of which 4.25 ha is required temporarily and remaining 2.135 ha land permanently. The entire land requirement belongs to the public land. The land requirement for the proposed project is given in **Table 7.**

Table 7: Land Requirement for the Project

Project Component	Public/Private		Government		Total (ha)
	Temporary	Permanent	Temporary	Permanent	
Approach Road and Bridge axis and river training	0	0	0	2.135	2.135
Construction Yard and Stockpiling Area	0	0	1.50	0	1.500
Construction Camp	0	0	1.10	0	1.100
Spoil Disposal	0	0	1.65	0	1.650
Total	0	0	4.25	2.135	6.385

2. Construction Camp

56. Construction camp can be established in respective bridge sites, which is located 100 m u/s nearby the road head. Since the number of construction crews will be small in number, the nearby houses can also be rented.

3. Material Stockpiling Site

57. There is availability of the land (within RoW of EWH) near the existing Bridges which can be used for the stockpiling of the construction materials. Stockpiling on particular site will not affect the smooth movement of vehicles during the construction period.

4. Spoil disposal Site

58. Around 3680 m^3 of spoil per bridge is likely to be generated during construction of foundation. All the spoils can be utilized as filling materials in river training works. The spoil generated will be disposed safely on the both banks of rivers nearby the bridge construction site with appropriate retaining wall protection, with the provision of toe wall. In managing the spoil in such manner will serve as the river bank protection measure.

5. Construction requirements

59. The construction of proposed approach roads and bridges construction will be conventional mechanized methods with partially labour based. Activities during construction includes civil works and river training works including excavation, use of heavy machinery and equipment, drilling, quarrying, burrowing, use of construction vehicles. The equipment like Truck, Grader, Pump, Vibrator roller, Roller, Water Bowser, Loader, Boiler, Sprayer, Air compressor, Hand sprayer, Aggregate spreader, Pneumatic Tyre, Mixer, Vibrator/Compactor, Generator, Bitumen distributer, Chip spreader, Tractor and 10-15 tons. Crane will be used during construction period. The project is planned to be constructed within 36 months after the contract award. The construction works will be halted during monsoon season (June to August).

60. Cement, sand, aggregates and steel reinforcement will be used as raw material for bridge construction while Gabion wires will be used for river training structures. Similarly, use of bitumen, paints, and chemicals used to operate the equipment and vehicles will be used. The design parameters for the proposed bridges have been adopted as per the design standard of DoR/IRC.

61. The study for availability of construction materials (boulders, cobble, gravel and sand) in river basin and borrow pit quarries for embankment fill material, existing local crusher plants exist at different location and the possible source of gravel is in Raatu river basin, Lama Khola, Kamala river basin and Masureya borrow pit. The collection of sand and gravel will be done by the use of machineries like excavators, loaders, tippers, etc. Similarly, other resources such as cement, reinforcement bars, bitumen, chemicals, petroleum etc., can be acquired from Biratnagar, Dharan or Itahari.

62. The energy required for the construction of the approach roads and Bridges will be generated from electricity supply around the project area. Likewise, diesel generators will also be used during the load shedding period.

63. For total project construction period (36 months) work force required for the project works is estimated at approximately 100 skilled and 375 unskilled laborers daily. The project will prioritize the local people in proposed approach roads and bridges construction works.

Table 8: Proposed Bridges to be Constructed

S. N.	Chainage	Name of Bridge	Length (m)	Type of Bridge	District
1	151+140	Chandra canal	11.20	Minor	Saptari
2	153+990	Sundari	375.00	Major	Saptari
3	156+300	Bavana	11.20	Minor	Saptari
4	157+160	Baghuwa	64.20	Major	Saptari

S. N.	Chainage	Name of Bridge	Length (m)	Type of Bridge	District
5	158+220	BandhKhola	11.20	Minor	Saptari
6	158+390	RaiKhola	64.20	Major	Saptari
7	158+860	Murkutuwa	11.20	Minor	Saptari
8	159+340	Dumarjou - 1	11.20	Minor	Saptari
9	159+400	Dumarjou - 2	11.20	Minor	Saptari
10	160+720	Mahuli	660.00	RCC	Saptari
11	164+480	Amsote	42.92	Minor	Saptari
12	165+410	Gehari	21.45	Minor	Saptari
13	166+030	Dumarjor	32.40	Minor	Saptari
14	166+730	Behai	32.40	Minor	Saptari
15	169+350	Dudhela	85.60	Major	Saptari
16	170+260	Khando	192.60	Major	Saptari
17	174+800	Tarkana - 1	7.80	Minor	Saptari
18	175+230	Tarkana - 2	13.70	Minor	Saptari
19	175+690	Tarkana - 3	22.50	Minor	Saptari
20	176+950	Phapi	13.45	Minor	Saptari
21	178+030	Deodhar	64.40	Minor	Saptari
22	179+690	Lakeshar	53.20	Major	Saptari
23	181+400	Kharak	128.40	Major	Saptari
24	182+330	Chapin - 1	7.80	Minor	Saptari
25	183+740	Chapin	90.80	Major	Saptari
26	185+410	Singeshra	11.20	Minor	Saptari
27	186+880	Amaha	53.20	Major	Saptari
28	187+810	Patharwa - 1	11.20	Minor	Saptari
29	188+170	Patharwa - 2	11.20	Minor	Saptari
30	190+450	Suranga	48.60	Minor	Saptari
31	190+890	Birdhana	42.90	Minor	Saptari
32	193+974	Balan	478.80	Major	Saptari
33	202+160	Saraswati	16.20	Minor	Siraha
34	206+850	Baburam	32.40	Minor	Siraha
35	210+430	Patharia - 2	22.40	Minor	Siraha
36	211+420	Kasaha	16.35	Minor	Siraha
37	212+410	Gagan - 1	11.20	Minor	Siraha
38	212+690	Gagan - 2	133.60	Major	Siraha
39	213+270	Satpatre	18.00	Minor	Siraha
40	216+720	Mainabati	85.60	Major	Siraha
41	221+190	Ghurmi	112.20	Major	Siraha
42	222+480	Bataha	42.80	Minor	Siraha
43	225+410	Jiba	53.20	Major	Siraha
44	226+040	Mainabati - 2	16.40	Minor	Siraha
45	226+320	Tetariya	16.40	Minor	Siraha
46	228+580	Dibha	32.40	Minor	Siraha
47	229+380	Bhalu	16.40	Minor	Siraha
48	229+950	Sukhalaha	22.40	Minor	Siraha
49	230+160	Bagaha	16.20	Minor	Siraha
50	232+440	Bhedhawa	73.40	Major	Siraha
51	233+640	Bhulkiya	22.00	Minor	Siraha
52	235+640	Ghatiya	11.20	Minor	Siraha
53	235+940	Baraha	11.20	Minor	Siraha
54	236+230	Kamala Canal	16.60	Minor	Siraha

Source: Detail Design Report, 2018

F. Project Implementation Schedule and Cost

64. Project construction period for the road will be approximately 36 months followed by 1-year defect liability period and 5-year performance-based maintenance. The same contractors will be responsible for the construction and maintenance related works. The estimated total project cost is approximately US$271 million including VAT and contingencies.

Figure 5: Probable Material Sources

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. The Kanchanpur–Kamala Road Section

65. Situated at an elevation of 108.93 m to 113 m from mean sea level, the Kanchanpur–Kamala Road, part of EWH is located in Saptari and Siraha districts in the Sagarmatha Zone, Province 2 of Nepal respectively. The road alignment passes through nine (9) municipalities and three (3) rural municipalities, namely Kanchanrup, Khadak, Surunga, Shambhunath municipalities and Agnisair Krishnasawaran, Rupani rural municipality in Saptari district and Lahan, Dhangadimai, Golbazar, Naraha rural municipality, Mirchaiya and Karjanha municipality of Siraha district as listed in **Table 9**.

66. The road provides connectivity to major settlements, market centres and agriculture production pockets. Total length of the project road section is about 87 km. **Table 9** presents the districts, municipalities and rural municipalities along the project road alignment.

Table 9: List of Districts, Municipalities and rural municipalities in the Project Area

Districts	Municipality	Rural Municipality
Saptari	Kanchanrup, Khadak, Surunga, Shambhunath	Agnisair Krishnasawaran, Rupani rural municipality
Siraha	Lahan, Dhangadimai, Golbazar, Mirchaiya and Karjanha municipality	Naraha rural municipality

67. The alignment passes through a number of built-up areas as listed below in **Table 10.**

Table 10: Major Settlements along the Road Corridor

From	To	Legend	From	To	Legend
00+000	00+100	Kanchanpur	37+400	37+500	Kadarbona
2+230	2+330	Dharam	37+780	37+880	Amaha
3+000	3+100	Kushaha	40+500	40+600	Kushaha
4+720	4+820	Simara	42+000	42+100	Kadmahachok
5+900	6+000	Baksaha	45+300	47+600	Lahan
9+620	10+300	Mahuli Bazar	54+400	54+500	Sonapur
11+700	11+800	Jandaul Bazar	55+700	57+500	Buddhanagar
12+850	12+950	Bhawanipur	58+240	58+700	Musaharniya
14+240	14+500	Itaharwa Kalauni	60+700	60+800	Kasaha
17+150	17+500	Birendra Bajar	63+760	65+290	Golbajar
18+800	18+900	Jagmohan	66+490	68+310	Choharwa
21+310	21+410	Rupani	71+080	71+180	Fatepur
23+000	23+100	Bhidiya Bajar	73+820	73+920	Mirchaiya
26+120	26+220	Kathauna	76+570	76+670	Rampur
26+500	26+600	Miyatol	77+450	77+550	Prayagpur
30+200	30+300	Kalyanpur	80+320	80+420	Gagaha
31+240	31+340	Bisanpur	81+280	81+380	Bastipur
32+680	32+780	Ranjitpur	85+600	86+823	Chamartol
33+690	33+790	Kharchhuhiya Bazar			

Source: Inventory Survey, 2018

2. Characteristics of the Existing Road

68. The project road section originates at Kanchanpur (Km 0+000), Saptari district from where the feeder road to Phattepur (now Saptakoshi municipality) starts and passes through various settlement areas, agricultural lands, rivers, canals and ends at the start of Kamala bridge (Km 85+000), Siraha district over Kamala river. The project road from Km 00+000 to Km 45+400 lies in the Saptari district and the remaining section of the road lies in the Siraha district. The project road lies in the plain area of terai at the beginning and runs over an embankment at later stretch with an easy gradient throughout the whole section.

69. The carriageway width along the alignment in average is about 7m and shoulder width 1m. Some major and minor cracks and pot holes are observed on the pavement surface along the road alignment. Masonry drains were observed along the starting section up to Km 15+000 and are in fair condition. The existing road is constructed on the embankment filling with earthen drains.

70. The pavement condition is observed to be in fair condition with cracks and pot holes in few locations. On the left-hand side 11.0 km drain is observed in which 1.0 Km is stone masonry drain, 6.0 km brick masonry drain and 4.0 km earthen drain whereas on the right-hand side 15.0 km drain is observed in which 3.5-km is stone masonry drain, 11.0 km brick masonry drain and 0.5 Km earthen drain. All these drains need to be dismantled for construction of four-lane road.

71. Obvious forest areas are not observed along the alignment but trees are observed at frequent interval on both sides of the road that requires to be removed in constructing four lane road.

72. Slab culverts and pipe culverts are used as cross-drain and small, medium and large bridges are observed at various locations. In settlement areas, drains were not properly managed. The road section has 37 minor bridges and 18 major bridges across the rivers and canals along the alignment. The Mirchaiya – Katari – Ghurmi Road starts at Km 73+070 from the project road towards the north.

3. Meteorology and Climate

73. Physiographically, the proposed road project area lies in terai region. Climatologically, the project area lies in tropical region. Siraha district climate is heavily influenced by the monsoon (June-September) with an average annual rainfall of 1442 mm. The maximum temperature averages 36º C and the minimum 17º C. In climate, Saptari varies only slightly from neighbouring Siraha. The average annual rainfall is 1450 mm. The average maximum temperature is 38º C, the low, 16º C.

4. Rainfall Data

74. The twenty-four hours maximum rainfall at different stations at different time period in relevant stations of Kanchanpur - Kamala road sector is shown in tabular form.

Table 11: Maximum daily rainfall recorded at Kanchanpur to Kamala Section of EWH

Year	Extreme : Rainfall(mm/day)						
	Rajbiraj	Jaleshwor	Gausala	Phatepur	Lahan	Janakpur	Amlekhganj
1990	143	86	60	18.2	87	73.8	256.5
1991	90	82	50.4	120	126	110	126.7

Year	Extreme : Rainfall(mm/day)						
1992	95.2	130.2	60	0	120	100.8	104
1993	159	128	80	101	116	192	399
1994	137	86	90.5	102	171.5	151.4	106.4
1995	85.2	87	130.2	157	222	194	252
1996	128.4	70	90	162	150	136	126
1997	146.2	82	20	182	217	210.2	142
1998	93.4	151	30.5	188	0	162	196
1999	125.4	128	80.3	145	63.1	126.2	202
2000	162	154	58	161.4	25	339.5	90.8
2001	132	72	39.6	120.4	170	114.8	190.4
2002	245.4	154	40.4	124	82	123.3	24
2003	131.6	DNA	43.6	128.8	98.5	200.4	312.4
2004	168.2	40	42.4	156.5	62	193.5	214
2005	92.6	184	149.4	74.6	42.5	191.8	180.8
2006	196	113	86.4	76	DNA	200.5	120.6
2007	43.6	170	219.2	170	42.5	255.3	231
2008	44.5	135	106	165	41.3	98.5	210
2009	43.8	49	239	157	56.2	283.2	133
2010	42	67	102.6	162	41.2	107.2	199
2011	121.5	106	252	215	43.2	141	101
2012	89	210	121.4	95	42.3	230.5	102
2013	62.5	50	140.5	152	78.5	101	260
2014	107	155	183.5	95	DNA	122.4	118
Avg.=	115.38	112.05	100.64	129.116	91.20	166.37	175.90

Source: DoHM, 2015

Table 12: Mean monthly temperature of Kanchanpur - Kamala Section of EWH

Temperature by Month (in Degree Celsius)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
1985	16.46	18.28	24.99	29.64	28.51	29.69	28.27	29.55	28.18	26.72	22.28	18.31
1986	16.49	18.38	23.88	27.45	27.47	30.58	28.83	29.24	27.91	24.89	22.54	18.35
1987	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1988	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1989	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1990	14.87	18.58	21.95	26.11	28.16	29.63	29.03	29.24	28.72	26.2	23.14	18.32
1991	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1992	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1993	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1994	17.26	17.73	23.72	27.41	30.3	30.1	29.75	29.24	28.22	25.35	22.59	18.36
1995	19.21	19.43	22.15	27.01	32.19	29.25	28.97	29.16	28.66	26.74	23.26	19.07
1996	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1997	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1998	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
1999	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2000	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2001	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2002	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2003	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2004	16.29	20.41	24.41	28.43	29.94	30.29	28.7	29.72	29.36	27.31	25.67	19.89
2005	16.32	24.03	24.31	25.26	28.59	29.39	29.67	29.43	29.32	26.93	25.25	DNA
2006	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2007	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA

Temperature by Month (in Degree Celsius)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
2008	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2009	16.17	16.94	23.21	29.26	29.79	30.53	29.5	27.53	28.65	27.76	24.14	15.7
2010	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2011	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2012	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2013	14.31	19.48	24.34	27.72	29.1	29.47	28.74	29.05	29.75	26.62	22.72	19.2
2014	DNA	DNA	DNA	27.85	29.8	29.74	29.55	29.26	29.11	26.8	23.75	17.82
Avg=	16.37	19.25	23.66	27.61	29.38	29.86	29.10	29.14	28.78	26.53	23.53	18.34

Source: DoHM, 2015

5. Topography and Soils

75. The project area lies in the plain Terai region of Nepal. The topography of project area is characterized by plain and flat land. This zone is characterized by coarse sandy cobble material and clayey soil with sandy soil. No rock formation is observed nor expected on shallow depth. The Terai plain, which is the northerly extension of the Gangetic plain, rises to 200 m elevation. The project area covers the parts of the Terai of the central Nepal. Geologically, it consists of Quaternary sediments. They are composed of fine to coarse sand and silt with clays which overlie gravel deposits in sand and silt matrix and are loosely deposited and uncemented.

6. Land Use Pattern

76. Land use pattern of project districts is described briefly in the table below.

Table 13: Land Use and Land Cover in Project Districts, Ha

S. N.	District	Total Forest Area	Shrub	Agricultural land/ grass	Water bodies	Barren land	Snow	Others	Total
1.	Saptari	30,286	82	94,397	3,154	8,169	0	544	136,632
2.	Siraha	20,202	679	94,268	818	4,201	0	0	120,168
	Total	**50,488**	**761**	**188,665**	**3,972**	**12,370**	**0**	**544**	**256,800**

Source: Environmental Statistics of Nepal, CBS, 2013

77. Land use pattern of 50 meters on either side from the center line of the road was observed and noted during walkthrough survey. Accordingly, lands in the project corridor are used for agriculture and settlements. Agriculture is another important land use practice along the road corridor. The major crops grown are rice, maize, millet, pulses and vegetables. Besides cultivation of crops, farm grown trees such as fodder, fruit species are grown around homestead areas. The entire alignment passes through plain terrain in which 39% passes through settlement areas, 42% through cultivated agricultural land, 15% through barren land and 4% through rivers and river banks.

Table 14: Land use pattern along the road alignment

Left Hand Side			Right Hand Side			Left Hand Side			Right Hand Side		
From	**To**	**Legend**	**From**	**To**	**Legend**	14+120	14+210	Agriculture	14+950	14+980	River
0+000	0+410	Settlement	0+000	0+400	Settlement	14+210	14+810	Barren Land	14+980	15+590	Barren Land
0+410	1+800	Agriculture	0+400	2+860	Cultivation	14+810	14+820	River	15+590	15+890	River
1+800	2+860	Settlement	2+860	3+010	Barren Land	14+820	14+980	Barren Land	15+890	16+240	Cultivation
2+860	3+020	Agriculture	3+010	3+200	Settlement	14+980	15+610	Agriculture	16+240	17+620	Barren Land
3+020	3+200	Barren Land	3+200	3+560	Barren Land	15+610	15+890	River	17+620	18+620	Cultivation
3+200	3+950	Agriculture	3+560	4+650	River	15+890	16+500	Settlement	18+620	18+900	Settlement
3+950	4+660	Barren Land	4+650	5+550	Settlement	16+500	17+640	Agriculture	18+980	19+780	Cultivation
4+660	4+820	Settlement	5+550	6+720	Cultivation	17+640	18+900	Barren Land	19+780	19+780	River
4+820	5+680	Agriculture	6+720	6+790	River	18+990	20+540	Agriculture	19+780	20+380	Cultivation
5+680	6+120	Settlement	6+790	7+210	Barren Land	20+540	21+990	Settlement	20+380	21+640	Settlement
6+120	6+720	Barren Land	7+210	7+390	Cultivation	21+990	22+330	Barren Land	21+640	22+040	Cultivation
6+720	6+790	River	7+390	7+770	Settlement	22+330	22+620	Settlement	22+040	23+340	Settlement
6+730	6+790	Barren Land	7+770	8+040	River	22+620	23+690	Agriculture	23+340	23+640	Barren Land
6+790	7+220	Agriculture	8+040	8+430	Barren Land	23+690	24+000	Settlement	23+640	24+030	Cultivation
7+220	7+770	River	8+430	8+440	Cultivation	24+000	24+110	Settlement	24+030	24+190	Settlement
7+770	7+800	Settlement	8+440	8+890	Settlement	24+320	24+340	Agriculture	24+190	24+670	Cultivation
7+800	8+040	Barren Land	8+890	9+510	Cultivation	24+340	24+780	River	24+690	24+700	Barren Land
8+040	8+410	River	9+510	10+930	Settlement	24+780	26+480	Settlement	24+700	25+150	Settlement
8+410	8+650	Agriculture	10+930	10+970	Barren Land	26+480	26+600	Agriculture	25+150	26+460	Cultivation
8+650	8+880	River	10+970	12+790	Cultivation	26+600	30+380	Settlement	26+490	26+610	Settlement
8+800	9+290	Settlement	12+790	12+880	Barren Land	30+380	30+620	Barren Land	26+610	29+200	Cultivation
9+290	10+000	Agriculture	12+880	14+020	Cultivation	30+620	30+900	Settlement	29+200	29+270	River
10+000	10+380	Settlement	14+020	14+080	River	30+900	31+010	Cultivation	29+450	31+350	Settlement
10+380	14+020	Barren Land	14+080	14+670	Settlement	31+010	31+350	Barren land	31+350	31+840	Cultivation
14+020	14+120	Settlement	14+670	14+950	Cultivation	31+350	31+840	Cultivation	31+840	32+140	Barren land
31+840	32+460	Settlement	32+140	32+460	Cultivation	56+210	56+420	Cultivation	56+420	57+830	Settlement
32+460	33+300	Barren land	32+460	33+410	Settlement	56+420	57+830	Settlement	57+830	58+240	Cultivation
33+300	33+410	Settlement	33+410	33+500	Barren land	57+830	58+240	Cultivation	58+240	58+720	Settlement
33+410	33+500	Cultivation	33+500	34+090	Settlement	58+240	58+720	Barren land	58+720	59+350	Cultivation
33+500	34+090	Settlement	34+090	34+520	Cultivation	58+720	59+350	Cultivation	59+350	59+740	Barren land
34+090	36+050	Cultivation	34+520	34+940	Settlement	59+350	59+740	Barren land	59+740	59+940	Cultivation
36+050	37+340	Settlement	34+940	36+960	Cultivation	59+740	59+940	Agriculture	59+940	60+230	Barren land
37+340	37+720	Cultivation	36+960	37+950	Settlement	59+940	60+230	Settlement	60+230	60+480	Cultivation
37+720	40+030	Settlement	37+950	39+660	Cultivation	60+480	60+890	Agriculture	60+480	60+890	Settlement
40+030	40+440	Cultivation	39+660	40+960	Settlement	60+890	60+940	Settlement	60+890	61+050	Cultivation

Left Hand Side			Right Hand Side			Left Hand Side			Right Hand Side		
40+440	40+960	Settlement	40+960	41+700	Cultivation	61+150	61+690	River	61+050	61+390	Settlement
40+960	41+700	Cultivation	41+700	42+650	Settlement	61+690	61+880	Agriculture	61+390	61+880	River
41+700	42+650	Barren land	42+650	42+730	Cultivation	61+880	61+930	River	61+880	61+910	Cultivation
42+650	42+730	Cultivation	42+730	44+000	Barren land	61+930	62+150	Agriculture	61+910	62+160	Settlement
42+730	44+440	Settlement	44+000	44+440	Cultivation	62+150	62+330	Barren Land	62+160	63+230	Cultivation
44+440	44+850	Cultivation	44+440	49+090	Settlement	62+330	62+350	River	63+230	63+240	River
44+850	49+090	Settlement	49+090	49+920	Cultivation	62+350	63+220	Settlement	63+240	63+340	Barren Land
49+090	50+810	Cultivation	49+920	50+810	Settlement	63+220	63+250	Barren Land	63+340	64+990	Cultivation
50+810	51+250	Settlement	50+810	52+150	Cultivation	63+250	64+070	Settlement	64+990	65+530	River
51+250	52+480	Cultivation	52+150	52+480	Settlement	64+070	64+980	Barren Land	65+530	66+180	Barren Land
52+480	52+630	Settlement	52+480	53+180	Cultivation	64+980	65+520	Settlement	66+180	66+370	Settlement
52+630	53+180	Cultivation	53+180	53+840	Settlement	65+520	65+740	Agriculture	66+370	67+170	Barren Land
53+180	53+840	Settlement	53+840	54+220	Cultivation	65+740	65+840	River	67+170	67+430	River
53+840	54+220	Cultivation	54+220	54+440	Settlement	65+840	66+180	Agriculture	67+430	67+650	Cultivation
54+220	54+440	Settlement	54+440	55+220	Cultivation	66+180	66+290	Barren Land	67+650	69+610	Settlement
54+440	55+220	Cultivation	55+220	56+210	Settlement	66+290	66+350	Settlement	69+610	69+840	Cultivation
55+220	56+210	Settlement	56+210	56+420	Cultivation	66+350	67+170	Agriculture	69+840	70+650	Settlement
67+170	67+510	Barren Land	70+650	70+760	Barren Land	80+120	80+500	Settlement	81+570	81+840	Settlement
67+510	68+500	Settlement	70+760	71+150	Cultivation	80+500	81+090	Barren Land	81+840	81+910	Cultivation
68+500	69+120	Barren Land	71+150	71+860	Settlement	81+090	81+580	Agriculture	81+910	82+240	Settlement
69+120	69+270	Settlement	71+860	71+950	Cultivation	81+580	81+680	River	82+240	82+540	Cultivation
69+270	69+610	Agriculture	71+950	72+470	Settlement	81+680	81+910	Agriculture	82+540	82+780	River
70+000	70+760	Settlement	72+470	74+800	Barren Land	81+910	82+240	Settlement	82+780	83+090	Cultivation
70+760	71+010	Agriculture	74+800	74+880	River	82+240	82+460	Agriculture	83+090	83+790	Settlement
71+010	71+360	River	74+880	75+460	Cultivation	82+460	82+700	Barren Land	83+790	84+200	Barren Land
71+360	71+890	Barren Land	75+460	75+470	Settlement	82+700	82+980	River	84+420	85+650	Cultivation
71+890	72+300	Settlement	75+470	75+700	River	82+980	83+070	Barren Land	85+650	85+670	Settlement
72+470	74+800	Barren Land	75+700	75+780	Barren Land	83+070	83+100	Agriculture	85+670	86+680	Cultivation
74+880	75+460	Agriculture	75+780	75+970	River	83+100	83+770	River	86+680	87+310	Settlement
75+500	75+720	Barren Land	75+970	77+290	Barren Land	83+770	84+020	Agriculture	87+310	86+823	Barren Land
75+720	75+780	Agriculture	77+290	77+580	Cultivation	84+020	84+040	Settlement			
75+780	75+970	Settlement	77+580	77+740	Settlement	84+040	84+360	Agriculture			
75+970	76+440	Agriculture	77+740	77+830	Cultivation	84+360	84+500	Settlement			
76+440	76+830	Settlement	77+830	77+990	Settlement	84+500	84+660	River			
76+830	77+320	Agriculture	77+990	78+000	Cultivation	84+660	85+660	Agriculture			
77+320	77+560	Settlement	78+000	78+330	Settlement	85+660	85+690	Barren Land			
77+560	77+660	Barren Land	78+330	78+820	Barren Land	85+690	86+823	Agriculture			

Left Hand Side			Right Hand Side			Left Hand Side			Right Hand Side		
77+660	77+850	River	78+820	78+860	River						
77+850	77+980	Barren Land	78+860	79+380	Cultivation						
77+980	78+820	Agriculture	79+380	79+410	River						
78+820	78+870	Settlement	79+410	79+600	Cultivation						
79+200	79+400	Barren Land	79+600	80+110	Settlement						
79+570	79+590	Agriculture	80+110	80+510	River						
79+590	79+670	Settlement	80+510	81+110	Barren Land						
79+670	80+120	Agriculture	81+110	81+570	Cultivation						

Source: Field Survey, 2018

7. Hydrology and Drainage

78. All rivers within Kanchanpur - Kamala road section originates from the foothill of Churiya of Saptari and Siraha districts. They flow from north to south till it reaches proposed bridge sites. The average slope of rivers near proposed bridge sites varies from 0.00216 to 0.00522. These rivers are of aggrading, degrading as well as stable nature. The river morphology of Kanchanpur - Kamala road section seems stable. Most of the rivers are non-perennial however Balan nadi (km. 193+974), Khando nadi (km. 170+260), Mainabati Nadi (km. 216+720), Gagan-2 (km. 212+690), Ghurmi nadi (km. 221+190), Amaha nadi (km. 186+880), Chapin nadi (km. 183+740), Kharak nadi (km. 181+740), Rai khola (km. 158+390) and Jiba khola (km. 225+410) shows less flow and other rivers such as Sundari-1 (km. 216+720), Badhuwa nadi, Dudhela nadi, Deodhar nadi, and Lakeshar nadi are completely dry condition during the dry period. High sediment flowing rivers are Balan nadi, Khando nadi, Mainabati Nadi Gagan-2, Ghurmi nadi, Amaha nadi, Chapin nadi, Kharak nadi, Rai khola and Jiba khola. Other rivers like Sundari-1, Badhuwa, Dudhela, Deodhar, Lakeshar are not having high sediment flow problem and these rivers are in more stable geomorphologic condition.

8. Geology

79. Geologically, the proposed major bridges (18) along Kanchanpur – Kamala section of East West Highway lies on the loose and thick recent alluvial and colluvial deposits. Physiographically, the proposed section and bridge sites lie on Bhabar zone, one of northern sub-division of Terai (Southern geological unit). The project area (river) along the road alignment has nearly gentle to moderate slope and composed of silty sand in riverbed followed by low plastic clayey silt with traces of fine sand. The alignment passes within about 1 km south of the Siwalik Hills nearby Amaha Khola (km. 186+880), whereas Siwalik is about 20 km north at proposed Balan Bridge site (km. 193+974).

9. Seismicity of the Project Area

80. Nepal is a seismically active country lying between collisions of the Indian and Eurasian plates and moving continuously resulting in frequent and often devastating earthquakes within the region. Nepal has experienced catastrophic earthquake damages in 1934, 1988 and recently in 2015. Recently tremor of earthquake having epicenter at Barpak of Gorkha and Sindhupalchok in 2015 and its aftershock has caused loss of several thousands of peoples and damaged tremendous value of infrastructure.

81. The UN Office for Coordination of Humanitarian Affairs (OCHA) Regional Office for Asia Pacific categorized the area in Nepal side as Degree VIII in the Modified Mercalli Scale, equivalent to Zone IV category of India.

10. Air, Noise and Water Quality

82. Air, noise quality of the project area is observed to be of good quality despite the vehicles plying. The sources of air pollution in these areas are mainly from vehicular emissions, fugitive dust particles related to vehicular movement and industrial emissions. Whereas, area with more economic activities near to the proposed bridge locations like Kanchanpur, Rupani, Lahan, Gol bazaar, Bandipur, Mirchaiya, Itaharawa Kallauni and Karjanha bazaar etc are observed to be exposed to moderate air and noise pollution. The noise generated by the vehicular operations,

industrial activity and other human activities are the main source of noise pollution. Noise pollution is created by moving vehicles with their unnecessarily blowing horn.

83. Water pollution continually takes place on the Terai, caused by both industrial and leakage of fuels and lubricants. Localized concentration of air, water and noise pollution is prominent within the settlement areas of Kanchanpur, Rupani, Siraha and Mirchaiya etc. Air, noise and water quality monitoring has been carried out in 6 locations for air and noise and 4 locations for water quality. Data analysis is undergoing, result of analysis will be presented in the final report.

84. **Baseline Air and Noise Levels**. Baseline air and noise levels were measured at different locations along the road on May 2018 to establish the baseline conditions in the proposed project. The monitoring was carried out at six locations. Parameters monitored for air quality include total suspended particulates (TSP), PM_{10}, $PM_{2.5}$, NOx, CO and SO_2.

85. **Methodology**. Monitoring of suspended matter in the ambient air at the selected sites was conducted by using Envirotech Respirable Dust Sampler, Model APM 460 NL high volume sampler and Envirotech small particle sampler Model APM 355. The samplers use a continuous duty blower to suck in an air stream. They are fitted with a particle size classifier, which separates particles greater than 10µm size from the air stream in case of APM 460 NL and in case of APM 355 arrangement is made for trapping of particles larger and 2.5 µm size in a filter paper soaked in silicone oil. The air stream is then passed through a filter paper to collect particles equal or lesser than 10µm size (PM10) in case of the former and particles equal to or lesser that 2.5 µm size in the latter machine. Gravimetric measurements yield values of suspended particulate matter (SPM), and PM_{10} or $PM_{2.5}$, the material retained on the filter papers.

86. The high-volume sampler is used to sample gaseous pollutants as well. A stream of unfiltered air is bubbled through a reagent, which either reacts chemically with the gas of interest or into which the gas is dissolved. Wet chemical techniques are then used to measure the concentration of the gas.

87. In the laboratory in Kathmandu, filter papers for collection of particles ≤ 10 microns were kept in desiccators for 24 hrs, weighed, the weights recorded. They were packed carefully in labeled envelopes. Cups for collection of coarser particles of >10 microns were also weighed and labeled. They were transported to the site. After each sampling run in the field, these were securely kept in envelopes/ containers with proper labeling and safely transported to the laboratory in Kathmandu, where they were received by the laboratory personnel, checked and recorded in the entry book. The filter papers were kept in desiccators for 24 hrs and weighed. The cups were also weighed and recorded. The difference in weights was used for calculating the suspended matter in the respective location during the monitoring time.

88. SOx and NOx were sampled simultaneously by the same instrument through the connected gas sampling gadget. Sodium hydroxide and Tetra-chloro-mercurate solutions are used for absorption of NOx and SOx respectively. The tubes were chilled by ice water placed on their outside to prevent evaporation and greater absorption. Samples were instantly stored at low temperature and transported to the laboratory in an ice box kept at low temperature till analysis to determine values of the parameters.

89. Sampling sites are indicated in **Table 15**. Corresponding results of air, noise and water levels are indicated in **Table 15.**

Table 15: Air and Noise Sampling Locations

S. No.	Location	Chainages
Air and Noise		
1.	Start point (Kanchanpur) Kanchanrup municipality	km 0+000
2.	Birendra bazaar Rupani rural municipality (RM)	km 17+150 – 17+500
3.	Kalyanpur bazaar Khadak municipality	km 30+200 – 30+300
4.	Lahan bazaar Lahan municipality	km 45+300 – 47+600
5.	Army barracks Naraha RM	km 70+000
6.	End point (Kamala bridge) Karjanha municipality	km 87+000
Surface Water		
1.	Sundari river Saptari district	
2.	Balan river Saptari & Siraha border	
Ground water		
1.	Tubewell –Kanchanpur, Saptari district	
2.	Tubewell - Lahan bazaar, Siraha district	

Table 16: 24-hour Baseline Air Quality Monitoring Results, µg/m3

Coordinates		Location	$PM_{2.5}$	PM_{10}	TSP	SOx	NOx	CO (8-hours)
Latitude	Longitude							
26.8796 N	86.1462 E	Kamala Bridge	26.40	87.30	317	9.7	0.9	ND
26.8107 N	86.2881E	Army Barracks	45.17	85.40	350	3.2	1.2	ND
26.7131N	86.4787E	Lahan Bazaar	57.72	109.12	410.14	6.00	0.51	ND
26.6411N	86.6249E	Kalyanpur	54.24	123.60	369.64	0.17	0.57	ND
26.6251N	86.7512E	Birendra Bazar	24.30	65.40	290.5	0.20	0.6	ND
26.6321N	86.9107E	Kanchanpur	46.00	59.69	159.8	5.60	0.42	ND
NAAQS standard			40.00	120.00	230.00			10,000

90. $PM_{2.5}$ level exceeded NAAQS standard in 4 out of 6 sampling sites. These fine particles, less than 2.5 micrometers, can come from various sources. The various road works, the dry weather, agricultural burning and motor vehicles traversing the East West Highway contributed to the high level of $PM_{2.5}$. Also, PM10 level in Kalyanpur exceeded the GoN standard. The same can be said for TSP, since 5 of the 6 sampling locations exceeded the national standard.

91. Of greater concern is the fine particles which tend to stay longer in the air than heavier particles. Because of their very small size, PM2.5 can bypass the nose and throat and directly penetrate deep into the lungs and circulatory system. Various studies concluded a close link between exposure to fine particles and premature death from heart and lung disease. It can also trigger or worsen chronic diseases such as asthma, heart attack, bronchitis and other respiratory problems.

92. **Table 17** indicates the noise level monitored in different sites along the proposed road.

Table 17: Noise Level Baseline Monitoring Results

Decibels	Kamala River	Army Camp	Lahan Bazar	Kalyan bazar	Birendra Bazar	Kanchanpur
L_{10}	84.58	87.49	83.88	85.51	87.6	81.19
L_{90}	63.16	61.1	62.25	66.54	62.3	64.4
L_{50}	75.25	72.85	72.6	74.2	74.3	72.6
L_{eq}	82.90	84.46	80.40	80.22	84.97	77.30
L_{max}	91.5	92.4	90.1	92	90.5	89.2
L_{min}	56.2	59.9	52.7	59.6	57.2	59.6
Average	73.53	73.67	72.88	76.23	74.23	73.03

B. Ecological Resources

1. Conservation Status

93. The proposed project area is not a designated site of nature conservation interest and there are no other such ecologically important sites in the project area.

2. Forest and Vegetation

94. Major species found within the project area are Sissau (*Dalbergia sissoo*), Khayar (*Acacia catechu*), Masala (*Eucalyptus sp.*), Bar (*Ficus bengalensis*), Pipal (*Ficus religiosa*), Simal (*Bombax ceiba*), Teak (*Tectona grandis*), Jamun (*Syzegium cumini*) etc. Others include mango (*Mangifera indica*), bamboo *(Bambusa vulgaris)* etc. The project area is free from any of the Community Forest and other forest type of National significance. The road section is free from any of the Community Forest and other forest type of National significance.

3. Wildlife

95. The project area forms a peri urban area and the habitat is disturbed with increasing settlements. Virtually no wildlife and wild animals of significance were noted within the project area. No endangered species inhabit the project area. Some notable species reported in the project area are Jackal (*Canis aureus*), Mongoose (*Herpestes auropunctatus),* Monkey (*Macacca mulatta*), porcupine (*Hystrix indica*), Squirrel (*Funambulus sp.*). However, none of these wildlife are endangered species. Bird species found in the Project area are Crow (*Corvus splendus*), cuckoo (*Cuculus micropterus*), dove (*Streptopelia spp.*), Sparrow (*Passer domesticus*), Pigeon (*Columba livia*) etc.

4. Fish and Other Aquatic Animals

96. The Project Rivers are mostly seasonal rivers that have minimum discharge during the dry season. The river discharge improves as the monsoon season arrives. The Mahuli and Balan River being the larger river having bigger catchment area has more discharge than other small rivers. Because of dry nature of the rivers, there are very few biotic inhabitants and much less fish in the river. Fish species found in water bodies are Bam and Hile. These fish species are mainly found in Balan, Mahuli, Khado Rivers which are within ZoI.

C. Socioeconomic Environment

1. Population status of project affected districts

97. According to the Census 2011 (CBS), total population of Saptari and Siraha districts are 639,284 and 637,328 respectively. The average family size of project districts is 5.28 and 5.40 respectively. The population density per square kilometer is 469.03 persons per square kilometer in Saptari and 536.47 persons per sq. km. in Siraha respectively.

Table 18: Population Distribution by Project affected districts

District	Total HHs	Total Population	Male	Female	Average HH Size	Population density	Area in Sq. km
Saptari	121,098	639,284	313,846	325,438	5.28	469.03	1363.00
Siraha	117,962	637,328	310,101	327,227	5.40	536.47	1188.00

District	Total HHs	Total Population	Male	Female	Average HH Size	Population density	Area in Sq. km
Total	**239,060**	**1,276,612**	**623,947**	**652,665**	**5.34**	**500.46**	**2551.00**

Source: District Development Profile of Nepal, CBS, 2011

2. Population description of Project Affected Municipality/Rural Municipality

98. According to 2011 census, total population of 9 municipalities and 3 Rural municipalities) touched by the proposed project road section is 524,142 with 100,225 households which accounts for 41.06 % of the project districts population. Gender-wise population distribution is estimated at 48.33% male and 51.67% female.

Table 19: Population Distribution by Project affected Municipality/Rural Municipality

Road Section	Municipality/Rural municipality	Total HHs	Population			Average HH Size
			Total	Male	Female	
Saptari District						
00+000 - 45+400	KanchanRup Municipality	10989	57,166	27,844	29,322	5.20
	Agnisair Krishna Sabaran Rural municipality	4716	23,813	11,247	12,566	5.05
	Rupani Rural municipality	5,012	26,387	12,824	13,563	5.26
	Shambhunath Municipality	5,817	30,207	14,334	15,873	5.19
	Khadak Municipality	8,615	45,368	21,308	24,060	5.27
	Surunga Municipality	9,888	50,445	23,823	26,622	5.10
Siraha District						
45+400 - 86+823	Lahan Municipality	17,182	91,766	45,515	46,251	5.34
	Golbazaar Municipality	10,294	53,416	25,998	27,418	5.19
	Dhangadimai Municipality	8,394	45,159	21,932	23,227	5.38
	Naraha Rural Municipality					5.27
	Mirchiaya Municipality	9,557	50,079	24,419	25,660	5.24
	Karjanha Municipality	6,088	30,967	14,770	16,197	5.09
	Total	**100,225**	**524,142**	**253,317**	**270,825**	**5.23**

Source: District Development Profile of Nepal, CBS, 2011

5. Caste/Ethnicity and Language

99. Siraha residents live in mixed ethnic and caste communities. The major groups are Yadav, Chaudhary (Tharu), Jha, Mishra, Brahmin and Chhetri, followed by Tamang, Rai, Newar and Magar. The latter groups, plus many of Brahmin and Chhetri, are recent migrants from the mid-Himalayan hills. A majority of the population speaks Maithili, a language closely related to Hindi. Nepali is the second most commonly spoken language. Most men and some women are bilingual. Some minority ethnic dialects are also spoken, such as Tharu. Like elsewhere in the Terai, ethnic composition and population in Saptari district are heavily influenced by recent migration from the middle hills and North India. Caste and ethnic groups include the Chaudhary (Tharu), Yadav, Bahun (Brahmin), Magar, Rajput and Muslims. The principal languages are Maithili and Nepali.

100. The predominant ethnic groups residing along the road section is Yadav, Tharu and Musalman. The other major castes are Teli, Dhanuk, Musahar, Khatwe, Chamar, Koiri/ Kushwaha, In the project affected Saptari district, Yadav is the largest ethnic population with 15.76% followed by Tharu (11.53%), Musalman (8.94%), Teli (7.31%), Dhanuk (6.53%), Musahar (6.04%), Khatwe (5.94%), Charmar (4.33%), Kathbaniyan (2.33%), Bantar/ Sardar (2.24%) and others (29.05%) (Refer Annex 6). Similarly, in the project affected Siraha district, Yadav is the

largest ethnic population with 24.38% followed by Musalman (7.49%), Musahar (6.27%), Koiri/ Kushwaha (6.01%), Chamar (5.67%), Teli (4.80%), Tharu (4.14%), Dhanuk (3.66%), Sudhi (2.75%), Mallaha (2.52%), Kewat (2.18%), Khatwe (2.18%) and others (27.95%) (Refer Annex 6) (Source: District Development Profile of Nepal, CBS, 2011).

101. In project area, language wise, 68.94% of total population speaks Maithaili, 12.16% people speak Tharu language, 8.28% people speak Nepali and 4.60% people speak Urdu. Tamang language is spoken by 1.55% followed by Magar language with 1.34%, Danuwar (0.38%) and Newari 0.37%. Along with these languages there are also various languages having users less than 1%.

6. Literacy Rate and Education Level

102. Saptari and Siraha districts have literacy rate of 54.50% and 50.15%, respectively. In the project affected area, as per 2011 Census, about 54.37% of population aged 5 years and above can read and write. The literacy status of the households covered by the household survey in the project area shows that about 11.14% populations are illiterate and 16.4% population had attended up to primary level, 16.13% have reached to higher secondary level and about 3.8% population are graduate or above graduate level. Table 19 shows the details of literacy status of surveyed households.

Table 20: Literacy Status of sample households

S. N.	Educational Status	Population			Percent (%)
		Male	Female	Total	
1	Below 5 year	323	269	592	11.02
2	Illiterate	211	387	598	11.14
3	Literate (up to 5)	327	449	776	14.45
4	Class (5-10)	428	454	882	16.42
5	Class (10-12)	864	568	1432	26.67
6	Graduate & above	573	293	866	16.13
7	Left school (School dropouts)	157	48	205	3.82
	Total	**2891**	**2479**	**5370**	

Source: Household Survey, 2018

7. Health facilities

103. There is 1 hospital along with other supporting health services organization in Saptari district. The supporting center includes 9 health posts and 103 Sub-health Posts in Saptari district. (Annual Report, DHO 12/13, Saptari).

104. Similarly, in Siraha district, there are 4 primary healthcare center, 11 Ilaka health post, 93 sub-health post, 11 health post, 2 government hospitals, 376 PHC/Outreach Clinics etc (Source: HMIS Report Health Fact Sheet, 2014).

8. Sanitation Facility

105. In the project influence area only 27.19 % of the households have toilet facilities. Those who have toilet mostly possess either pan or pit type toilet with flush system.

9. Drinking Water

106. In the project area, major source of drinking water is found to be from Tubewell/handpump piped water (81.59%). About 8.69 % of households use uncovered well/kuwa for the purpose of drinking water and about 5.84 % of the household also use tap/piped water as a source of drinking water. Other source of drinking water is river/stream.

10. Occupational Status

107. In Saptari district, about 22.48 % of total population has their main occupation as agriculture in their own land, and small segments of the population (4.41%) have adopted their main occupation as agriculture in the basis of salary/wage work. Household work as their occupation accounted for 25.31percent, is followed by student (22.00%). About 9.07 percent of the population was engaged in external jobs in abroad. Occupational pattern is more or less same in case of male and female except in case of salaried non-agriculture occupation and abroad external job where female participation is quite low i.e. only 1.38 and 1.05 percent in comparison to 8.34 and 8.02 percent reported by male. (Source: District Profile: Siraha, MoAD/BRCH/Agriculture Management Information System, 2015).

108. Similarly, in Siraha district, about 24.73 percent of the population has adopted their main occupation as agriculture in their own land, and few segments of the population (2.15%) have adopted their main occupation as agriculture in the basis of salary/wage work. Household work as their occupation accounting for 23.08 percent is followed by student accounting for 22.81 percent. About 11.94 percent of the population was engaged in external jobs in abroad. Occupational pattern is more or less same in case of male and female except in case of salaried non-agriculture occupation and abroad external job where female participation is quite low i.e. only 1.64 and 1.17 percent in comparison to 8.32 and 10.76 percent reported by male. (Source: District Profile: Siraha, MoAD/BRCH/Agriculture Management Information System, 2015).

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

109. Road improvement projects are likely to bring several changes in the local environment which are both beneficial and adverse. This section of IEE identifies the nature, extent and magnitude of all such likely changes vis-a-vis project activities for all stage of project cycle i.e. pre-construction, construction and operation. Beneficial impacts are mostly long-term and permanent whereas adverse impacts are localized and temporary in nature and are likely to occur mostly during construction stage.

110. Potential impacts on physical, biological and socio-economic and cultural environment are identified and predicted based on the existing baseline condition with respect to the proposed Sub-project interventions in terms of type of impact (direct/indirect), their magnitude (low/moderate/high), duration (short term/ medium term/long term), and extent (site specific/local/regional/global).

A. Potential Beneficial Impacts

111. The proposed road for upgrading passes through various major settlements in the district. The construction works will provide different opportunities to the local people ranging from unskilled labour to skilled work. There would also be spin-offs leading to improved farm and off-farm activities, which may ultimately benefit the local economy. The beneficial impacts of the subproject during the construction stage are summarized below.

1. Employment and Income

112. The key benefit that local people may expect from the construction works is employment during the construction stage. The construction works offer a wide range of works for about 1000,000 person-days of unskilled, 300,000 person-days of skilled labourers. Local people would generate substantial incomes from unskilled and semi-skilled jobs. The amount of money that is injected in the peri-urban economy in the form of wage earnings will directly enhance the initiation of various ancillary economic activities and enterprise development. The impact is thus direct, of high significance, local but short term in nature. If the earned wage income is saved and utilized for micro-enterprises, benefits can be for long term duration.

2. Enterprise Development and Commercialization

113. During the construction period, different types of commercial activities will come into operation in order to meet the demand of labour groups, construction crew and Sub-project team. In general, the enterprises will include food and tea shops, groceries, lodges and restaurants for serving large numbers of people. The demand for local products such as pulses, vegetables, fruits, etc. will rise during the construction period which may provide added impetus for local production and marketing. This will contribute to the local economy and may help reduce peri-urban poverty. Such benefits may contribute to enterprise development which often continues to entrench beyond the construction period. This impact will be direct, of moderate significance, local and long-term in nature.

3. Skills Enhancement

114. The underlying policy of the labour-intensive approach is to employ local specifically poor (unskilled) labour force, to the extent possible, for works that can be carried out manually. This strategy not only provides employment opportunities for the local poor people but also supports

the transfer of skills and technical know-how while working in construction work such as masonry, gabion works and roadside plantation. An estimated 1,000,000 person days of unskilled employment is envisaged in the Sub-project. This impact will be direct, of high significance, local and long-term in nature.

4. Improved Access and Promotion of Green House Gas Reduction

115. The upgraded road from 2 lanes to 4 lanes AC will offer easy, comfortable, safe and quick access eliminating existing traffic congestion and reduction in roadway accidents. Consequently, the transportation of goods and services from India to the project region and to other parts of the country will be easier, faster, and cheaper. The improved road surface will reduce the wear and tear on vehicles parts thus reducing the general costs for spare parts; increase the fuel efficiency and reduce vehicular emissions. This entails in reduction of CO_2 emissions. The proposed plantation of road side avenue trees will also add ground in natural consumption of CO_2 and emission of oxygen in the surrounding atmosphere. Though CO_2 emissions magnitude driven by transportation sector in Nepal is relatively insignificant, the upgraded access itself will somehow be beneficial in fuel efficiency. Further, the proposed full width bituminous sealing of pavement within built up area of Mirchaiya, Bandipur, Golbazar, Rupani, Kathauna and Kanchanpur will reduce dust emission and associated health hazards. This will be of direct, of high significance, regional and of long-term in nature.

5. Rise of Land Value

116. Road construction and upgrading often leads to rise in land values along the road corridor. Increased land values also enhance farmer's capability for borrowing loans on collaterals. High value lands are easily acceptable to banks and micro-finance institutions to provide loans. This impact will be direct, of moderate significance, local and long-term in nature.

6. Increased Crop Productivity and Sale of Farm Products

117. The upgraded road will provide improved access to seeds, chemical fertilizer, irrigation, agriculture extension, new crop technologies and markets assisting in increased agriculture production and diversification. Agro-industries may be established in nearby areas based on local products such as raw materials. This will enhance economic activities within the area. Such impacts will be direct, of moderate significance, regional extent and of long-term in nature.

7. Enhancement of Social Services

118. Because of the improved access, other socio-economic development activities including health, education, communication, market, etc can be increased. The operation of the road will also contribute to the increase in quality services in the social sector as more competent agencies and people will enter into the area to provide services. This will have indirect, of moderate significance, regional and long-term impact of the proposed subproject.

8. Women Empowerment

119. Improved transportation will strengthen women in particular while providing better access to schools, health centers, and markets. More frequent visits to such agencies and areas due to improved access will increase women's knowledge, awareness and confidence level. Priority for employment in construction works without gender biased wage rates in the Subproject will facilitate women to directly earn money. Increase in number of NGOs/CBOs that focus on women

development help address problems like HIV/AIDS, safe sex, safe motherhood, etc. The impacts are of indirect, of moderate significance, local to regional and long-term in nature.

B. Adverse Impacts

120. The Subproject activities during construction and in the operation of the road may create a number of adverse impacts on the local environment. These are discussed briefly in the following sub-sections.

1. Construction Phase

a. Impacts on Physical Environment

Table 21: Physical Environmental Issues and Impacts

Issues	Impacts	Direct/ Indirect	Extent	Duration	Magnitude	Initiation
Earthworks / Slope Stability	• Soil erosion on embanked slope • Monsoon siltation on adjacent farmland and water body.	D	Site	Long	L	C & O
	• Disruption of Public Utilities • Disruption of electrical and telephone poles • Disruption of existing cross-drainage structures • Disruption of existing Bus Bays • Disruption of water supply pipelines	D	Local	Medium	H	C
Drainage and Water Management	• Water logging and Inundation • Sedimentation of surface waters • Destruction of vegetation and agricultural lands	D	Site Specific	Long	M	C & O
Traffic Hazard and Road Safety	• Roadway accident risks • Disruption in Smooth flow of traffic	D	Local	Long	M	C & O
Operation and Closure of Quarries and Borrow Pits	• Disruption of natural land contour, disturbance in natural drainage and scouring of river beds.	I	Local	Short	L	C

Issues	Impacts	Direct/ Indirect	Extent	Duration	Magnitude	Initiation
	• Ponding, water logging and water pollution.					
Stockpiling of Construction Materials and Debris Disposal	• Siltation and pollution • Disturbance to private property	D	Site	Short	L	C
Air Pollution	• Localized dust emission • Localized increase in gas emissions from vehicles	D	Local	Short	L	C & O
Noise Pollution	Nuisance to local residence	D	Local	Short	L	C & O
Water Pollution	Effect on adjoining water bodies from construction activities	D	Local	Short	L	C & O
Use of Bitumen / Combustible / and Toxic Materials	• Use of fuel wood to heat Bitumen • Release of Bitumen into the environment (runoff of bitumen into surface waters) • Fire and explosion hazard • Spills and leaks	D	Local	Short	L	C

Note:
D = Direct Impacts I = Indirect Impacts L = Low Impacts
M = Moderate Impacts H = High Impacts C = Construction Phase
O = Operation (commissioning) Phase

b. Earthworks / Slope Stability

121. **Impacts:** The major activity associated with proposed road upgrading involves formation of embankment on both sides for widening from two to four-lane standard. Exposed embanked slope to rain and wind could cause soil erosion and siltation in monsoon affecting adjacent farmland as well as clogging drains and cross-drainage. In particular it could affect Chandra Canal that crosses the highway at km 02+300 and Kamala irrigation canal at km 51+200. The impact will be direct, of low magnitude, site specific and long-term in nature.

122. **Mitigation:** Measures to mitigate impacts arising from earthworks include:

- The top soil (0-25 cm) from the productive land (borrow areas, road widening areas, etc.) shall be preserved and reused for plantation and restoration purposes.
- It shall be ensured that any private land taken on lease, used community or/ government land for access road and construction/labour camp shall be restored back to its original land use before handing it over back to land owner.

- Soil erosion shall be stabilized by applying engineering as well as bioengineering techniques;
- During road improvement, only required vegetation shall be cleared and eroded bare slopes shall be revegetated.

c. Disruption of Public Utilities

123. **Impacts.** The existing public utilities and services located within the COI will be affected by the proposed road upgrading. These will require removal/relocation, extension, reinstatement, demolition and construction depending upon their function and necessities. These services include: about transformer (34), power supplying lines (526 electric poles, 240 lamp posts etc.); 179 telephone poles and public tubewell (5). (Source: Inventory Survey, 2018).

124. **Mitigation:** The shifting of the utilities will be done in a manner to create minimum disruption and inconvenience to the service users. In particular the following actions will be taken:

- Inform public in advance through local media on the schedule of shifting of respective utility structure
- Plan shifting activities in a manner to minimize the time of non-availability of the respective service
- Take advanced actions and process necessary clearances, transfer of funds etc. to the respective utility service provider so as not to cause any delays to the road construction schedule

d. Drainage and Water Management

125. **Impact:** The water bodies within the Subproject area are occasional ponds, seasonal streams and most importantly surface water flows in wet season that are basically managed for irrigation purposes. Water logging and inundation is in particular recorded within settlement areas along the road alignment. The likely impacts will be sedimentation of surface waters and destruction of vegetation and agricultural land. With adequate drainage and cross-drainage structures, it is unlikely that there will be any residual adverse impacts on the environment.

126. **Mitigation:**

- Existing natural drainage system shall not be disturbed and construction near/inside rivers, streams, ponds will be avoided during the rainy season
- Causeways shall be provided in each perennial and seasonal streams as well as rivulets. In addition, adequate cross drainage structures shall also be provided to avoid natural flow of water especially for unusual rainfall events.
- The size of the drainage structures shall be designed to accommodate increasing volumes of water.
- The size of the drainage structures shall be designed to accommodate increasing volumes of water.

e. Siltation and Deterioration in Surface Water Quality

127. **Impact:** Construction activities may increase turbidity level increasing the sediment load. Sometimes contamination of surface water may take place due to accidental spills of construction materials, oil, grease, fuel, and paint. Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers camps and from spillages from

vehicle parking and/or fuel and lubricant storage areas. During construction care will need to be exercised to control silt so that the water available in the ponds and wells especially those located very near to the ROW may not be contaminated.

128. **Mitigation:** The following mitigation measures shall be implemented to minimize siltation and deterioration of surface water quality:

- Construction works near waterways/water bodies will not be undertaken during the monsoon season
- The Contractor are prohibited to dispose excavated spoils and wastes into streams water.
- All chemicals and oil shall be stored away from water and shall be stored at concreted platform with catchments pits for spills collection.
- The Contractor shall arrange training programme to all equipment operators, drivers, and warehouse personnel on immediate response for spill contamination and eventual clean-up. Further, emergency procedures and reports preferably written in easy to understand local dialects shall be distributed to the workers as well as local people.
- Silt fencing and/or brush barrier shall be installed for collecting sediments before letting them into the water body. Silt/sediment shall be collected and stockpiled for possible reuse as surfacing of slopes for re-vegetation.
- All wastes arising from the construction sites shall be disposed in an environmentally acceptable manner. The wastes shall be collected, stored and transported at approved disposal sites.
- No vehicles or equipment shall be washed, parked or refuelled near streams water, to avoid contamination of streams water from fuel and lubricants.
- Vehicle parking and maintenance areas will have waterproof floors from which drainage is collected and treated to legal standards.
- Large labour camps shall be avoided along the alignment and shall be located at least 500m away from settlements and river sides. Construction labourers shall be preferably recruited from the local community. Sewage from labour camps shall be managed in such a way that it shall not be polluted streams water and other public and private areas. No untreated sanitary wastewater shall be discharged into the streams water.
- Temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies/waterways

f. Traffic Hazard and Road Safety

129. **Impact:** Considerable vehicular traffic exists as the road forms one of the major links to neighbouring India via Kakarbhitta. The upgrading of the road works will disrupt smooth flow of traffic with increase in chances of road accidents. Inadequate provisions of road safety measure such as road safety signals, appropriate diversions and lack of enforcement of traffic rules during construction and operation period may invite accidents. The anticipated impacts will be direct, of moderate magnitude, local and long-term in nature.

130. **Mitigation:**

- The Contractor shall arrange to prepare a comprehensive traffic management plan to avoid disruption of the existing traffic due to construction activities.

- Installation of speed calming/controlling structures like bumps near designated pedestrian crossing areas shall be arranged.
- The Contractor shall be responsible for erecting signs, signals or barriers on sensitive and risky areas, which should be visible from long distance.
- After construction is completed in a particular section, it shall be opened for normal traffic operation.
- Use of delineators, traffic cones, empty bitumen drums, barricades, and flag men shall be used to ensure traffic management and safety.
- Regular safety audit on safety measures shall be conducted during construction.
- Use of haulage trucks heavier than the carrying capacity of the haulage roads and existing roads shall be avoided. The contractor shall be responsible for repair and maintenance of damaged existing road by the haulage trucks.

g. Operation and Closure of Quarries and Borrow Pits

131. **Impact:** The construction of the proposed road works particularly embankment fill, sub-base, base, Asphalt Concrete, DBST, drainage, cross-drainage and other structures will require extraction of loose materials, stone, chipping, sand and aggregates. These construction materials will be brought from the approved and established quarry sites for extraction of loose materials.

132. Extraction activity could disrupt natural land contours and vegetation resulting in erosion, disturbance in natural drainage patterns, siltation from surface waters, water pollution, ponding and water logging. Since the major source of quarry will be the alluvium deposits of various rivers located outside the road alignment, the direct and significant impact of quarries is not expected.

133. **Mitigation:** Measures to mitigate impacts arising from operation and closure of quarries and borrow pits include:

- Borrow pits and quarry sites shall be selected avoiding protected and sensitive areas, nearby settlements, water sources, and in forest areas and fertile agriculture lands. The potential sites shall be the waste and low quality of barren lands.
- Approval from authorities of government and land owners shall be taken.
- Suitable size of borrow pits and quarry sites shall be operated as per required volume of materials.
- Top soil shall be stockpiled and preserved for reuse during reinstatement of sites.
- In turn, preserved top soil shall be spread and grasses seeding with long mulch and tree planting shall be carried out as a part of bioengineering. Leguminous plant species shall be planted to restore nitrogen in the soil.
- Monitoring the implementation of borrow pits and quarry sites restoration plan will be carried out

h. Stockpiling of Construction Materials and Debris Disposal

134. **Impact:** The construction materials if not properly stored or stockpiled will lead to siltation and pollution of surface water resulting from uncontrolled runoff of storage piles. This in turn will disturb adjoining private property. Construction debris disposed haphazardly is likely to promote erosion and soil instability, destruction of private property, crops, and irrigation system, disruption of natural drainage systems and surface water pollution. The identified location for stockpiling are at chainage km (4+400, 6+950, 7+000, 23+700, 40+700, 42+500,54+200,65+800, 68+100,

75+000, 82+100, 84+700 and 86+600). The impact will be direct, of low magnitude, site specific and short-term in nature.

135. **Mitigation:** Some of the measures to lessen the impact of stockpiling of construction materials and disposal of debris include:

- The Contractor shall prepare a detailed management plan including suitable disposal locations for spoils/wastes and that shall be approved by the Supervision Consultant.
- Locations for disposal shall be selected with the consent of local community, local body representatives, and the sites shall be located at least 1 km away from the settlements, schools, hospitals, religious and cultural sites, water sources including other sensitive areas from environmental point of view.
- The Contractor shall reuse spoils/wastes for construction purposes to the extent as possible.
- No spoils or waste will be disposed on the valley side of the road.

i. Air, Noise and Vibration

136. **Impact:** During implementation of the Proposal, there are chances of dust and vehicular gas emission due to movement of construction vehicle and operation of crusher plant. This will be temporarily intense along the construction sites. Nearby settlements and construction workers may be affected by dust. As most of the construction works will be carried out during the dry season, dust emission will be expected to be locally high. Dust will also affect the road side vegetation and agricultural crops. These including increase in vehicular emission may add ground for increase in greenhouse gases, though in negligible amount. There are chances for littering of construction materials during its transportation.

137. At present, the Subproject area does experience noise pollution due to vehicles plying on the road. However, during construction, the increased construction activities mainly movement of heavy equipment and the operation of construction plants may cause noise nuisance to local nearby residence. There may be vibration effects along the road alignment.

138. During the construction stage, the adjoining water bodies are at risk of being affected due to construction activities i.e. surface runoffs, pollution from vehicles (oil changes/spills, fuel leaks etc) and waste from the labour camps if not managed well.

139. The anticipated impacts on air, noise and water bodies will be direct, of low significance, local and short-term in nature.

140. **Mitigation:** Based on the identified impacts of air pollution, the proposed mitigation measures are the following:

- Water sprinkling, water fogging, broom sweeping shall be carried out in dust prone locations, unpaved haulage roads[1], earthworks, stockpiles including asphalt mixing plant areas.
- Open burning of solid wastes (plastic, paper, organic matters) shall be prohibited.

[1] Water Flushing/Broom Sweeping can reduce emission from 0-96%

- Use of dust control methods (such as covers, water suppression on unpaved road surfaces, or increase moisture content for open materials storage piles) shall be practiced.
- Very old vehicles emitting gases beyond prescribed standard shall be checked and avoided.
- Masks and personal protective equipment shall be provided to the construction workers to minimize inhalation of suspended particulate matters.
- Mixing plants including crushers and the batching plants shall be located at least 1 km downwind from the nearest settlement only after receiving permission from the Supervision Consultant. Hot mix plant shall be fitted with stack/chimney of adequate height as prescribed by Supervision Consultant to ensure enough dispersion of exit gases.
- Heaters shall be used for heating purpose to the extent feasible.
- Only crushers licensed by GoN shall be used.
- LPG or kerosene shall be used as fuel source in construction camps instead of wood. Tree cutting for fuel wood shall be restricted.
- Diesel Generating (DG) sets shall be fitted with adequate height.
- Diesel with low sulphur content shall be used in DG sets as well as other machineries.
- Air quality shall be monitored during construction stage and if monitored parameters are above the prescribed limit, suitable control measures shall be applied.

141. The following mitigation measures shall be applied to avoid and/or reduce impact of noise arising through various activities during construction:

- Temporary construction facilities such as labour camps, vehicle maintenance workshop and earth moving equipment shall be located away from settlements and other sensitive areas as far as possible.
- Noise sources such as stone crushers, vehicles movements and work at stone quarry and borrow pit shall be re-located to less sensitive areas to take advantage of distance and shielding.
- Silencers shall be installed to construction equipment and machinery and maintained properly.
- Equipment and machinery with lower sound power levels shall be selected for the use.
- Protection devices such as ear plugs/ or ear muffs shall be provided to the workers during period of operating high noise generating machines.
- Noise levels shall be measured to ensure the effectiveness of mitigation measures.
- Construction activities shall be carried out only between 6 AM to 6 PM to avoid disturbance to nearby communities at night.
- Noise barriers such as earth mounts or walls of wood, metal that form a solid obstacle between the road and roadside community shall be used, especially in the schools and hospitals.
- A Grievance Redress Mechanism shall be developed to record and respond to complaints on noise by the local communities.

142. The following mitigation measures shall be applied to avoid and/or reduce vibration during various construction activities:

- Precaution shall be taken while using the machines and equipment, especially nearby public and private infrastructures.
- Contractor shall aware the operator for careful handling of machines and equipment.
- Where required controlled blasting techniques shall be adopted.
- The Contractor shall inform the community in due time about operations that bear the risk of nuisance and accidents, especially when blasting operations are underway.

j. Use of Bitumen / Combustible / Toxic Materials

143. **Impact:** The proposed Sub-project involves DBST pavement which will require safe storage and use of bitumen. Use of fuel wood to heat bitumen and release of bitumen into environment (runoff of bitumen into surface waters) are the potential impacts likely to occur if handled inappropriately. Similarly, storage and use of petrol, diesel, oil and lubricants including disposal of used oil, lubricants and solvents may invite explosion hazard, ground and surface water pollution resulting runoff from spills/leaks and improperly discarded used oil and lubricants. The anticipated impact will be direct, of low significance, local and short term in nature.

144. **Mitigation:** The following mitigation measures will be implemented to prevent pollution from bitumen and hazardous chemicals required for construction:

- Bitumen emulsion (that will not require heating through use of fuelwood) will be used to the extent possible.
- Bitumen drums will be stored in a secure place within the construction and camp site and at least 500m from any water bodies.
- No bleeding of bitumen into the soil and nearby water bodies will be allowed.
- All fuel, lubricants and chemicals will be stored in an enclosed and proper designated area within the camp site with restricted access.
- The area should have concrete floor with provision to capture any spilled fuel or chemicals.

C. Impacts on Biological Environment

Table 22: Biological Environmental Issues and Impacts

Issues	Impacts	Direct/ Indirect	Extent	Duration	Magnitude	Initiation
Vegetation and Forest Resource	Loss of vegetation	D	Site	Long	M	C & O

Note:
D = Direct Impacts I = Indirect Impacts L = Low Impacts M = Moderate Impacts
H = High Impacts C = Construction Phase O = Operation Phase

145. **Vegetation and Forest Resources.** The proposed road upgrading works entails clearing of road side trees with girth ranging from 0.5m to 3m and height from 3m to 12m. These trees stand within the proposed road formation width. The number of trees required for felling are as follows.

Table 23: Detail of Affected Roadside Trees

Type of Affected Trees	Total Number
Sissau (*Dalbergia sissoo*), Masala (*Eucalyptus sp.*), Bar (*Ficus bengalensis*), Pipal (*Ficus religiosa*), Simal (*Bombax ceiba*), Khayar (*Acacia Catechu*), Teak (*Tectona grandis*), Jamun (*Syzegium cumini*), mango (*Mangifera indica*), bamboo (*Bambusa vulgaris*) etc.	5627

146. The anticipated impact is of direct, site specific, of moderate significance and long term in nature.

147. **Mitigation:** Compensatory plantation at the national mandatory rate of 1:25 will be carried out including necessary protection to ensure survival of the planted trees. Given that about 5627 trees will need to be felled, a total of about 140,675 trees will need to be planted. Of this some trees will be planted along the roadside by the contractor and the remaining by the Department of Forests (DOF) based on budgetary transfer from DOR.

148. Assuming that trees can be planted on both sides of the road with a space of 20m in between trees for 80% of the road length, roughly 7000[1] trees can be planted along the road. These trees will be planted by the contractor and required costs will be included in the Bill of Quantity for the contractor. As stated in the Gender Action Plan (GAP) for the project women participation of atleast 30% will be encouraged in the tree plantation activities by the contractor.

149. The remaining number of 133,675 trees (140,675 – 7000) will be planted by the DOF. DOR will coordinate with DOF to ensure that semi-annual monitoring progress reports are provided by DOF on the progress of plantation.

150. Other mitigation measures on re-vegetation activities include:

- Trees shall be felled only after receiving permissions from the concerned authorities.
- Plantation and protection of shrubs and bushes including grass seeding shall increase aesthetic value of the area. Thus, it is recommended that the project shall arrange for planting suitable species of shrubs and small trees including grass seeding at available spaces and protection of natural forest vegetation.
- During construction, only necessary hillside slopes with vegetative covers shall be cut and cleared. The cleared bushes and grasses shall be replanted on bare slopes.
- No spoils including bitumen containers and other waste/spoil generated from roads excavation shall be thrown in and around the forest areas.
- If slopes with the vegetative covers are cleared they shall be re-vegetated by the suitable local species.

D. Impacts on Social, Economic and Cultural Environment

Table 24: Social, Socio-economic and Cultural Environmental Issues and Impacts

Issues	Impacts	Direct/ Indirect	Extent	Duration	Magnitude	Initiation
Land and Building Acquisition	• Demolition of Boundary walls	D	Local	Long	M	C

[1] 87000m (road length)/20m = 4350 trees; 4350 x 2 (two sides of road) = 8700 trees; 80% of 8700 = 6960

Issues	Impacts	Direct/ Indirect	Extent	Duration	Magnitude	Initiation
	• Demolition of Houses • Removal of temporary shops of road side vendors					
Stress on Public Utilities & Facilities	• Influx of outside workers exerting pressure on local services.	I	Local	Short	L	C & O
Occupational Health and Safety, STDs and Nuisance from Construction Camps	• Health risks and hazards due to lack of adequate safety measures • Poor labour camp, unsafe water and unhygienic conditions • Health risks due to influx of outside and migrant labours • Inadequate living space for labourers	D	Local	Short	M	C
Conflict due to Influx of Construction Workers	• Spread of alcohol consumption & gambling • Potential for STD such as HIV/AIDS	D	Local	Short	L	C & O

Note:
D = Direct Impacts I = Indirect Impacts L = Low Impacts
M = Moderate Impacts H = High Impacts C = Construction Phase
O = Operation Phase

1. Land and Building Acquisition

151. **Impact:** The Corridor of Impact (COI) is in general clear as the land within the proposed formation width has already been acquired by GoN. Thus, the subproject will not require any acquisition of land for the upgrading purpose**.**

152. However, a total of 460 structures belonging to 381 households (1982 persons) will be affected by the project. Most of the structures are commercial (74%), 15% are residential cum commercial (all of which are partially affected) and 10% are residential as given in the table 25 below. All of the structures belong to non-titled holders in the existing ROW.

Table 25: Types of Assets by loss and structure type

S. No.	Type of Asset Affected	No. of affected structures	%	No. of affected HHs	No. of APs
1	Residential Structures	44	10%	35	182
2	Commercial Structures including Ghumti	342	74%	272	1415
3	Residential Cum Commercial	70	15%	70	364
4	Others	4	1%	4	21
	Total	**460**	**100%**	**381**	**1982**

Source: Field Survey, April, 2018

153. Since it is an upgrading of existing highway where COI is already acquired by the GoN, disfiguration of landscape and change in land use due to road embankment will be insignificant. These impacts will be of direct, local, moderate in magnitude and long term in nature.

154. **Mitigation:** Appropriate compensation for the affected people will be provided in accordance with the entitlement matrix provided in the resettlement plan (RP) for the road. The RP provides detailed information on different types of impacts, compensation rate and relevant livelihood restoration activities.

2. Stress on Public Utilities and Facilities

155. **Impact:** Influx of large numbers of construction crews will exert pressure on existing public utilities and service facilities such as communication, water supply, solid waste management, health and medicine and transportation. As the Sub-project area constitutes a well-developed area, where adequate social services are available, pressure on existing available services will be insignificant. However, the impacts will be indirect, of low significance, short-term and local in nature**.**

156. **Mitigation:** The contractor will ensure to source water for construction and construction camps in a manner not to burden the existing local water supply system. The contractor may source water from new sources such as new bore wells for use in construction camps and river water when rivers exist near the construction site. Waste management facilities at the camp sites such as dust bins, compost pits and linkage with relevant municipal waste collection system must be arranged at all camp sites by the contractor.

3. Occupational Health and Safety, STDs and Nuisance from Construction Camps

157. **Impact:** During the construction phase, the work personnel will be exposed to various health risks and hazards due to injuries to workers while working without adequate safety measures and equipment. Typical health hazards will be encountered during handling of hazardous materials, machinery movement, bitumen works etc. Other potential impacts to health are respiratory and eye diseases due to exposure to dust and emissions.

158. Health risks are commonly associated with poor labour camp conditions. Unsafe water sources and unhygienic conditions (lack of latrines and washing facilities) bear the risk of additional and often endemic diseases, such as dysentery, diarrhea, and cholera.

159. Uncontrolled water logging and badly managed borrow pits bear the risks of spreading water borne diseases like malaria fever. Increase in STDs (HIV/AIDS), caused among others by the influx of outside and migrant labourers might pose health risks to the public. Inadequate living space and harassment may increase the stress levels for labourers, especially those who are recruited from outside the local communities. Most of the impacts related to this will be of direct, moderate significance, local and short-term in nature.

160. **Mitigation:** The following measures will be taken by the contractor at the camp sites:

- Efforts shall be made to establish construction camp at such sites so as to utilise the existing houses/ infrastructure as far as possible.
- The Contractor shall be required to prepare detailed plan for construction camp including location (distance from settlements, drainage facility, outdoor facilities,

and surrounding areas), housing facilities (site roads, drainage, waste management and other facilities) and need to get approval from the Supervision Consultant.

- Basic facilities such as fire precaution, lavatories and showers, potable water supply, clean eating area, lighting, safe access, air supply, LPG /kerosene, and others shall be provided.
- Appropriate facilities for women and children shall be provided in the construction campsites.
- First aid facilities shall be made available at camp sites. In addition to this, collaboration with VDC level health/sub-health posts for major injury cases including a contingency plan for emergency cases shall be prepared.
- The Contractor shall ensure that all workers, drivers, delivery crew, as well as the communities are aware of the risk of communicable diseases such as HIV virus, STD and AIDS. To prevent the risk of transmission of such diseases, awareness raising programmes such as information education, posters, and consultation and communication campaigns about primary health care shall be organized regularly.
- The Contractor shall be responsible to control open space defecation and pollution of stream sites and public places by workers.
- The Contractor shall ensure that sufficient and good quality of food stuff at reasonable price including adequate and safe drinking water has been supplied to the workers.

161. The following measures will be taken to ensure worker safety at construction sites:

- The Contractor shall ensure that internationally accepted and practiced safety measures are adopted during (i) road work (ii) handling of large construction equipment and machineries (iii) handling of chemicals including hazardous materials and inflammable substances (iii) welding/hot work (iv) electrical works etc. .
- The occupational health and safety (OHS) Clauses established by the DoR shall be included in the work contracts. This refers basically the FIDIC rules for road construction works encompassing all accident prevention measures which can happen at work sites and in the camps.
- The Contractor shall keep at site a fulltime Safety and Environment Monitoring Officer and a Medical Officer. Safety Officer shall ensure proper safety measures undertaken at camps and work sites. Regular safety drill shall be conducted and safety signs shall be kept at work areas.
- The Contractor shall arrange all personal protective equipment (PPEs) for workers, including first aid facilities at construction sites. An emergency plan shall be prepared duly approved by the Supervision Consultant to respond to any instance of safety hazard.
- Entry of unauthorised persons to the construction sites and equipment storage sites shall be restricted.
- Workers shall not be allowed to enter work areas without wearing proper safety gear (hard hat, work boot, gloves, ear muffles, face mask, reflective jacket, goggles, safety belt etc. as appropriate)
- General medical centre with a bed shall be established at the campsite to treat simple/minor injuries or illness. Arrangement shall be made with the District Hospital to keep a dedicated bed for emergency treatment of project staff and

workers, and a doctor of the hospital shall periodically make a visit to the site office for health check-up of workers

4. Social Conflicts due to Influx of Construction Workers

162. **Impact:** The amount of money that enters into the area during construction phase as wage payment may induce local inflation. Increased income of local labourers and construction crews of the contractor can lead to negative impacts such as spread of alcohol consumption and gambling. Influx of migrant workers also bears potential for prostitution, and potential increase in STDs such as HIV/AIDS. Issue on differential wage payment among men and women could lead to conflict. These impacts leading possibly to social and cultural conflicts will be direct, low in magnitude, local and short-term in nature.

163. **Mitigation:** The contract agreement with the contractor must require the contractor to disallow any inappropriate social behavior such as alcoholism, gambling, prostitution and creating conflicts with the local community. Requirements maybe be made for immediate termination of employment for any employee causing any of the social bad behavior. Regular HIV/AIDS and STD awareness campaigns will be carried out for the workers as well as local community people living near the construction site. Equal pay for similar type of work will be provided to men and women workers.

5. Operation and Maintenance Phase

164. The road construction will have a one-year defect liability period and five-year performance-based maintenance period. The same contractors will be responsible for the construction and the maintenance of the road. The following section discusses the anticipated impacts and recommended mitigation measures to be implemented during the defect liability and maintenance period.

E. Impacts on Physical Environment

1. Slope Stability and Drainage Management

165. **Impact:** During the operational phase, embankment slope could be destabilized due to monsoon rain, inadequate drainage works, faulty construction and inadequate vegetative measures. The stability of slopes may also be affected by human activities such as animal grazing and tethered cattle along road edge. The impacts will be direct, moderate, site-specific and long-term in nature.

166. Poor maintenance of drainage structures, especially after heavy rainfall will lead to drainage problems, water logging, and erosion. Apart from road damage, minor slope failures may occur causing problems to the local environments.

167. **Mitigation:** Landslides and soil erosion occur due to both natural and induced phenomena thus continuous monitoring of the road condition will be necessary especially during and after rainy season. DoR has established a system of employing road maintenance staff that are responsible for routine and recurrent maintenance of roads like cleaning up drains and soil deposited on the roads due to slope failures and erosion. This practice will be continued with allocation of adequate of numbers of staff to the project road.

2. Camp conditions

168. Rehabilitated labour camp sites including side drains and cross drainage structures shall be monitored regularly to check for blockage.

169. Locations of quarry sites and borrow pits shall be monitored and if found not restored properly then the Contractor shall be asked for correction of these works until defect labiality period also.

3. Road Accidents

170. **Impact:** Operation of the road also increase the chances of road accidents, particularly involving children. Inadequate provisions of road safety measures such as road safety signals, lack of enforcement of traffic rules, houses built adjoining road within the RoW, schools adjacent to road during operation period may invite accidents. The anticipated impacts will be direct, of low magnitude, local and long-term in nature.

171. **Mitigation:** Road safety features construction on the road such as speed control signs, speed bumps, zebra crossing and underpasses for pedestrians and separate lanes for bicycles and motorcycle users in urban areas will be maintained properly so that they remain functional at all times.

172. Various road safety awareness related activities are planned to be carried out under the project and a technical assistance (TA) project attached to the loan. These include (i) a road safety awareness campaign for 50 schools and 500 communities; (ii) the preparation of a national road safety policy and road action plan, (iii) the strengthening of the road safety council and (iv) a road safety assessment for the 1,024 km-long EWH. These activities are expected to substantially improve the road safety conditions and behavior along the EWH.

4. Air Pollution

173. The source of air pollution in this area will be the exhaust from the vehicles using fossil fuels and vehicle fumes from any other fuel powered mechanical equipment. The impacts associated with this will be of direct nature, moderate in magnitude, locally confined and long term in nature.

174. Air emissions due to vehicular movement are one of the prime sources of air pollution in the study area. The project road is currently having 2lanes, which is planned to be upgraded to 4 to 6-lane highway with service roads on either side of the road. The widening and upgradation of the road will result into ease of traffic movement and reduction of traffic congestion, In order to assess the impact of current traffic volume on the surrounding areas as well as for prediction of impact on air quality due to future projected growth of traffic volume with road improvement this air quality dispersion modelling study has been performed.

175. Quantitative assessment for predicted level of pollutants concentration has been done using AERMOD, a recommended model by USEPA for prediction of air quality from point, area and line sources. It is based on Gaussian dispersion which incorporates the Monin Obukhov boundary layer dispersion parameters for estimating horizontal cross wind and vertical dispersion. In ISC-AERMOD View software, the line sources are characterized as volume sources. After drawing the road alignment and putting the information related to carriageway width, vertical dimension, source elevation, base elevation and release height, the model converts the road alignment to the number of volume sources. The model, then simulates the effect of emissions from continuous/variable volume sources on neighbourhood air quality and identified discrete

receptors. The model is an hour-by-hour steady state Gaussian model which takes into account special features like Terrain adjustments, Gradual plume rise, Buoyancy-induced dispersion, Complex terrain treatment, etc. The total road alignment has been taken into consideration for the prediction of vehicular exhaust emission. Major criteria pollutants generated due to vehicular exhaust are oxides of nitrogen (NOx), carbon monoxide (CO), fine particulate $PM_{2.5}$ and sulphur dioxide (SO_2). Hence these four pollutants are taken into consideration in this study[1]. Various input parameters for the prediction of pollutant concentrations have been considered as given below:

5. Traffic Density

176. A detailed study of the traffic density along the project road was conducted as part of the detailed project designing. The project consists of 87 km Road section between Kanchanpur and Kamala. Based on the traffic count and projection, the project road is divided into 7 homogenous sections. Summary of traffic projection in terms of PCUs/day at each section taking into consideration the optimistic scenario has been presented in **Table 26**. Based on the assessment of current traffic speed and projected traffic speed due to road improvement, it is assumed that weighted average for cars in the base case will be 60 km/hr, whereas in post-project case it will be 100 km/hr throughout the project design life of 25 years.

Table 26: Homogenous Sections Considered in the Study with Projected Traffic

Road	Section	Section Length (km)	PCU/day				
			2018	2023	2033	2038	2043
Kanchanpur – Kamala Road	A	20.351	10779	13273	19502	24111	30215
	B	21.68	12686	16200	24463	31307	40624
	C	8.364	18257	22768	34917	44516	57570
	D	7.399	15250	19141	29816	38442	50240
	E	10.587	12478	15701	24650	31959	41986
	F	5.00	11989	15006	23228	29809	38771
	G	13.47	10865	13475	20390	25735	32932

177. **Emission Rate.** To assess the contribution of the vehicles emission, which will ply on the project road sections, the emission factors for NOx and CO were generated by using MOBILE 6 Vehicle Emission Modelling Software, which takes into consideration the road type, surface, average speed as well as improvement in fuel efficiency over a period of time into consideration for generation of emission factors. The tailpipe emissions of PM2.5 were taken from the study carried out by the Automotive Research Association of India (ARAI) for different vehicle types, as most of the vehicles are exported from India to Nepal. No dust emission due to resuspension of road dust during vehicle movement and wind have been considered in this modelling study. SO2 emissions rate has been calculated based on the sulphur content of fuel (500 ppm) and fuel economy (mileage) of the passenger cars. The emission factors are based on speed. It is to be noted that the after road widening and strengthening, the design speed is considered to be 100 km/hr for cars. The emission factors used for criteria pollutants are presented in **Table 27.**

[1] This modeling study does not take into consideration particulate matter generation because of resuspension of road dust, which may occur due to movement of vehicles on the road as well as wind conditions.

Figure 6: Traffic Projections

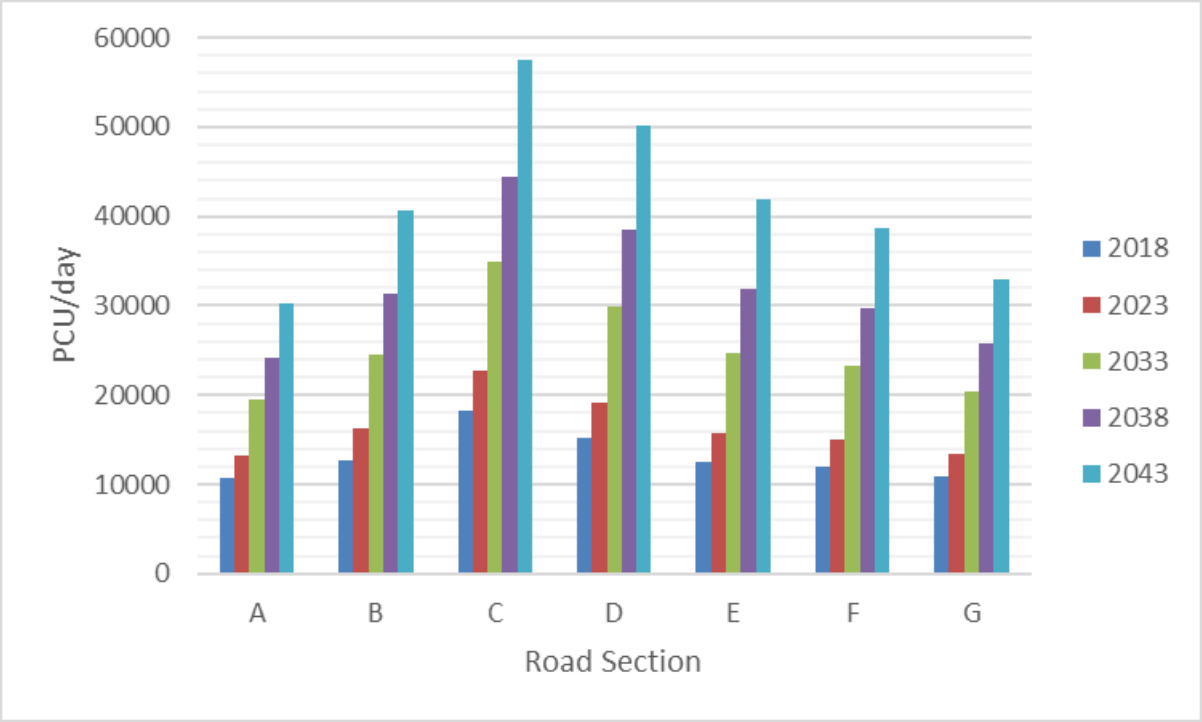


Table 27: Emission Factors for Criteria Pollutants

Pollutant	Year 2018		Year 2023		Year 2033		Year 2038		Year 2043	
	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)
NOx	30	0.64	60	0.45	60	0.45	60	0.45	60	0.45
CO	30	11.59	60	10.69	60	10.69	60	10.69	60	10.69
$PM_{2.5}$	30	0.18	60	0.18	60	0.18	60	0.18	60	0.18
SO_2	30	0.22	60	0.22	60	0.22	60	0.22	60	0.22

178. **Receptors.** The complete alignment of the project road has been drawn with respect to UTM coordinates. The area around these road sections were divided into 100 m x 100 m grids. Baseline ambient air quality monitoring was conducted at 6 locations along the project road corridor and these were also considered as discrete receptors. Road section with location of these receptors are presented in **Figure 8**.

179. **Predicted Ground Level Concentrations:** The prediction of maximum ground level concentration on each road section has been carried out. The prediction for CO was conducted for 8-hourly concentrations, whereas for NO_x, $PM_{2.5}$ and SO_2 were conducted for 24 hourly concentrations. Predicted concentrations of each homogenous road section for Year 2018 (base case) and for Year 2023, 2033, 2038 and 2041 (post-project case) are presented for all seven sections. The predicted concentrations at identified receptors are presented in **Table 28** and **Table 29**. In addition to that sample ground level concentrations for different prediction years around the project road (homogenous section A) for 24-hourly average NOx concentration are presented in **Figure 9**.

180. **Prediction results**: Analysis of modelling results ascertains that the predicted level of concentrations due to emissions from vehicle exhaust for all the four parameters along all the seven homogenous sections of the project road will be well within the permissible limit for entire project horizon for SO2 and CO, however, there will be exceedance in NOx ground level concentrations along the sections B, C and D during the later phases of the project and in PM2.5 ground level concentration in Section C and D, which is primarily attributed due to proximity of receptors to the project road and higher traffic density in these sections.

181. **Conclusions:** In the existing scenario, due to lesser width and higher roughness, the average vehicle speed is low, which results in more exhaust gas emissions. In the post-project scenario, improved road conditions and congestion free traffic movement will reduce emissions. However, on the other hand high growth of traffic and better road conditions with improved average speed, will have significant increase in concentration of the criteria pollutants. This will result into exceedances during the later phase of the project life and would require further upgradation of the roads.

182. **Recommended Mitigation Measures:** To control emission levels during later years of operation the following measures will be implemented by DOR:

- Maintenance of road conditions including shoulders and cut slope turfing.
- Densely spaced trees shall be planted close to sensitive locations such as hospital, school boundaries and near religious places.
- All caution signs for speed regulation and lane driving shall be maintained near habitat areas and sensitive receptors such as schools, temples and health centers.
- Educative awareness boards for safe and fuel efficient driving shall be fixed at selective locations.
- DoR will coordinate with relevant agencies on the implementation on and enforce Nepal Vehicle Mass Emission Standard, 1999 and will stipulate vehicle owners to engage in proper and regular vehicle maintenance.
- Air pollution by dust will be controlled with provision of paved shoulders, especially in the sensitive/built up areas.
- DoR will partner with Development organizations (NGO, INGO and CBOs) to motivate the local communities to maintain greenery along the road apart from their houses by planting fodder, fuel wood and fruit trees including flowering plants.

Table 28: Predicted Ground Level Concentrations of NOx and CO at Identified Receptors

Road Section	Receptor	Predicted NOx					Predicted CO				
		24 Hourly Maximum Ground Level Concentration ($\mu g/m^3$)					8 Hourly Maximum Ground Level Concentration ($\mu g/m^3$)				
		2018	2023	2033	2038	2043	2018	2023	2033	2038	2043
A	AQ 1	10.4	17.2	25.3	31.5	39.6	262.7	432.4	1354.9	1683.0	2120.5
A	AQ 2	17.5	38.4	56.5	70.0	88.0	844.1	1857.4	2222.9	2748.6	3446.8
B	AQ 3	26.7	44.8	67.7	86.6	112.3	815.1	1367.6	2355.1	3013.3	3910.2
C	AQ 4	42.8	71.6	109.9	140.0	181.2	1383.4	2316.1	4342.6	5535.0	7161.8
F	AQ 5	13.9	14.7	22.8	29.2	38.0	640.6	679.4	1353.3	1733.0	2251.6
G	AQ 6	29.5	31.4	47.5	60.0	76.8	914.4	974.4	1467.9	1852.3	2370.8

Table 29: Predicted Ground Level Concentrations of $PM_{2.5}$ and SO_2 at Identified Receptors

Road Section	Receptor	Predicted SO2					Predicted PM2.5				
		24 Hourly Maximum Ground Level Concentration ($\mu g/m^3$)					24 Hourly Maximum Ground Level Concentration ($\mu g/m^3$)				
		2018	2023	2033	2038	2043	2018	2023	2033	2038	2043
A	AQ 1	3.6	5.9	8.7	10.8	13.6	2.9	4.8	7.1	8.8	11.2
A	AQ 2	6.0	13.2	19.4	24.1	30.2	4.9	10.8	15.9	19.7	24.7
B	AQ 3	9.2	15.4	23.3	29.8	38.6	7.5	12.6	19.0	24.3	31.6
C	AQ 4	14.7	24.6	37.8	48.1	62.3	12.0	20.1	30.9	39.4	51.0
F	AQ 5	4.8	5.1	7.8	10.1	13.1	3.9	4.1	6.4	8.2	10.7
G	AQ 6	10.1	10.8	16.3	20.6	26.4	8.3	8.8	13.4	16.9	21.6

Figure 7: Project Road and Receptors on Topographic Map

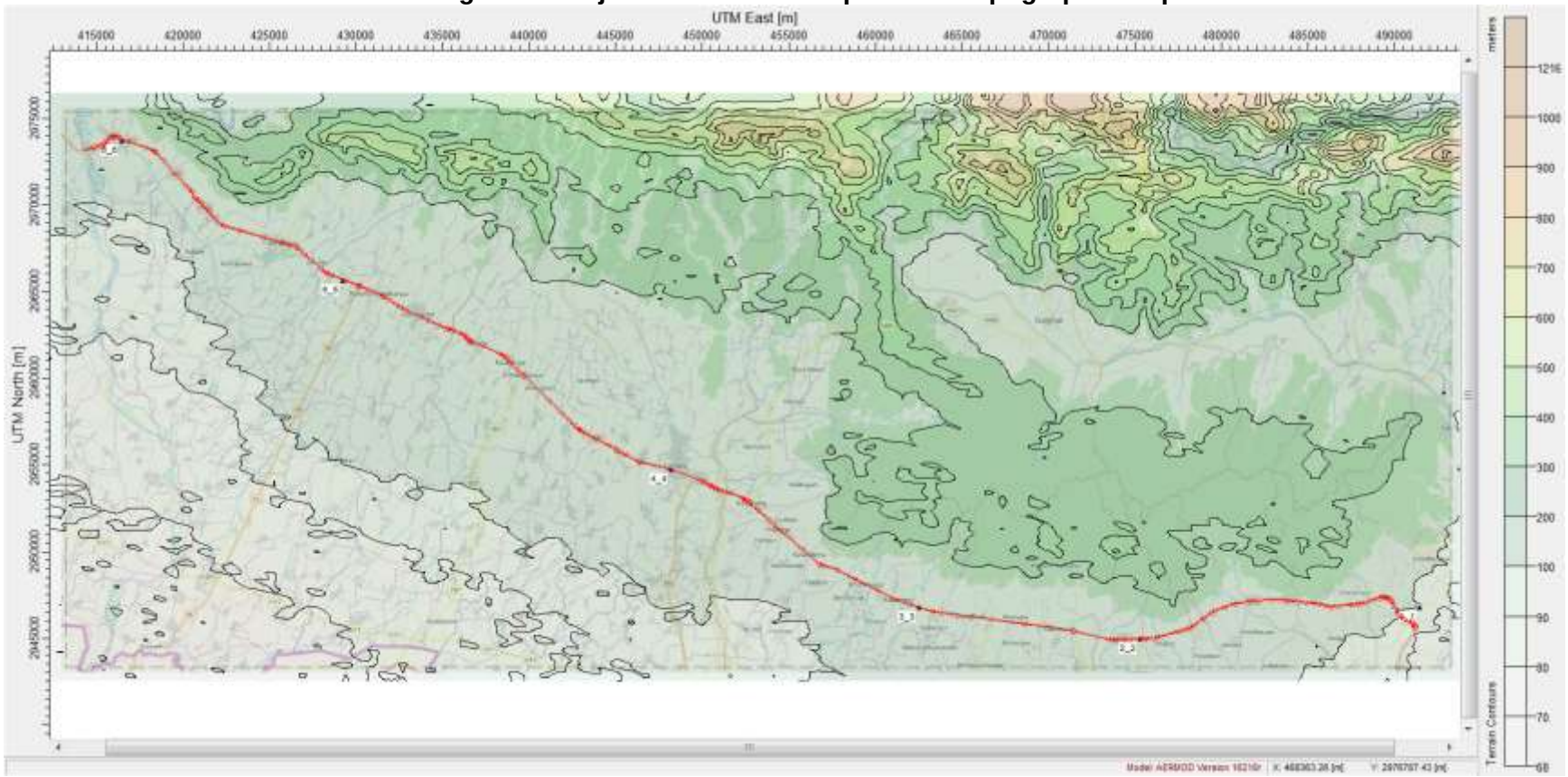
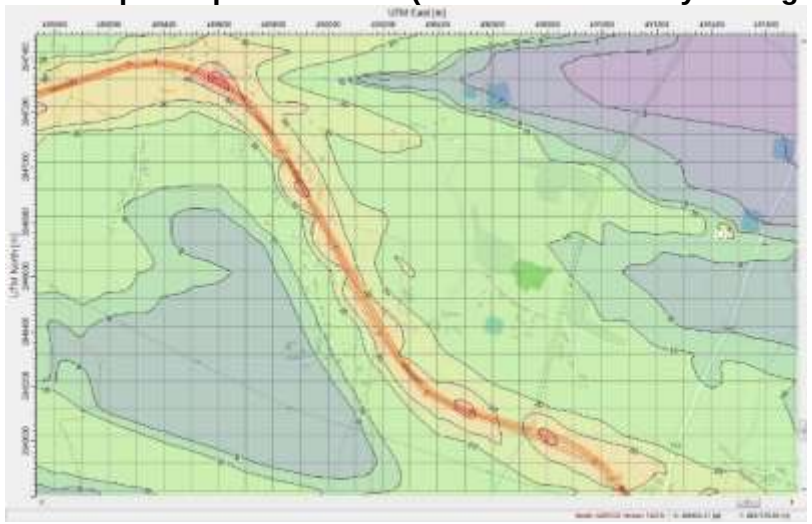
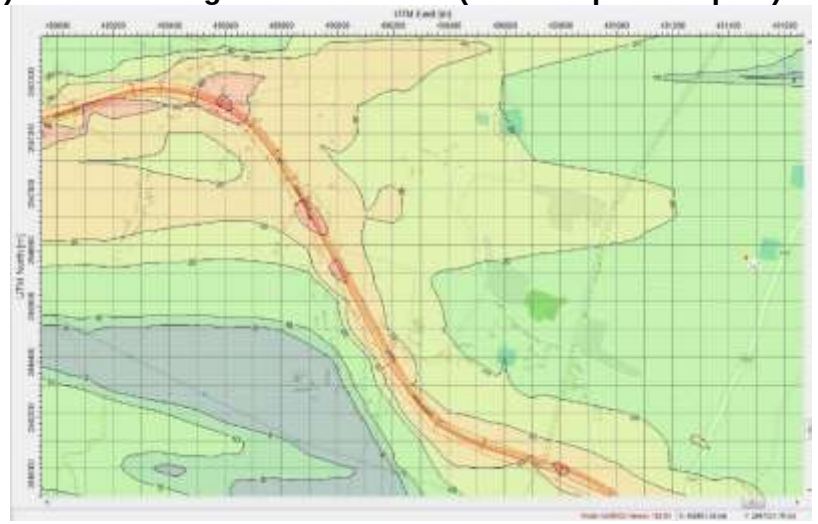


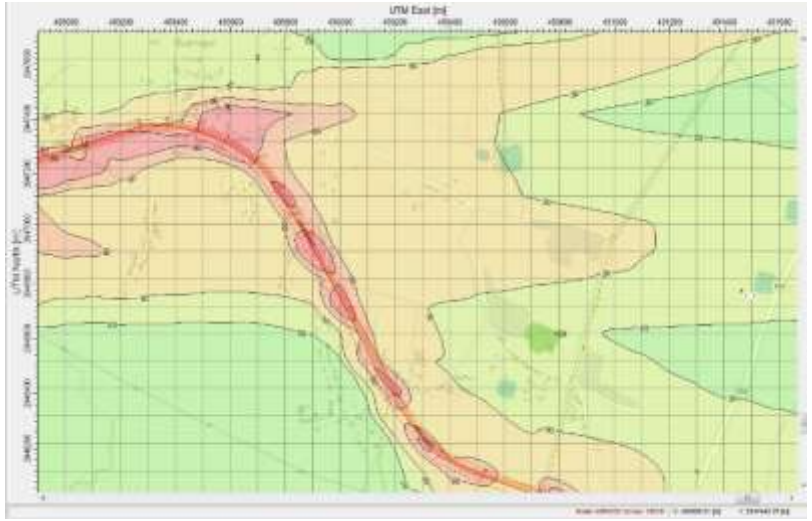
Figure 8: Sample Isopleths of NOx (Maximum 24-hourly average) – Near Homogenous Section A (Kanchanpur – Rupani)



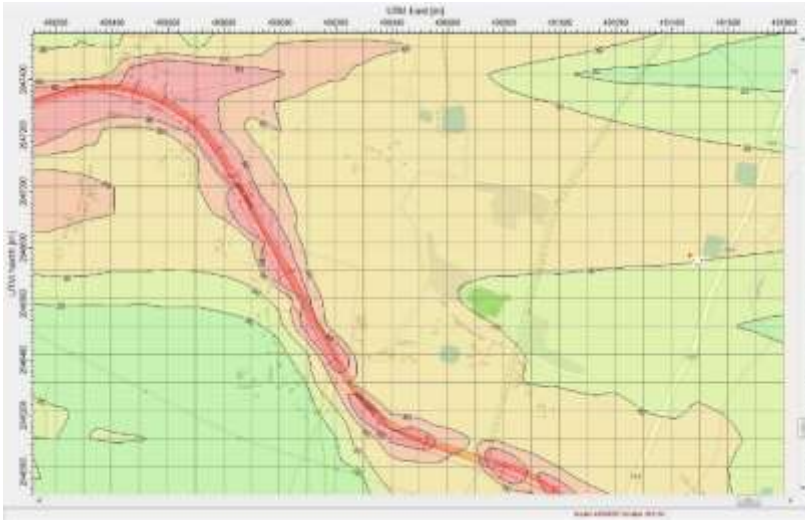
2018



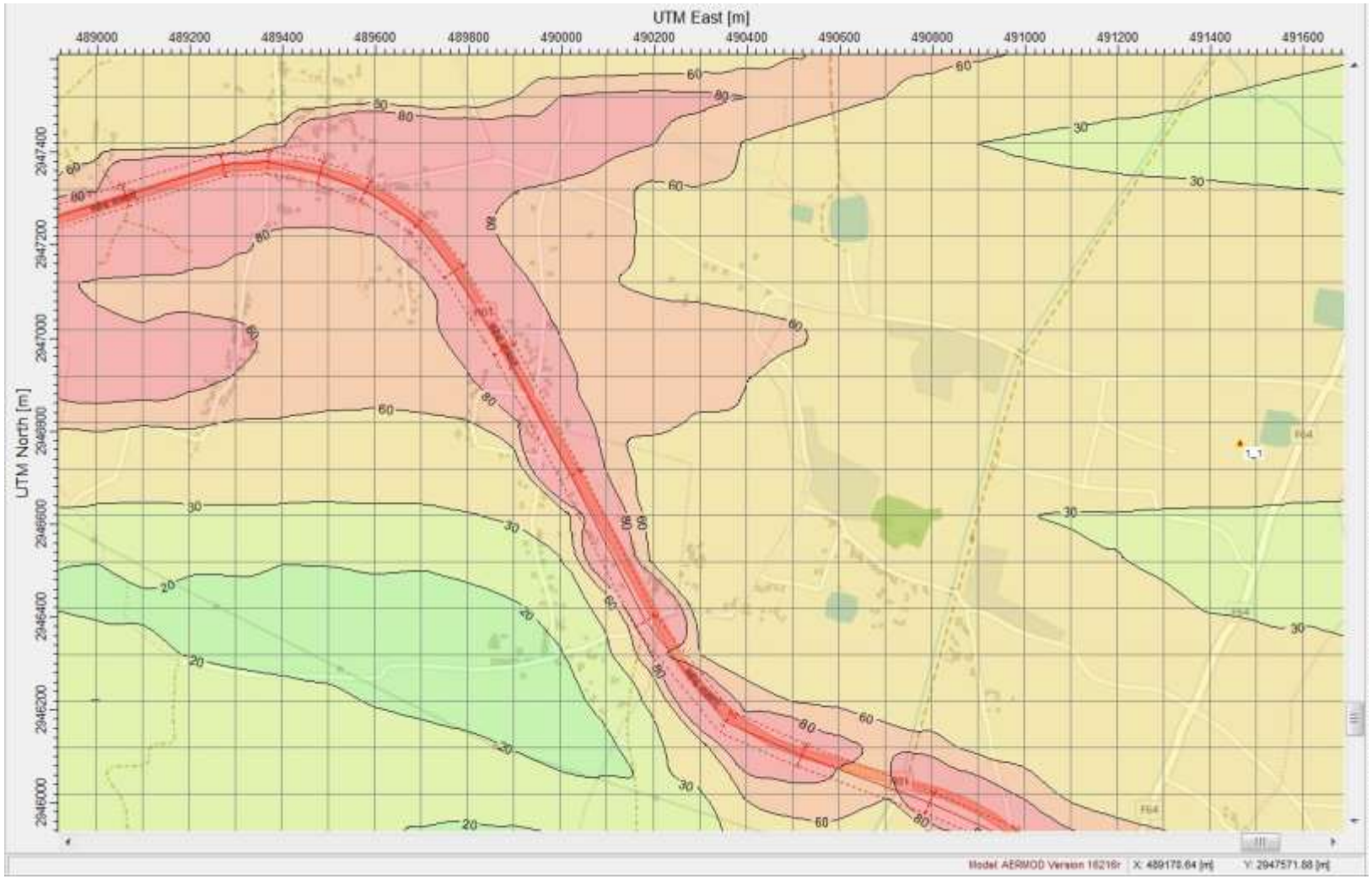
2023



2033



2038


UTM East [m]
489000
489200
489400
489600
489800
490000
490200
490400
490600
490800
491000
491200
491400
491600
UTM North [m]
2947400
2947200
2947000
2946800
2946600
2946400
2946200
2946000
60
80
30
20
Model AERMOD Version 16216r
X: 489170.64 [m]
Y: 2947571.88 [m]

2043

6. Noise

183. Noise modelling has been carried out for the Kanchanpur – Kamala Road Section covering road length of 87 km in Saptari and Siraha districts of Eastern Development Region of Nepal, by using noise prediction tool (SoundPlan) and applying the noise prediction standards of Traffic Noise Model – FHWA; 1998 (TNM) to predict the noise generation due to the traffic movement as well as its propagation in the surrounding environment.

184. The road noise module is split into 6 separate road-sections; first the emissions of the line source are evaluated and assigned to the road source objects in the Geo-Database. In a second step noise levels are calculated for standalone receivers or as part of the Grid Noise Map. Sound PLAN has implemented the TNM 2.5 rules and regulations of the FHWA standards.

185. Assumptions considered in the modelling study include:

- Height of sources is 0.5 m above the carriageway.
- Model does not take into account background noise such as noise generated due to anthropogenic activities, industrial activities, movement/ operation of other noise generating sources, such as trains, aero planes, etc.
- Model does consider the ground level absorption of the noise, however, due to very limited specific information with respect to absorbing media all along the project road (e.g. walls, solid barriers, dense vegetation, etc.), same was not considered in this study. This also helps in considering the worst case scenario for the modelling study.
- Average meteorological conditions had been taken into consideration.
- During the pre-project scenario (Year 2018), average speed of cars was considered as 60 kmph during daytime and 80 kmph during night time. During the post project scenario, design speed of the project road is 100 kmph for cars and same is considered during the post project scenario both during day and night time.
- Traffic forecast data provided in the DPR has been used to generate different scenarios of noise propagation during the project lifecycle.
- Considering the change in topography in the project road, terrain effect has been considered.

186. In noise propagation model vehicles are classified onto passenger car units (PCU). The entire project road has been divided into six homogenous sections based on the traffic density assessed in the DPR.

Table 30: Homogenous Sections Considered in the Study with Projected Traffic

Section	Section Length (km)	PCU/day				
		2018	2023	2033	2038	2043
A	20.351	10779	13273	19502	24111	30215
B	21.68	12686	16200	24463	31307	40624
C	8.364	18257	22768	34917	44516	57570
D	7.399	15250	19141	29816	38442	50240
E	10.587	12478	15701	24650	31959	41986
F	5.00	11989	15006	23228	29809	38771
G	13.47	10865	13475	20390	25735	32932

7. Traffic Projections

187. The prediction of noise propagation had considered following five assessment years based on the traffic projections provided in the DPR:

- 1st Prediction (Year 2018, i.e. current operation)
- 2nd Prediction - Year 2023 (post upgradation)
- 3rd Prediction Year 2033
- 4th Prediction Year 2038
- 5th Prediction Year 2043

188. For all the five assessment years, prediction of noise has been carried out all along the project road with a grid size of 20 m x 20 m as part of grid noise assessment. In addition to that, noise prediction was also carried out at 6 noise sensitive receptors along the project road, where noise monitoring was carried out during the baseline studies. Project road with noise sensitive receptors considered during the baseline study on topographic map are presented in Figure 10.

189. The outputs of the assessment are presented in Table 31. The table shows the noise levels that will be generated by traffic at the respective noise sensitive receptors along the project road on either side of the centerline of the road without mitigation. In addition to that baseline noise levels monitored during the baseline study are also presented in this table. The baseline in six locations (L50), or the noise level exceeded for 50% of the measurement duration, exceeded both the Nepal sound quality standard (Table 32) and that of the World Bank (Table 33). For L90, or the noise level exceeded for 90% of the measurement, 5 out of six locations met the national and World Bank standards for commercial areas. Nepal standard for noise for commercial area is 65 dBA during day time and 55 dBA during night time. The World Bank standard, which is from the WHO guideline, is 70 dBA for both day and night time for commercial area. A comparison of baseline data with noise generated due to traffic movement clearly indicates that noise is also generated from a variety of other sources near the noise monitoring locations, due to which both L50 and L90 noise levels were observed more than the predicted noise levels during the base year 2018. It is to be noted that all the monitoring was carried out at busy market areas close to the project road, except at Kanchanpur, where the location is close to other road network.

190. Table 10 shows that there will be incremental increase in noise level due to expected increase in traffic. From baseline year 2018, the predicted incremental increase ranged from 0.5 to 1 dBA in all sampling locations (day and night time) after 5 years, gradually increasing from 2.3 to 2.8 dBA after 15 years. These incremental increases will initially be negligible and inaudible to human ear. Only after 20 years, or in 2038 that the increase of more than 3 dBA will be audible to the human ear.

191. The grid noise maps for the base year 2018 near all the six receptors during daytime are presented in Figure 11. Furthermore, day and night time noise grid maps near receptor N6 (Kamala) for different prediction years are presented in Figure 12.

192. **Conclusions:** It is evident from the above tables that there will be constant increase in the noise levels due to increase in traffic intensity as well as average speed of vehicles over the road's design life. However, improvement and widening of road will provide better access and lesser congestion near the market and residential places, which will help in curbing the noise generated due to traffic congestion, honking etc. Overall, free flow of traffic movement and use of service roads by local traffic will help in reducing the localized noise impact as well. It is recommended that noise level should be monitored at least once every 5 years during operation particularly near sensitive receptors. If the noise levels are found to be higher than the projected

levels and exceeding 3 dBA, mitigation measures such as noise barriers maybe put up to minimize the impacts on affected people. Sensitive receptors are indicated in Table 34.

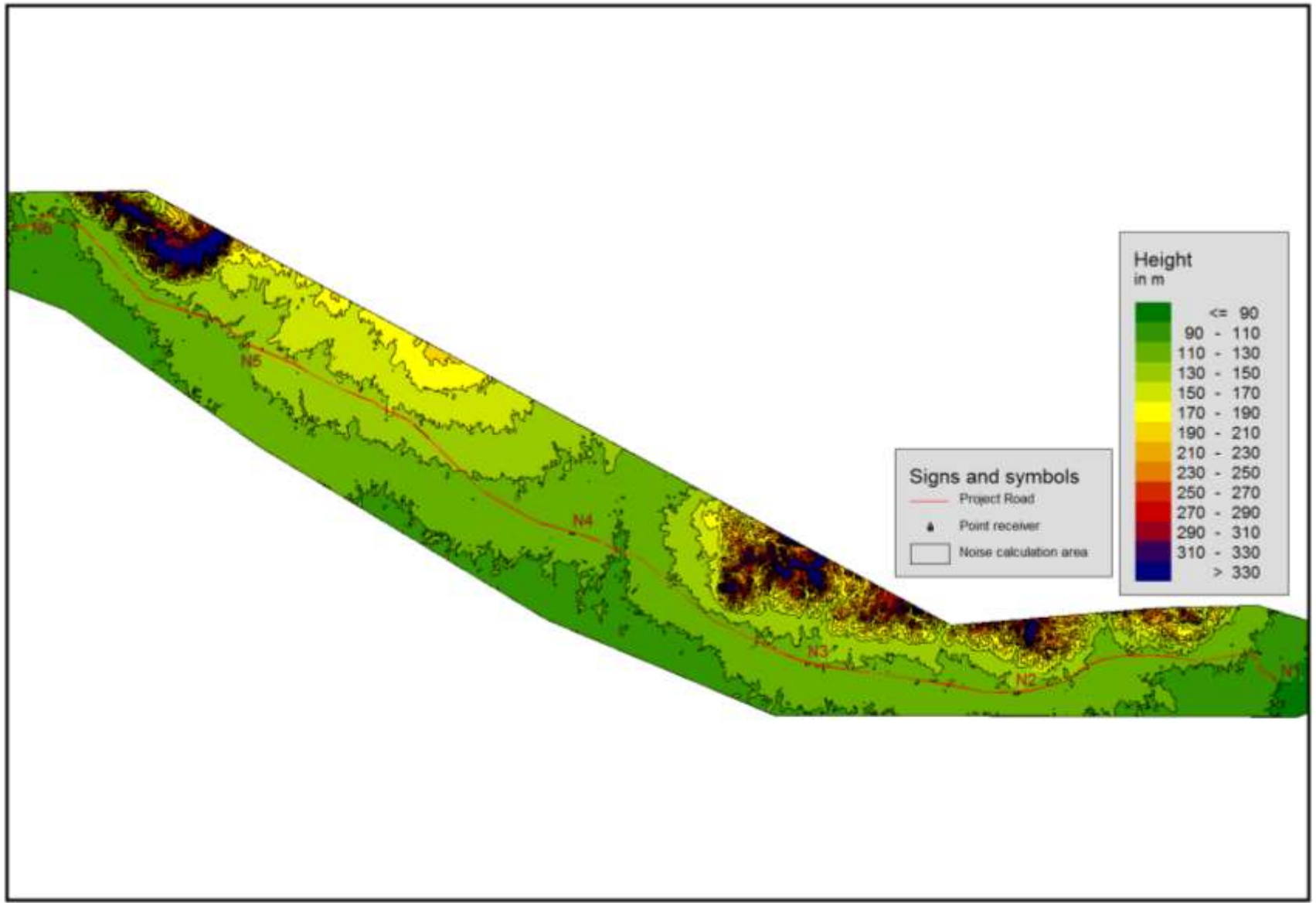


Figure 9: Project Road with Noise Monitoring Locations on Topographic Map

Table 31: Predicted Noise Levels along the Project Road (without mitigation)

Receiver	Location	Baseline Noise		Predicted Noise due to Road Traffic[a]									
				Year 2018		Year 2023		Year 2033		Year 2038		Year 2043	
		L_{50} (dB(A))	L_{90} (dB(A))	L_d (dB(A))	L_n (dB(A))	L_d (dB(A))	L_n (dB(A))	L_d (dB(A))	L_n (dB(A))	L_d (dB(A))	L_n (dB(A))	L_d (dB(A))	L_n (dB(A))
N1	Kanchanpur	72.6	64.4	37.7	30.3	38.6	31.2	40.3	32.9	41.2	33.8	42.2	34.8
Incremental noise increase in comparison to baseline levels (2018)						0.9	0.9	2.6	2.6	3.5	3.5	4.5	4.5
N2	Birendra Bazar	74.3	62.3	58.7	51.3	59.6	52.2	61.3	53.9	62.2	54.8	63.2	55.8
Incremental noise increase in comparison to baseline levels (2018)						0.9	0.9	2.6	2.6	3.5	3.5	4.5	4.5
N3	Kalyan Bazar	74.2	66.5	59.2	51.8	60.2	52.9	62.0	54.6	63.1	55.7	64.2	56.9
Incremental noise increase in comparison to baseline levels (2018)						1	1.1	2.8	2.8	3.9	3.9	5	5.1
N4	Lahan Bazar	72.6	62.3	60.4	53.0	61.4	54.0	63.2	55.8	64.3	56.9	65.4	58.0
Incremental noise increase in comparison to baseline levels (2018)						1	1	2.8	2.8	3.9	3.9	5	5
N5	Army Camp	72.9	61.1	57.5	50.1	58.4	51.1	60.3	53.0	61.4	54.1	62.6	55.2
Incremental noise increase in comparison to baseline levels (2018)						0.9	1	2.8	2.9	3.9	4	5.1	5.1
N6	Kamala	75.3	63.2	56.4	49.0	56.9	49.5	58.7	51.3	59.7	52.3	60.8	53.4
Incremental noise increase in comparison to baseline levels (2018)						0.5	0.5	2.3	2.3	3.3	3.3	4.4	4.4

[a]Does not include existing background noise of 34.9 dB(A) during the day and 34.1dB(A) during the night

Table 32: National Ambient Sound Quality Standard, 2012

Area	Day, dBA	Night, dBA
Industrial	75	70
Commercial	65	55
Rural residential	45	40
Urban residential	55	50
Mixed residential	63	55
Peace area	50	40

Table 33: Noise Level Guidelines, International Finance Corporation, The World Bank Group[5]

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 – 22:00	22:00 – 07:00
Residential, institutional, educational	55	45
Industrial, commercial	70	70

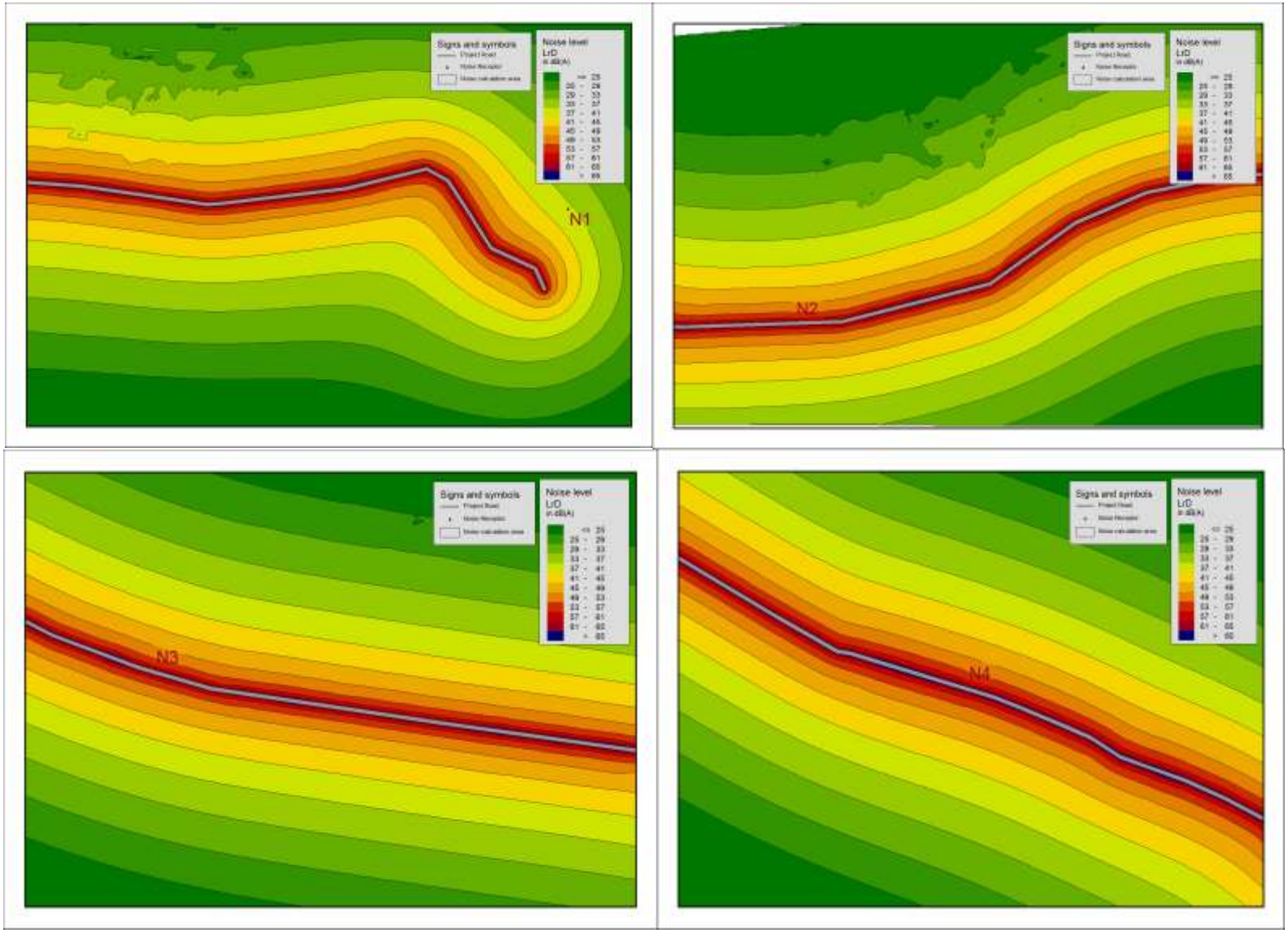
Table 34: Sensitive Receptors Along the 87-km Kanchanpur – Kamala Road

Chainage (km)	LHS/ RHS	Co-ordinates		Distance from C/L (m)	Type of receptors
		Latitude (°N)	Longitude (°E)		
4+250	RHS	26.643968	86.879577	75	Hospital
26+150	RHS	26.635107	86.666832	25	Clinic
27+450	RHS	26.636746	86.652894	19	Health post
37+570	LHS	26.668624	86.559155	18	Primary health care
44+970	RHS	26.706211	86.498792	25	Hospital
44+960	RHS	26.70582	86.499067	11	Hospital
45+525	LHS	26.707873	86.49374	26	Hospital
45+630	RHS	26.708445	86.492652	18	Hospital
45+750	RHS	26.708728	86.49218	30	Hospital
45+870	LHS	26.70885	86.49047	30	Hospital
45+900	LHS	26.709079	896.49003	30	Hospital
45+000	RHS	26.709593	86.489352	22	Hospital
55+880	LHS	26.752513	86.4061523	22	Clinic
69+340	RHS	26.810983	86.288109	30	Hospital
82+680	LHS	26.875538	86.179889	40	Health post
2+810	RHS	26.647394	86.893564	40	Primary School
5+200	LHS	26.642921	86.870305	30	Primary School
5+780	LHS	26.642469	86.864092	22	HS School
9+680	RHS	26.645488	86.825847	24	Secondary School
10+030	LHS	26.645434	86.822107	25	Primary School
12+050	LHS	26.64231	86.802267	26	Secondary School
18+550	RHS	26.625029	86.741442	100	Secondary School
21+780	LHS	26.629665	86.709381	40	Secondary School
29+600	LHS	26.639246	86.631309	50	Primary School
29+900	LHS	26.639879	86.628783	25	Primary School
30+000	RHS	26.640331	86.628043	50	Secondary School
30+100	LHS	26.640622	86.626835	25	Primary School
30+120	RHS	26.640535	86.626317	25	Primary School
32+900	LHS	26.649544	86.600593	25	Secondary School
35+900	RHS	26.661369	86.573532	30	College
36+400	LHS	26.662898	86.568724	40	Secondary School
40+850	LHS	26.687969	86.534433	30	Secondary School
45+550	LHS	26.707905	86.493609	45	Primary School
46+000	RHS	26.709593	86.489352	22	HS School

[5] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

Chainage (km)	LHS/ RHS	Co-ordinates		Distance from C/L (m)	Type of receptors
		Latitude (°N)	Longitude (°E)		
46+080	LHS	26.709547	86.488468	35	HS School
46+200	LHS	26.710293	86.487281	70	HS School
47+370	LHS	26.713401	86.47608	25	Secondary School
50+000	RHS	26.720926	86.45153	25	Secondary School
53+350	LHS	26.736016	86.421958	25	Primary School
55+860	LHS	26.751759	86.404215	24	Secondary School
60+920	LHS	26.778825	86.364083	19	Secondary School
61+250	LHS	26.78031	86.360842	19	Primary School
63+610	LHS	26.788838	86.339785	25	Secondary School
66+680	LHS	26.800791	86.312633	75	Secondary School
67+400	LHS	26.804429	86.306295	25	Secondary School
67+920	RHS	26.806235	86.301341	105	Secondary School
70+900	RHS	26.817285	86.274214	35	Secondary School
73+100	RHS	26.829416	86.255716	27	Secondary School
74+400	RHS	26.832444	86.243963	25	Secondary School
77+500	RHS	26.840888	86.214724	25	Secondary School
77+800	RHS	26.843124	86.212273	23	HS School
81+230	RHS	26.865952	86.189524	100	Secondary School
85+600	RHS	26.884348	86.15205	35	Primary School

Figure 10: Noise Grid Maps of Project Road (2018) - Daytime



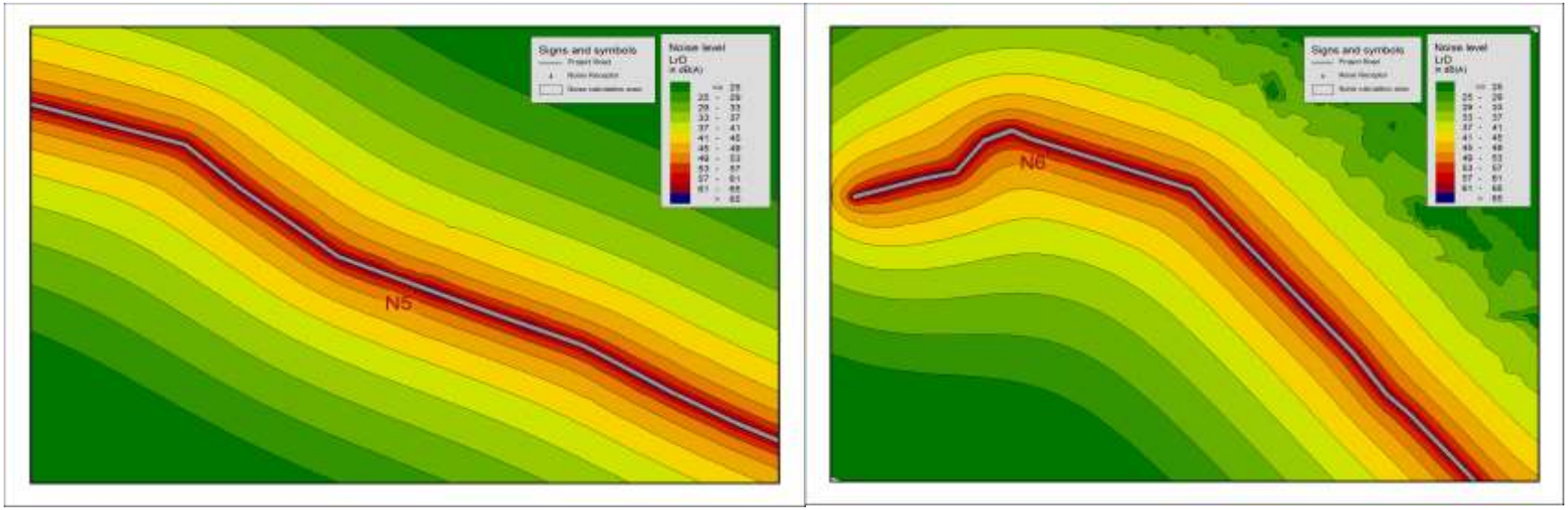
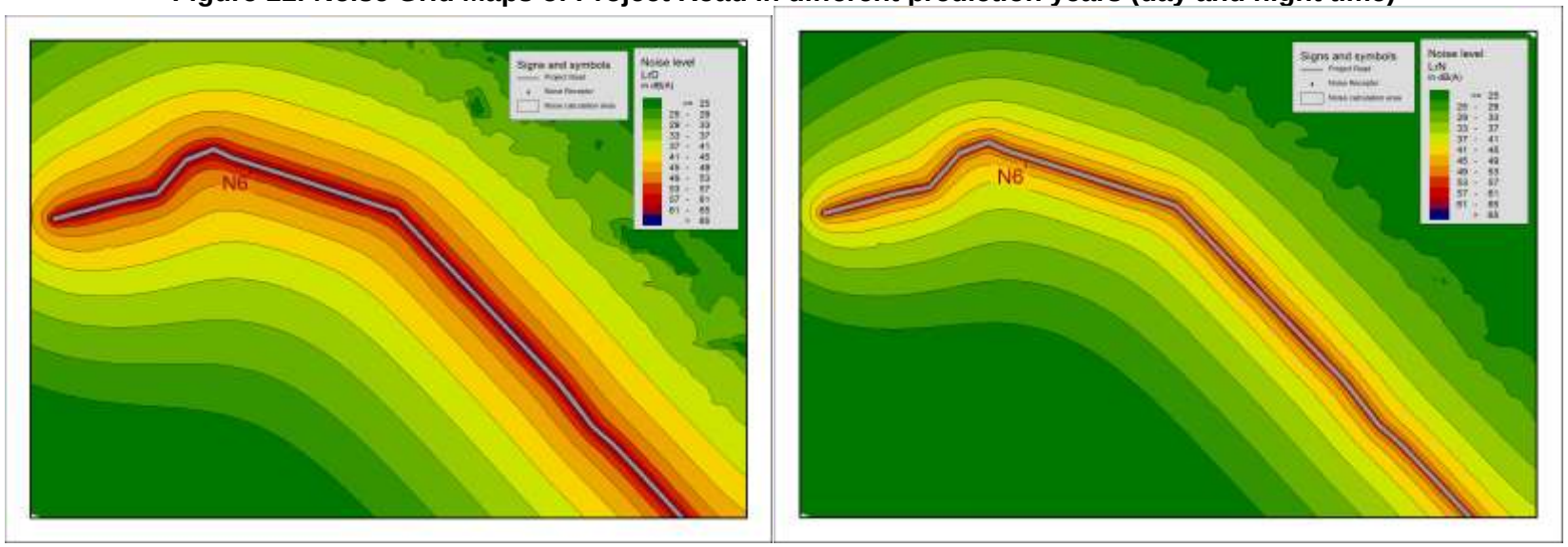
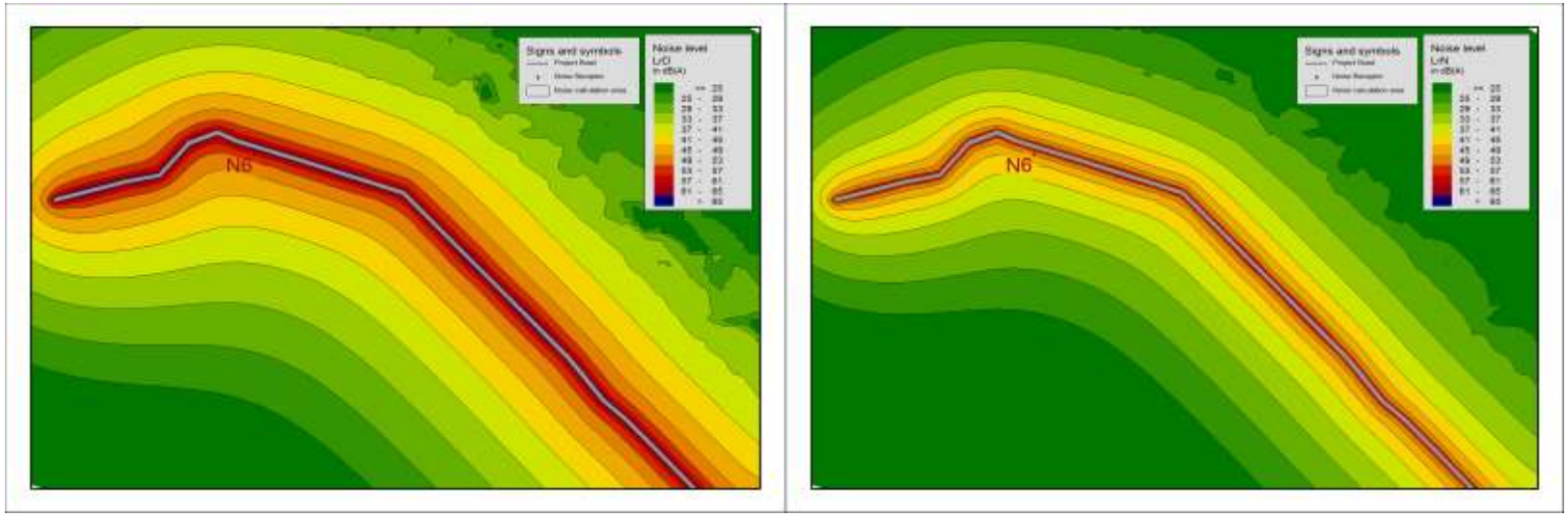


Figure 11: Noise Grid Maps of Project Road in different prediction years (day and night time)



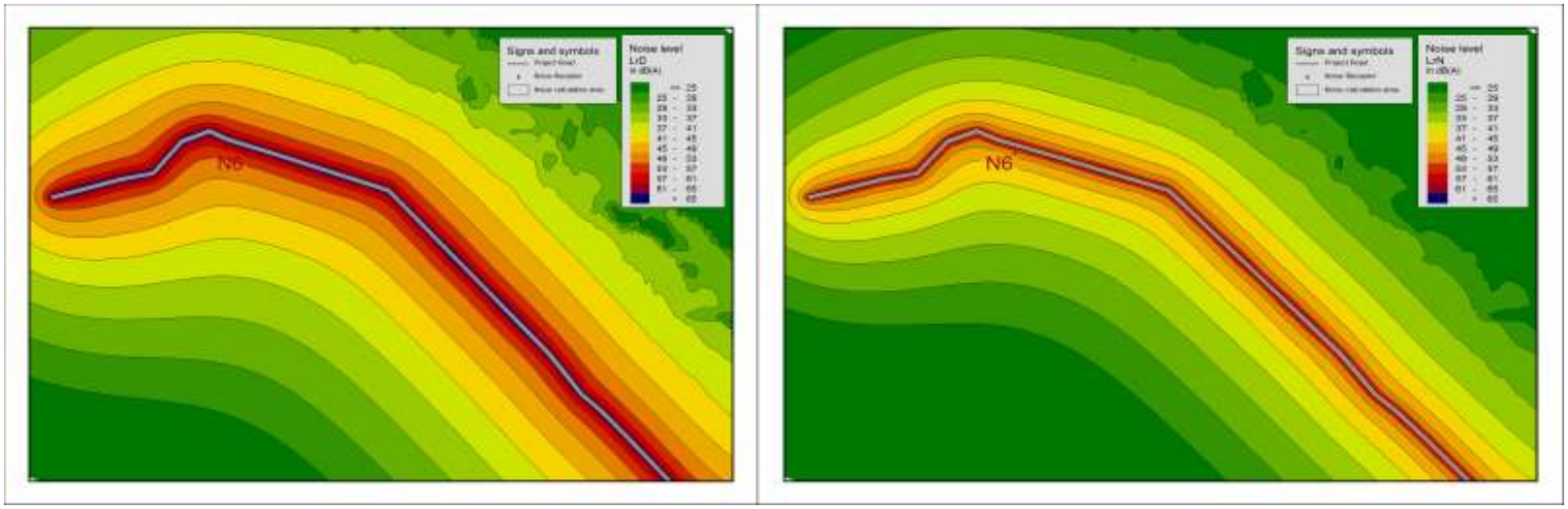
Day **Night**

Year 2018



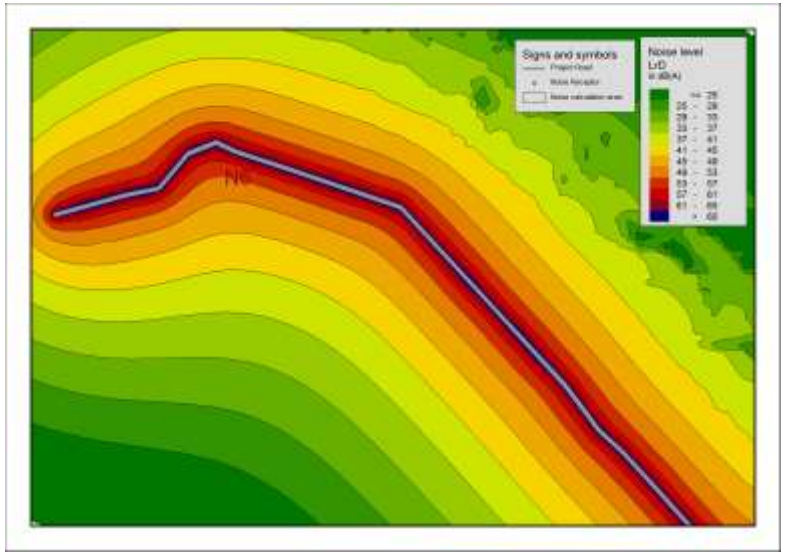
Day **Night**

Year 2023

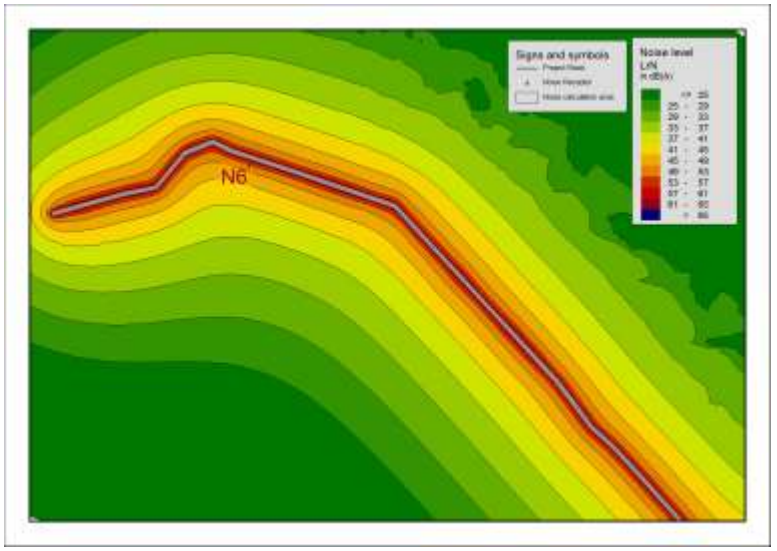


Day **Night**

Year 2033

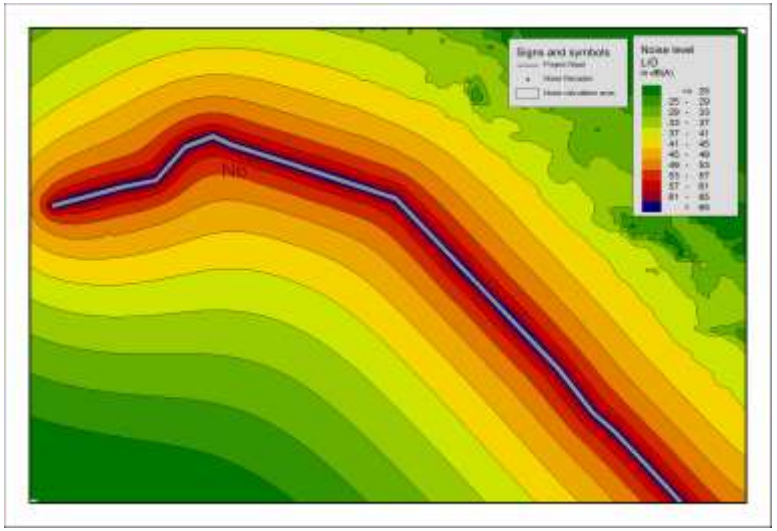


Day

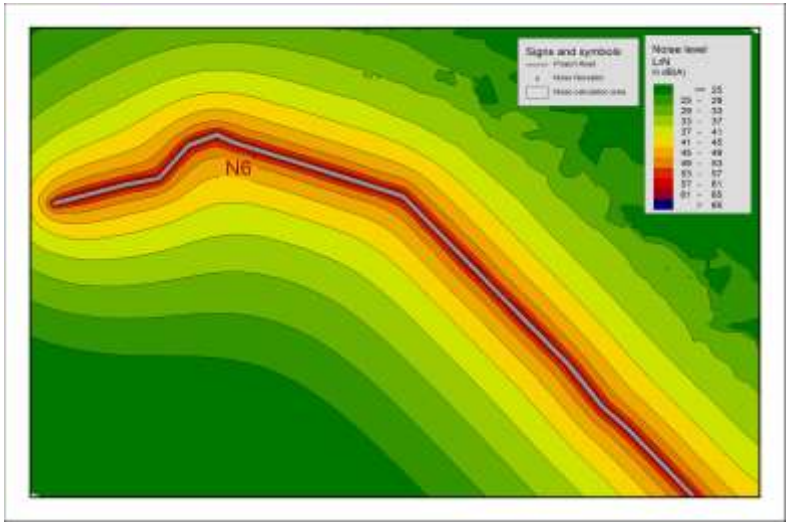


Night

Year 2038



Day



Night

Year 2043

F. Impacts on Biological Environment

1. Vegetation Destruction

193. **Impact:** The road side avenue tree plantings are prone to damage by human as well as domestic animal activities.

194. **Mitigation:** The contractor will still be on board during the 1-year defect liability period and 5-year performance-based maintenance period. Hence, proper maintenance of trees planted under the project will be carried out by the contractor for at least 3 years after planting the sapling. Maintenance activities will include watering the seedling and ensuring that fencing provided is not destroyed by cattle or people.

Table 35: Summary of Beneficial and Adverse Impacts

S. No.	Issues	Impacts
[A] Beneficial Impact		
A1 Construction Stage		
1	Employment and Income	Income from unskilled & semi-skilled jobs
2	Enterprise Development and Commercialization	Commercial activities to meet demand of labour groups
3	Skills Enhancement	Transfer of skills and technical know-how
A2 Operation and Maintenance Stage		
1	Improved Access and Promotion of Green House Gas Reduction	• Easy, comfortable, safe and quick access eliminating existing traffic congestion and reduction in roadway accidents. • Reduction in CO_2 emissions. • Reduction in dust emission
2	Rise of Land Value	Rise in land values.
3	Increased Crop Productivity and Sale of Farm Products	Improved access will enhance agro-industries.
4	Enhancement of Social Services	Socio-economic development activities including health, education, communication, market etc will be increased.
5	Women Empowerment	Improved transportation strengthens women in providing better access to schools, health centers and markets.
[B] Adverse Impacts		
B1 Construction Stage		
B1.1 Social, Economic and Cultural Environment		
1	Land and Building Acquisition	• Demolition of Boundary walls • Demolition of Houses • Removal of temporary shops of road side vendors
2	Stress on Public Utilities & Facilities	Influx of outside workers exerting pressure on local services.
3	Occupational Health and Safety, STDs and Nuisance from Construction Camps	• Health risks and hazards due to lack of adequate safety measures • Poor labour camp, unsafe water and unhygienic conditions • Health risks due to influx of outside and migrant labours • Inadequate living space for labourers
4	Conflict due to Influx of Construction Workers	• Spread of alcohol consumption & gambling • Potential for STD such as HIV/AIDS
B1.2 Biological Environment		
1	Vegetation and Forest Resource	Loss of vegetation
B1.3 Physical and Chemical Environment		

S. No.	Issues	Impacts
1	Earthworks / Slope Stability	• Soil erosion on embanked slope • Monsoon siltation on adjacent farmland and water body
2	Disruption of Public Utilities	• Disruption of electrical and telephone poles • Disruption of existing cross-drainage structures • Disruption of existing Bus Bays • Disruption of underground water supply pipelines
3	Traffic Hazard and Road Safety	• Roadway accident risks • Disruption in Smooth flow of traffic
4	Operation and Closure of Quarries and Borrow Pits	• Disruption of natural land contour, disturbance in natural drainage and scouring of river beds. • Ponding, water logging, and water pollution.
5	Stockpiling of Construction Materials and Debris Disposal	• Siltation and pollution • Disturbance to private property
6	Air Pollution	• Localized dust emission • Localized increase in gas emissions from vehicles
7	Noise Pollution	Nuisance to local residence
8	Water Pollution	Effect on adjoining water bodies from construction activities.
9	Use of Bitumen / Combustible / and Toxic Materials	• Use of fuel wood to heat Bitumen • Release of Bitumen into the environment (runoff of bitumen into surface waters) • Fire and explosion hazard • Spills and leaks
B2 Operation and Maintenance Stage		
B2.1 Social, Economic and Cultural Environment		
1	Population Pressure and Impact due to New Settlement along the Road Alignment	Ribbon development i.e., the establishment of settlements, shops and food stalls along the road side.
2	Social Conflicts	Trigger or increase illegal activities such as alcohol consumption, gambling and prostitution.
B2.2 Biological Environment		
1	Vegetation Destruction	Tree plantings could be damaged by human as well domestic animal activities.
B2.3 Physical and Chemical Environment		
1	Slope Stability	Embankment slope could be destabilized due to monsoon rain, inadequate drainage works, faulty construction and inadequate vegetative measures.
2	Drainage and Water Management	Poor maintenance of drainage structures, especially after heavy rainfall will lead to drainage problems, water logging, and erosion.
3	Road Accidents	Operation of the road also increase the chances of road accidents, particularly involving children.
4	Pollution of Water Resources	Local water pollution and damage to road surface by leakage/spills of fuel, lubricants and hydrocarbons that may not only affect the aesthetic value of water bodies but also have detrimental effects on the health of people and animals relying on these sources.
5	Pollution of Air and Noise	Air pollution in this area will be the exhaust from the vehicles using fossil fuels and vehicle fumes from any other fuel powered mechanical equipment. Increase in noise level.

G. Climate Change Consideration

1. Climate Change Mitigation

195. Transportation sector is one of the major contributors to the increase in greenhouse gas emission. The sector accounts for about 28% of global primary energy consumption[6], and 13.5% of world greenhouse gas emission, of which road sector accounts for 9.9%.[7] As far as CO2 emission is concerned, road transport in Nepal dominates the energy use pattern, accounting for 86.5% of total sectoral consumption.[8]

196. GHG emission likely to be generated from the project road have been computed using the Transport Emissions Evaluation Model for Projects (TEEMP)[9] developed by Clean Air Asia10 and was utilized to assess the CO2 gross emissions with and without the project improvement. The main improvement from the project that was considered for the model are better surface roughness with less than 2.5m/km and widening of project road from 2-lane to 4 lanes. These were translated into increase in traffic speed and hence fuel consumption. The model has also been used for CO2 emission assessment during construction stage. The model also allows for the inclusion of impacts related to traffic congestion with and without project through provisions for inserting data on the traffic numbers, lane width, number of lanes and volume/capacity saturation limit.

197. Few assumptions made in this software are:

a) Fuel efficiency as reckoned in business as usual (BAU) and with project scenario (WPS) is given in **Table 36**. It is assumed that the fuel efficiency of the vehicles would increase due to improvement of the road.

b) It is assumed that there would be no or minimum number of vehicles with vintage year before 2000 using Euro –I fuel type after 20 years (**Table 37**). Pre-Euro vehicles are assumed to be completely discarded for vehicle categories except 3 wheelers.

---

[6] U.S. Energy Information Administration, Annual Energy Review
2011, DOE/EIA-0384(2011), September 2012, p.37-38. Accessed: January 29, 2013, <http://www.eia.gov/totalenergy/data/annul/pdf/aer.pdf>
Scenario Analysis of Road Transport Energy Consumption and Greenhouse Gas Emission in Nepal (PDF Free Download). Available from: https://www.researchgate.net/publication/296348292_Scenario_Analysis_of_Road_Transport_Energy_Consumption_and_Greenhouse_Gas_Emission_in_Nepal [accessed May 25 2018].

[7] Alex Kirby, 2008. CCCC Kick The Habit, A UN Guide to Climate
Neutrality, UNEP, p.34-44. Accessed: January29, 2013, <http://www.grida.no/files/publications/kick-the-habit/kick_full_lr.pdf>.
Scenario Analysis of Road Transport Energy Consumption and Greenhouse Gas Emission in Nepal (PDF Free Download). Available from: https://www.researchgate.net/publication/296348292_Scenario_Analysis_of_Road_Transport_Energy_Consumption_and_Greenhouse_Gas_Emission_in_Nepal [accessed May 25 2018].

[8] Government of Nepal, Water and Energy Commission Secretariat
(WECS), 2010. Energy Sector Synopsis Report, p.88-92.

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

[10]A network of 250 organizations in 31 countries established by the Asian Development Bank, World Bank, and USAID to promote better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors.

Table 36: Fuel efficiency in km/l

Scenario	BAU		WPS	
	Petrol	Diesel	Petrol	Diesel
2 Wheeler	40.00		50.00	
3 Wheeler		15.00		20.00
Car	12.00	15.00	15.00	20.00
LCV		5.00		8.00
Bus		5.00		8.00
HCV		5.00		8.00

Source: DPR Consultant

Table 37: Emission Standards of Fleet (%)

Vehicle Type	Current Scenario				Post 20 Years		
	Pre-Euro	Euro I	Euro II	Euro III	Euro I	Euro II	Euro III
2 Wheeler		50%	50%			30%	70%
3 Wheeler	80%	20%			20%	40%	40%
Car		40%	40%	20%		40%	60%
LCV		70%	20%	10%	10%	40%	50%
Bus		70%	20%	10%	10%	40%	50%
HCV		70%	20%	10%	10%	40%	50%

Source: DPR Consultant

198. The model demands information on length of road or section, lane configuration, mode wise count of AADT in vehicles, average trip length, share or local traffic, trip length of local traffic, fleet characteristics i.e. breakdown of fleet based on fuel type, percentage breakdown of vehicle-fuel type based on Euro standard. Traffic forecasts were taken from the detailed project report, which is having variable increase depending upon the vehicle type and is presented in Error! Reference source not found. **38**.

Table 38: Traffic Growth Rates Adopted for Kanchanpur – Kamala Road, %

Period	2-Wheelers	3-Wheelers	Car	Bus	2-Axle	Multi-Axle
2017~ 2018	13.34	0.77	9.08	6.71	9.08	4.01
2019 ~ 2020	11.56	0.46	7.84	4.15	7.84	4.33
2021 ~ 2022	8.88	0.11	6.01	3.19	6.01	4.77
2023 ~ 2027	6.91	-0.04	4.68	2.49	4.68	3.68
2028 ~ 2032	7.43	-0.10	5.03	2.67	5.03	2.88
2033 ~ 2037	8.74	-0.19	5.91	3.14	5.91	3.09

Source: DPR Consultant

199. Input parameters as considered for all the project road section are as given in **Table 39**. Design period is 20 years and volume capacity saturation limit based on the current traffic velocity is considered as 1.5 for the entire project road. Traffic data, expressed in AADT, is shown in **Table 40**.

Table 39: Input Parameters for TEEMP

S. No.	Particular	Kanchanpur – Kamala Road
1	Length of Road (km)	86.851
2	BAU - No. of Lanes	2
3	WPS - No. of Lanes	4
4	BAU - Lane Width (m)	3.75
5	WPS - Lane Widht (m)	3.75
6	BAU - Roughness (m/km)	6.0

S. No.	Particular	Kanchanpur – Kamala Road
7	WPS - Roughness (m/km)	2.5
8	Induced Traffic	20%
9	Start of Assessment Year	2018

Source: DPR Consultant

Table 40: Traffic Data and Projection

AADT, volume per day	Kanchanpur (00+000)		Rupani (20+351)		Kadmaha (42+031)		Chourhawa (68+381)		Mirchaiya (73+381)	
	2018	2037	2018	2037	2018	2037	2018	2037	2018	2037
2-wheelers	1246	5586	1728	7747	5477	24554	4313	19336	2798	12544
3-wheelers	113	21	87	16	468	86	280	52	380	70
Car	340	2603	276	2113	487	3729	318	2435	306	2343
Multiaxle	1084	2082	1161	2230	1961	3767	1249	2399	1305	2507
Bus	923	1605	1323	2301	1745	3035	1069	1859	1053	1831
Two-axle	818	2289	839	2347	2040	5708	1677	4692	1467	4104

Source: DPR Consultant

200. Maximum PCU for 2 and 4 lanes were considered as 36,000 and 80,000, respectively. In the absence of emission factors data for vehicles in Nepal, emission factors were mostly taken from the CPCB/ MoEF & CC, India (2007) Draft Report on Emission Factor Development for Indian Vehicles, The Automotive Research Association of India, and C. Reynolds et. al (2011) Climate and Health Relevant Emissions from in-use Indian three-wheelers rickshaw as presented in **Table 40**. Furthermore, it has been assumed that after 24 years, there will be reduction of 15% in the emissions, due to advancement of technology and improved efficiency:

Table 41: CO_2 Emission Factors for different vehicle types[11]

Vehicle Type	CO_2 Emission Factor (kg/L)	
	Gasoline	Diesel
2-Wheel	2.28	
3-Wheel		2.63
Cars/ Jeeps	2.59	2.68
Multiaxle		3.21
Bus		3.61
Two-axle		3.50

201. It was assumed that the 2-wheelers and 3-wheelers have average trip distance of about 5 km in each section, whereas all other vehicles do use the entire length as average trip distance. Furthermore, 2-wheelers and 3-wheelers constitute 90% each of the total local traffic, whereas car, Multiaxle, Bus and Two-axle constitute 100% respectively of the total local traffic. It has also been assumed that over the time, the fleet composition will change and the assumption taken for the same are as follows:

202. Emissions from road construction were estimated by using the emission factor for rural/urban roads, by using ADB - Carbon footprint 1(http://www.adb.org/documents/reports/estimating-carbon-footprints-road-projects/default.asp), which is equivalent to 48,400 kg CO2/km of road construction.

203. Estimated carbon emissions. The proposed road widening and upgrading resulting to surface roughness and road capacity improvements have implications in CO2 emissions.

[11]It has been assumed that the emission factors will be reduced by 15% in 24 years.

Improved roughness results to higher speed and lesser emissions while increase road users increases emissions. These factors are further affected by traffic congestion once the volume/capacity saturation limit.

204. The design life of road is 20 years. Total CO2 emission at business-as-usual and with project scenarios (without induced traffic), and with project scenario (with induced traffic) were estimated as 1,559,728 tons, 1,648,044 tons, and 1,955,503 tons, respectively. The increase in CO2 emission with project scenario compared to BAU is greater, because of steady growth in the number of vehicles during the 20-year period.

205. Total CO2 emissions at business-as-usual (BAU), and with project (including construction) scenario (WPS) were estimated at 77,989 tons/year and 82,402 tons/year (without induced traffic) and 97,775 tons/year (with induced traffic), respectively. The BAU scenario is less than the 100,000 tons/year threshold set in ADB SPS 2009, while the with project scenarios are slightly below the threshold.

2. Climate Change Adaptation

206. **Climate Change in Nepal:** Based on climate modelling experiments, the Intergovernmental Panel on Climate Change (IPCC) AR4 model suggests that warming would be significant in Himalayan Highlands including the Tibetan Plateau and arid regions of Asia.[12] The model indicates that summer precipitation is likely to increase in south Asia during this century. An increase in occurrence of extreme weather events including heat waves and intense precipitation events is also projected in the region. Although the annual mean temperature is projected to go up in the region, precipitation events are envisaged to be more erratic in the future implying increasing uncertainty. For projected changes in surface temperature and precipitation in the South Asian region under SRES A1F1 (highest future emission trajectory) and B1 (lowest future emission trajectory) pathways for three time slices (2020s, 2050s, and 2080s), reference is made to Table 10.5 (chapter 10, page 480) of the IPCC AR4 report on the website: *www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf*

207. The National Adaptation Program of Action (NAPA) for Nepal hinges on climate projections conducted by the Organization for Economic Cooperation and Development (OECD) and the Nepal Climate Vulnerability Study Team (NCVST).13 The OECD analysis of GCM SRES-B2 (low emissions scenario) model projects mean annual temperature increases of 1.2°C by 2030, 1.7°C by 2050, and 3°C by 2100 relative to a pre-2000 baseline. On the other hand, the NCVST's Regional Circulation Models (RCMs) project mean annual temperature increases of 1.4°C by 2030, 2.8°C by 2060 and 4.7°C by 2090. Both predict warmer winter temperatures. The overall projections are similar to those of the IPCC that predict a warming trend with variable, unpredictable and extreme weather events (floods and droughts), and increase in frequency and intensity of rain during the wet season and longer droughts.

208. The Climate Change Policy of Nepal broadly outlines the problems and challenges that the nation is likely to encounter in its current and future developmental plans and activities.14

---

[12] IPCC. 2007. Climate Change 2007, Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Fourth Assessment Report on Intergovernmental Panel on Climate Change (IPCC). Geneva. www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf

[13] Government of Nepal, Ministry of Science, Technology and Environment. 2010. Nepal, National Adaptation Programme of Action (NAPA). Kathmandu

[14] Government of Nepal. 2011. *Climate Change Policy.* Kathmandu. https://ldcclimate.files.wordpress.com/2012/05/climate-change-policy-eng-nep.pdf

Although sectoral climate change policies are not addressed as due to dearth of in-depth sector-specific studies, yet on the overall, the policy mentions for the adoption of low-emissions clean and green renewable technologies and climate resilient adaptations in infrastructure development to mitigate the adverse impacts of climate change. (*https://ldcclimate.files.wordpress.com/2012/05/climate-change-policy-eng-nep.pdf)*

209. **Road Sector Climate Risks.** The impacts of climate change and natural disasters on road transport in Nepal are presented in a background paper by MOPIT at the ninth regional environmentally sustainable transport forum held in Kathmandu in November 2015.[15] The paper conveys that over the decade, Nepal has been experiencing early impacts of climate change that has caused unprecedented heavy rain and massive floods followed by long spells of drought. Between 1970 and 2010, there were 35 major flooding instances recorded at various parts of the country damaging large segments of highways and feeder roads with huge economic losses in terms of road closures lasting up to several days.

210. In Nepal, floods of devastating nature are triggered by different mechanisms such as: (i) continuous rainfall and cloudburst (CLOFs), (ii) glacial lake outburst floods (GLOFs), (iii) landslide dam outburst floods (LDOFs), (iv) floods triggered by the failure of infrastructure, and (v) sheet flooding or inundation in lowland areas due to an obstruction imposed against the flow.

211. To tackle the risks imposed by climate change in the road sector of Nepal, MOPIT states that the traditional way of designing and implementing transport infrastructure is not adequate for long-term sustainability of the road networks, and recommends enhancing the resilience of development plans to climate risk in its entirety as a strategic and proactive move requiring that anticipated climate threats be assessed before implementing the plans so that measures to reduce those threats can be built into the plan itself.

212. The background paper of MOPIT presents a comprehensive review of the potential impacts of climate change and the road design parameters that need to addressed to avoid damage caused by different climatic disasters (**Table 42**).

Table 42: Impact of Climate Change and Disaster on Road Transportation and Potential Design Considerations for the Future

CC	Primary Impacts	Secondary Impacts	Design Considerations
Temperature Increase	(a) Road Investment - Road investment marginalized by excessive migration due to water scarcity (local roads)		- Consideration of appropriate design life - Stage construction - Design based on existing traffic (low volume road)
	(b) Pavement - Increased fatigue bituminous pavement needing additional maintenance cost	- Increased VOC with additional	- Use of stiff bitumen - Soft bitumen with solvent in water (emulsion) - Control soil moisture

[15] United Nations Centre For Regional Development and Government of Nepal, MOPIT. 2015. *Ninth Regional Environmentally Sustainable Transport Forum in Asia: Climate and Disaster Resilient Transport System and Infrastructure Development for Nepal.* Kathmandu.
http://www.uncrd.or.jp/content/documents/3381Background%20Paper%20-EST%20Plenary%20Session%202%20(No.%202).pdf

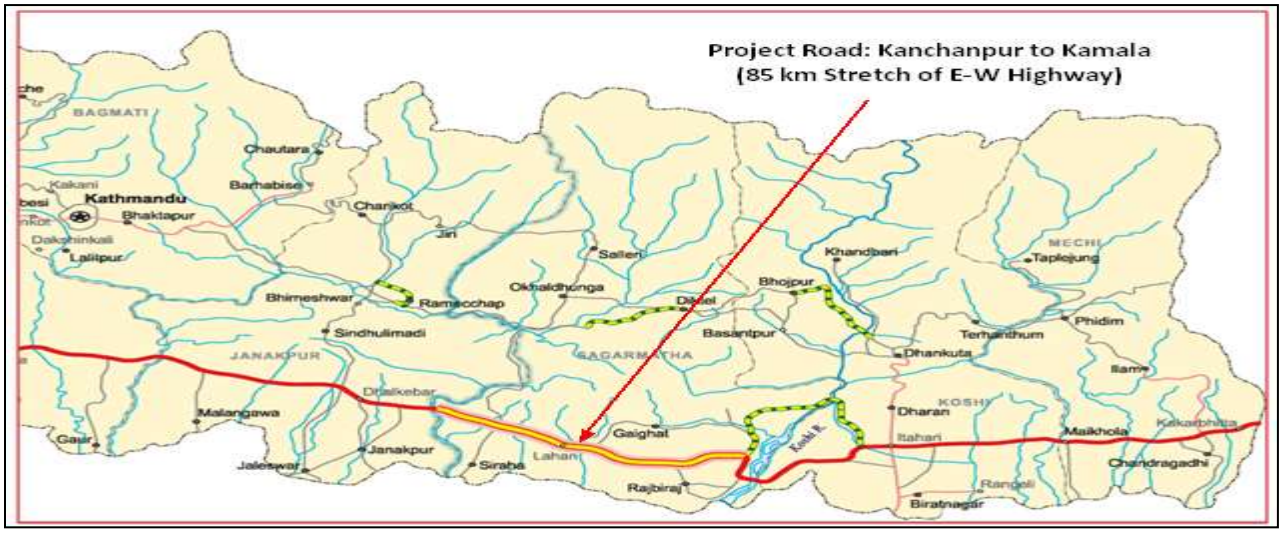
CC	Primary Impacts	Secondary Impacts	Design Considerations
	- Deterioration of gravel surface due to excessive moisture loss leading to additional cycle of resurfacing	consumption of fuel - Possibility of increase in road accidents - Increased maintenance cost	- Adapt gravel sealing (Otta-seal / grav-seal) - Additional road safety provision
	(c) Bridges - Thermal expansion of bridges - Buckling of joints of steel structure - Higher corrosion activity at locations with high humidity		- Careful attention to material used for joints - Extensive use corrosion protection material
Temperature Decrease	(a) Pavement - Exposure to snow conditions - Affect road transport operations - Increased O & M costs	- Increase in road accidents	- Adopt micro-texture pavement standards for urban and high volume roads
High Rainfall / Flooding	(a) Pavement - Deterioration of gravel surface due to excessive moisture - Deterioration of bituminous pavement with faster trend calling for early intervention for periodic maintenance or overlay	- Increased VOC with additional consumption of fuel - Possibility of increase in road accidents - Increased maintenance cost	- Adopt resilient drainage system - Improve soil strengthening and rock stabilization techniques - Resilient asphalt and concrete pavement - Regular survey and maintenance measures
	(b) Road Embankment and Drainage Structures - Damage to road drainage structures including foundation due to high runoff - Breaching of road embankments resulting in loss of road sections - Submersion of road - Landslides and road blocks - Erosion	- Traffic disruption - Road closure for indefinite periods - Weakening of pavement structures due to submersion of road embankment for longer period of time	- Proper discharge estimation to design the size and shape of drains and drain slope - Slope protection in mountain roads - Proper sub-surface drains and catch drains - Increase road surface camber for quick removal of surface water on pavement - Building line defence for embankment to prevent complete failure (reinforced earth)
	(c) Bridges - Scouring of bridge foundations	- Disruption of traffic	- Creating additional free-board (flood return period estimation)

CC	Primary Impacts	Secondary Impacts	Design Considerations
	- Submersion of bridge - Bridge washout		- Protection of river and banks - Revising bridge selection criteria specific to location with possible climate change impact
Landslides	(a) Road embankment & Drainage Structures - Failure of embankment and drainage structures	- Traffic disruption - Damage to utilities (urban roads)	- Vulnerability of road slopes regularly checked and monitored (highways and feeder roads)

Source: Intergovernmental Panel on Climate Change. 2007. Climate Change 2007, Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Fourth Assessment Report on Intergovernmental Panel on Climate Change. Geneva.

3. Project Description

213. **Physiographic Profile of the Project Area.** Along a south-to-north transect, Nepal is broadly divided into three major physiographic belts: Terai, Middle Himalayas (including the foothills, Siwalik), and High Himalayas. The road project lies in south eastern part of Nepal (see **Figure 13**) where the physiographic relief (**Figure 14**) along the road alignment falls in the "Terai" belt. The Terai is the longitudinal stretch of lowland with widths varying from 20 to 50 km from the international border with India till the Nepal Himalayan foothills and stretches the whole southern region of Nepal. The Terai region is generally low relief with elevation varying from 65m to 300m above median sea level and as part of the Indo-Gangetic plain the Terai soil is composed of alluvial sediments deposited by northerly drainages. The climate in the Terai region is hot humid



tropical with an annual average temperature of 25°C and the rainfall there varies from 1,200 mm to 3,000 mm per annum.

Figure 12: Project Area

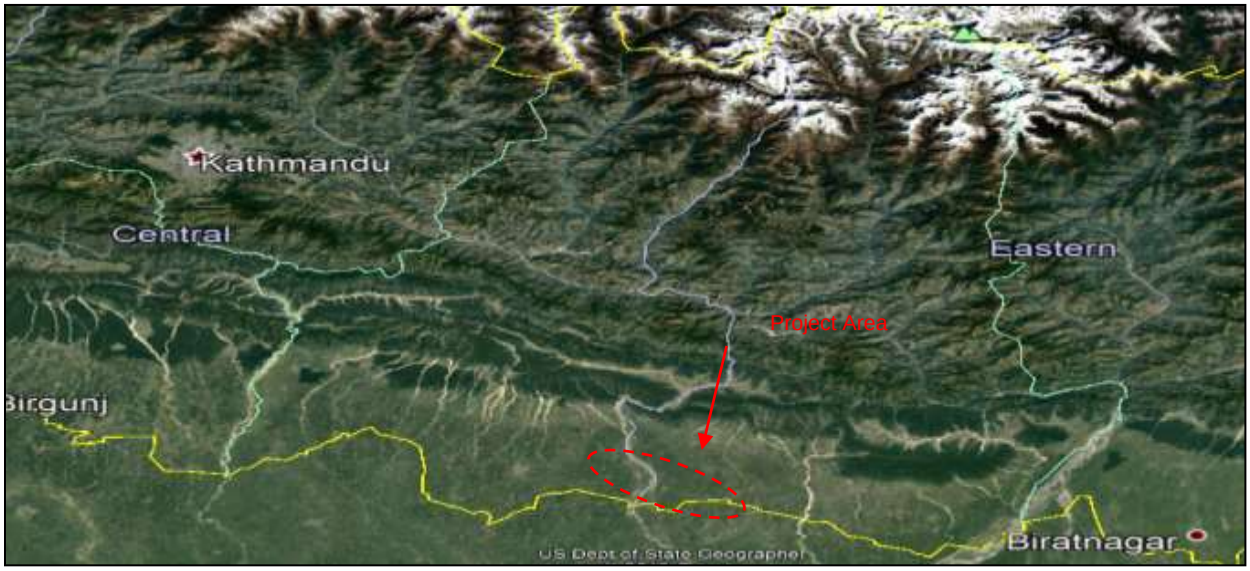


Figure 13: Physical Relief (Google Earth)
Source: Asian Development Bank, Google Earth.

214. The Terai is a well-developed drainage of Himalayan-fed, south flowing perennial rivers and features numerous rain-fed ephemeral streams drain the area. In general, river morphology in the Terai area is characterized by the following: (a) severe erosion in the northern hill slopes, (b) excessive sediment load, (c) wide and braided channels, and (d) very high peak floods.[16] A

215. rainfall intensity of 350 mm for consecutive 48 hours is considered as high intensity rainfall and rainfall exceeding 70 mm per hour is considered as cloudburst rainfall which disrupts both the slopes and channel equilibrium at the local as well as regional scales. During the monsoon months from June to September, all these rivers including the numerous ephemerals in the Terai are in spate with bank-full discharges and more than often inundate large tracts of adjoining lowlands.

216. **Current State of Condition of Existing Road.** This road project intends to rehabilitate and upgrade about 87 km of national highway between the settlements of Kanchanpur and Kamala situated along the EWH in southeastern part of Nepal. Based on visual observations gathered on 17 April 2018, the condition of the present two-lane road between Kanchanpur to Kamala is summarized below. In general, KK Road traverses through natural features composed of various land use patterns mainly agricultural amidst intermix of scattered settlements, both rural and semi-urban.

(i) The geometric alignment of the KK road is fairly level with very little rise and fall of gradient. Natural physical impediments such as rocky cliffs and crags, geological depressions (landforms sunken or depressed below the surrounding area) that would encumber the building up of road embankment and widening of road width along the present alignment are observed to be least to none.

(ii) No excessive standing water and water discharging onto or from within, and/or flowing across the road were observed; perhaps the scenario would be different

[16] Flooding and Inundation in Nepal Terai: Issues and Concerns; B.R. Adhikari, Hydro Nepal, Issue No. 12, 2013

had the field visit been during the monsoon season. Road subsidence or collapse as a result of pavement sub-surface failures was not observed.

(iii) No open potholes and visible pavement defects such as tell-tale signs of rutting / cracking, remnants of flood debris and other hazardous obstructions on the carriageway were observed. Pavement maintenance works had been recently carried out.

(iv) Road drainages particularly those along human settlements showed accumulations of debris and growth in side drains and channels, and inlet and outlet pits were observed to be obstructed with sludge effects.

(v) No visible signs of damages due to overtopping of bridges and cross-drainages by flood events were observed; Sediment load and flood debris along streambeds both upstream and downstream of cross-drainages as a result of annual rainfall events were observed but the general passageways for runoffs were observed clear of blockages, indicating routine maintenance works had been recently done.

217. **Objectives of the Climate Risk and Vulnerability Adaptation.** In terms of road infrastructure, Nepal has already experienced in the past extreme events that has caused interruptions, economic losses and loss of lives, whether stemming from natural hazards or human impacts. In many ways, hazard proofing infrastructure is not a new concept as engineers have historically taken into account information on various hazards and potential impacts for in the design, construction, use, and maintenance of road infrastructure.

218. This CRVA aims to document the risks associated with climate change vulnerability and risks, and in response examines the adaptation approaches engaged in the design of the project road with the particular objective of reducing the perceived negative impacts under an uncertain future climate. The CRVA is complex in the sense that an accepted common methodology for assessing and prioritizing climate risks does not exist and as such does not lend a well-defined set of solutions. Adaptation decision making can be very challenging as the identification and assessment of reliable and appropriate climate risk information and the translation thereafter to a doable exploit can at best remain arguable. A glossary of CRVA terms is in Appendix 2.

219. **Scope and Limitation.** Climate change impacts on road infrastructure projects are well documented in ADB's 2011 publication, "Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects," which also provides a step-by-step methodological approach to assist project teams to incorporate climate change adaptation measures into road transport projects. Adaptation options in the road transport sector are grouped into engineering (structural) options and non-engineering options. In addition, a decision not to act, or to maintain a business as usual approach ("do nothing" option) has also been retained as a possible option, where based on circumstances and findings from impact, vulnerability, and adaptation assessments that doing nothing (no climate proofing) may also be the best course of action.

220. Appendix 1 is a reproduction of MOPIT'S background paper that advises adaptation considerations to be incorporated in the road design process with the objective to ameliorate the impacts of climate change and involved natural disasters. In terms of impacts on road infrastructure by climate variables such as temperature, rainfall and associated flooding, all of which are foreseen to increase in both frequency and magnitude, MOPIT'S recommendations primarily focus on improving, strengthening and consolidating the technical requirements and standards of road works. These recommendations have evolved through DOR's past experience and assessed levels of risks, and which if executed with due diligence in the design of the KK road is a form of adaptation to climate change where long-term sustainability is questioned.

221. Based on the nature and progress of studies carried out for the KK road by the design team, the scope of this CRVA is limited to just two of the engineering adaptation tasks amongst the several indicated in the ToR and which are: (i) where relevant, review hydrological studies carried out by the engineering team and provide inputs to integrate future climate data into the study, and (ii) In consultation with the design engineers of the project identify climate adaptation measures or design modifications for projects to mitigate the key climate risks identified. Bon this basis, the CRVA aims to address primary impacts on pavement of road, road embankment and drainage structures as highlighted in Table 1 (Appendix 1).

222. **Adaptation Measures.** Knowledge of meteorological parameters of a site plays a vital role in designing of engineering structures. The design of engineering structures requires an understanding of extreme weather conditions that may occur at the site of interest, which is very essential so that the structures can be designed to withstand weather stresses. The key climate risk identified for the KK road project is that related to extreme rainfall events as extreme precipitation events are one of the primary natural causes of flooding.

223. **Design Rainfall[17]**. As precursor to design of drainages for the road, the engineering team has executed a rainfall assessment using historical rainfall data collated from several stations located in the project corridor. The annual maximum daily precipitation values from each of the met stations have been subjected to best-fit frequency analysis and where magnitudes of extreme events to their frequencies of occurrence have been determined.

224. The provision for adequate drainage is of paramount importance in road design and cannot be overemphasized as the presence of excess water or moisture within the roadway will adversely affect the engineering properties of the materials with which it was constructed. Thus, any drainage installation is sized according to the probability of occurrence of an expected peak discharge during the design life of the installation. This relates to the intensity and duration of rainfall events occurring not only in the direct vicinity of the structure, but also upstream of the structure. Noting that none of the met stations in the project area provide hourly or sub-hourly rainfall intensities, the design of the KK road derives the intensity-duration-frequency relationships through an empirical method described as best adapted and widely used in Nepal.

225. In terms of climate change adaptation, the KK road design team has taken the following considerations.

(i) Rainfall intensity estimate has been increased by 10%; and
(ii) The design return period is now taken as 20 years as opposed to 10 years under customary (standard) practices in Nepal. Thus the design rainfall intensity value chosen is for a recurrence interval of 20 years.

226. Literature reviews indicate gaps between the need for considering climate change impacts in design, and actual published guidelines that incorporate climate change in extreme precipitation and flood frequency. To offset this gap, some countries around the world have begun adopting policy design guidelines on climate change adjustment factors to be applied to current design estimates depending on design return period and projection horizon. For instance, Belgium applies a +30% climate change adjustment factor on the design rainfall derived through stationary frequency analysis, Denmark sets 20%, 30% and 40% increases for return periods 2, 10 and 100 years, and the UK adopts 10%, 20% and 30% increases for projection years 2055, 2085 and

[17] Report on Hydrological/Hydraulic and Drainage Study for The Phase-I Roads/Bridges; Kanchanpur – Kamala Road, Nepal, May 2018.

2115[18]. The KK project's 10% increment agrees with UK's 2055 projection year increment, and as such this CRVA assumes this increment as fairly reasonable given the fact that cross and longitudinal drains are taken care of by periodic adaptive maintenance.

227. In item (ii) above, the design of the project drainage structures is achieved by increasing the return periods to account for uncertainties rather than using a lower recurrence period. However, society and planners are concerned with knowing whether a system will remain undamaged within a given design period. The term 'return period' gives little information regarding the reliability or the likelihood that a given project will perform as expected; an effective communication tool would be 'risk'. In the case of KK drainage with a typical design life of 20 years, the system risk is 64% when a 20-year return period is considered, an improvement from 88% if 10-year return period was used.

228. To achieve a risk of say < 10% commensurate with a design life of 20 years, the average return period of the design event will be in several hundreds of years, and the provision of such level of risk immunity will come at a very high cost, which may be difficult to justify because of inherent uncertainties. One could justify higher return periods for vital infrastructure systems that have long service lives such as bridges, unlike small drainage infrastructure designed for a shorter service life where appropriate adaptations in design, construction, operation, and maintenance practices can be effectively implemented over time.

229. **Design Storm Runoff.** The estimation of design storm runoff is necessary for the design of hydraulic structures and to quantify the risk of failure of the structures. The project corridor is a well-developed drainage of Himalayan-fed, south flowing perennial rivers and besides is characterized by numerous rain-fed ephemeral streams. However, none of the perennial streams are gauged and in the absence of stream flow records, a number of regional empirical methods to predict peak flows developed for the region have been analyzed and compared. The project road traverses some 200 natural drainages with around 95% associated with catchment areas less than 1 km^2. Cross-drainage infrastructures of various culvert configurations such as box, slab, pipe, etc. have been proposed for these minor drainages.

230. In terms of climate change adaptation, the KK road design team has taken the following considerations.

(i) Estimates of design flood discharge for the small drainages are adopted from the rational method as this method provided higher discharge values in comparison with other four empirical methods applied in Nepal;
(ii) The total of numbers of cross-drainages is increased from 230 existing to 236. Further all old existing 65 numbers of pipe culverts of 600 mm diameter are now to be replaced by 900 mm diameter pipes;
(iii) The flood discharge capacities of the various cross-drainage structures have been reverse-checked for adequacy to convey the design flood, and alterations in design dimensions made accordingly whilst maintaining adequate freeboard; and
(iv) Road embankment heights in critical stretches of the KK road to be increased by about 1m well above flood level.

231. **Design Flood.** Estimations of design flood with regards to two bridges over fairly sized perennial rivers Madi and Seti having upper catchment areas of 1117 and 578 km^2 respectively

[18] FLOODFREQ Cost Action ESO901; European Cooperation in Science and Technology, Center for Ecology and Hydrology, 2013; http://www.cost-floodfreq.eu

have been carried out for the determination of high flood levels and scour depths. Both rivers are gauged with flow records spanning 41 years (1975-2015) for the Madi river and, 20 years (1964-1983) for the Seti river, the latter record exhibiting discontinuity from 1984 onwards for some reasons. In the case of Madi river and because of the fairly good length and quality of flow records, the annual maximum instantaneous flood discharges have been subjected to a frequency analysis best described by a 3-parameter log normal distribution and have derived peak discharges for various return periods. In the case of Seti river and owing to poor quality of data, a number of methods have been employed of which the peak flood discharges by the Synder's method has been adopted as found to yield higher flood estimates as compared to other methods.

232. The design of bridges has taken the following considerations in the light of future uncertainties.

(i) Level of sophistication improved in the determination of high flood levels (HFL); Computations done using HEC-RAS 5.0.0 model and calibrated corresponding to 100-year return flood; and
(ii) Customary freeboard to be maintained for bridges by Nepal standards of 1.5m; however, the design now adopts 2m freeboard, the 33% increase above normal hydraulic clearance requirements is assumed as climate change adjustment factor.

233. **Conclusion:** The objective of the DOR and MOPIT is to have a functional road built to high quality and durable standards, able to withstand future climate impacts. In addition to climate induced factors such as extreme temperature and rainfall impacting the road, other decisive factors such as construction techniques, choice and grade of materials from the base layer to upper pavement structure, designed to excellent bearing capacity, capable of withstanding a broad range of stresses with adequate drainage and protection works and supported by an proficient maintenance management are the foremost concerns expected to be addressed in the design of the KK road.

234. Many practical problems in road transport system design require knowledge of the behavior of extreme values as transport infrastructures are sensitive to changes in climate extremes rather than climate averages. In general, the project design has made best attempts to address climate extremes through customary statistical procedures with allowances kept for future climate uncertainties. Climate change adaptation requires an appropriate balance to be struck between safety and required strength and serviceability over the life of the structure and over initial and maintenance costs. This balance could be achieved using realistic estimates of future climatic design loads which however is very perplexing with the current level of knowledge.

H. Adaptation Costs

235. Table 43 presents the incremental costs for adaptation measures for the proposed road and bridges upgrading for Kanchanpur – Kamala Road. The adaptation comprised drainage design modification, increase in road embankment, and increase in freeboard height of bridges.

Table 43: Incremental Costs for Adaptation Measures for Kanchanpur – Kamala Road

Adaptation Measure	Details	Cost ($million
A. Drainage works		
1. Addition of new cross drainage structures	6 numbers (900mm dia. Hume pipe)	2148.7
2. Increase in size of pipe culverts	65 numbers (600mm to 900m diameter)	23151.28

Adaptation Measure	Details	Cost ($million
3. Replacement of pipe culverts with box culverts	111 numbers; increase in capacity by over 10%	449,293.9
4. Replacement of slab culverts with box culverts	102 numbers; increase in capacity also	130,150.5
5. Replacement of old box culvert with new one with higher capacity	33 numbers; with some increase in capacity	46,152.9
B. Road		
6. Increase in road level	About 10cm increase throughout the road	149,818
C. Bridges		
7. Increase in freeboard by upto 0.5 m hence increase in flood carrying capacity	40 bridges; additional freeboard by median value of 0.47m	465809.6
D. Slope protection measures		
8. Bioengineering	Vegetation of road embankment slopes at selected sections	670,525.8
TOTAL COST		**1,937,050.21**

I. Conclusion

236. The ultimate objective of the DoR and that of the MoPIT is to have a functional road built to high quality and durable standards able to withstand future climate impacts and their core concerns are laid out succinctly in Table 1 (Appendix 1). In addition to climate induced factors such as extreme temperature and rainfall impacting the road, other decisive factors such as construction techniques, choice and grade of materials from the base layer to upper pavement structure, designed to excellent bearing capacity, capable of withstanding a broad range of stresses with adequate drainage and protection works and supported by an proficient maintenance management are the foremost concerns expected to be addressed in the design of the KK road.

237. Many practical problems in road transport system design require knowledge of the behaviour of extreme values as transport infrastructures are sensitive to changes in climate extremes rather than climate averages. In general, the project design has made best attempts to address climate extremes through customary statistical procedures with allowances kept for future climate uncertainties. Climate change adaptation requires an appropriate balance to be struck between safety and required strength and serviceability over the life of the structure and over initial and maintenance costs. This balance could be achieved using realistic estimates of future climatic design loads which however is very perplexing with the current level of knowledge.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

238. Public consultations were organized at two levels namely, (i) district level, and (ii) Project level. The key objectives of consultations were to disseminate the project concept, activities, and policies, rules, and regulations and effects and impacts of the project activities on the environment and to seek suggestions and opinions from all stakeholders and affected people. The more vigorous consultations were held at the project level among the affected people and stakeholders.

239. Some comments or suggestions from the concerned stakeholders and affected peoples were also collected. The proposed Kanchanpur – Kamala Road subproject is intended to complement above bridge construction. Major issues raised were employment opportunity for the locals, compensation for the affected land, adequate cross-drainage structures so that natural irrigation system is not altered etc.

240. As per GoN rule, a 15 days Public Notice on the project was published in a national daily newspaper and inclusion of opinions and suggestions received into the IEE report is mandatory (EPR 97, clause 7.2). The ADB SPS 2009, requires consultation to be carried out during the early stage of IEE report preparation. Public consultations have been undertaken consistent with the ADB requirements. Principles of information dissemination, information solicitation, integration, coordination and engagement into dialogue were incorporated in the consultation process.

241. The consultation purposes and methods that were undertaken during the process are highlighted in **Table 44.**

Table 44: Consultation with Affected People and Stakeholders

Stakeholders	Purpose	Method
District level	To brief the project and project and objectives Request for the relevancy of the project To asses protected areas, wildlife reserves, forest situation, community managed forests, and other projects and programs ongoing in the district Request for relevant secondary information	Official letter Formal and informal meeting with district level stakeholders. viz. officials of Chief District Administration Office, District Coordination Committee, District Forest Office, District Soil Conservation Office, and other relevant district level agencies
Municipality/Rural Municipality Level	Disseminate all five principles of ADB Safeguard Policy including information dissemination, information solicitation, integration, co-ordination and engagement into dialogue Information dissemination about the project, project approach, likely environmental impacts-both: beneficial and adverse, and enhancement measures for beneficial and mitigation measures for adverse impacts and sharing on ideas, suggestions and perception	Earlier requests were made to stakeholders (affected people, NGOs, vulnerable groups of people, including the poor and Indigenous people) through municipality/Rural municipality to attend meeting. Group meetings/consultations, individual meeting/sharing including focus group discussions
• Welcomed the project • Shared experiences on difficulties faced due to bad condition of road especially risk of accidents, inundation problem during monsoon season, increased dust pollution. • Shared encouragement in high value crops production if the road is improved. • Expressed concern on protection of religious and cultural sites and their reinstatement. • Expressed concern on land and private properties compensation.		

Stakeholders	Purpose	Method
• Road safety measures should be provided in Birendra Bazar and Rupani Bazar. It should be purposed overhead bridge for population and under pass grazing animals nearby settlement. • If public structures & public utilities such as optical fiber, cable network and drinking water pipe and electric lines are going to be affected within the RoW, such structures should be relocated in a convenient places as requested by community. • Lahan city is troubled due to drainage blocked by the house owners at south side of the road who built structures on their own. Therefore, to drain out the accumulated ground water, sufficient cross drainages are required. • In Kathauna chowk which is near to the school area should be purpose Zebra crossing and under pass near to Rupani Bazar for animal crossing. • Necessary number of Overhead Bridges in major market centers and similar numbers of under pass for the cattle passing is required. • If the road will construct 6 lanes in market area there will be difficulty in road crossing by children and the aged people that should be consider by making Zebra crossing places, pedestrian movement and disable friendly design.		

Table 45: Summary of Public Consultation Meetings

S. No.	Municipality/Rural Municipality	Location	Number of participants	Date
1	Kanchanprup Municipality	Kanchanpur -8	10 (9 male, 1 female)	23 March, 2018
2	Agnisaer Krishna Sawaran Rural Municipality	Agnisaer Krishna Sawaran Ward No. 2	5 (2 male, 3 female)	28 March, 2018
3	Surunga Municipality	Srunga-4	11 (10 male, 1 female)	29 March, 2018
4	Rupani Rural Municipality	Rupani Bazar-1	8 (7 male, 1 female)	30 March, 2018
5	Lahan Municipality	Lahan Bazaar	14 (12 male, 2 female)	29 April, 2018
6	Shambhunath Municipality	Kathauna	6 (5 male, 1 female)	29 April, 2018
7	Khadak Municipality	Kalyanpur Bazar -5	8 (8 male, 0 female)	29 April, 2018
8	Golbazar Municipality	Golbazar	14 (14 male, 0 female)	2 May, 2018
9	Dhangadimai Municipality	Dhangadi Bazar	19 (17 male, 2 female)	2 May, 2018
10	Mirchaiya Municipality	Ramnagar-5	14 (13 male, 1 female)	2 May, 2018
11	Karjanha Municipality	Karjanha-4	6 (5 male, 1 female)	31 March, 2018
	Total		**115 (102 male, 13 female)**	

242. Information was disclosed through public consultation and more formally by making documents and other materials available in a form and at a location in which they can be easily accessed by stakeholders. This involved making a summary of draft reports available (in the local language) at public locations/municipality in the community and providing a mechanism for the receipt of comments and making documents available more widely. In this regard, ADB encourages governments to upload all documents onto their own website. The full IEE report will be disclosed on the ADB and DoR website and made available to the interested parties upon request.

243. Monitoring is one of the components of EMP. Monitoring of physical, biological and socio-economic parameters of the environment of this project will be carried out. The outcomes of the monitoring activities will be maintained in a database. The results of monitoring will also be disclosed in the form of charts, figures, graphs, and samples, etc., to the local people, school students and other interested stakeholders. In the process of compliance monitoring of the project construction, local people and construction workers will be consulted. The monitoring reports will also be disclosed on the ADB website.

244. The Implementing Agency (DoR) will extend and expand the consultation and disclosure process during the implementation (construction) of the project. The feedback of the affected people, stakeholders and the public has been incorporated in the detailed project design for implementation during construction.

245. Several meetings and focus group discussions (FGDs) were held with stakeholders and affected people to keep them abreast of the project and to get feedback and incorporated in in the Detailed Design. DoR will also make copies of the IEE report and any other project reports for interested people available in the Nepali language.

Figure 14: Public Consultation Photographs

		
Plate 1: Public Consultation with Affected People at Amaha	Plate 2: Public Consultation at Mahuli	Plate 3: Consultation with local representatives of Rupani Rural Municipality
		
Plate 4: Public Consultation of Sambhunath Municipality	Plate 5: Public Consultation with Affected Families at Choharba	Plate 6: Public Consultation at local body office

246. This IEE and other relevant project documents will be made available at public locations in the project affected municipality/Rural municipality and posted on the websites of executing agency and ADB. The consultation process will be continued and expanded during the project implementation to ensure stakeholders participate fully in project execution, as well as to implement comprehensive information, education, and communication plan.

247. The public consultation and disclosure program with all interested and affected parties will remain a continuous process throughout the project implementation, and shall include the following:

A. Consultations during construction stage

(i) Public meetings with affected communities to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and
(ii) Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and to provide a mechanism through which stakeholders can participate in project monitoring and evaluation.

B. Project disclosure

(i) Public information campaigns (via newspaper, flyers, and media) to explain the project to the wider population of the project area and prepare them for disruptions they may experience once construction is underway;
(ii) Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in local language;
(iii) Formal disclosure of completed project reports by making copies available at convenient locations in the project area, and informing the public of their availability; and
(iv) Providing a mechanism through which comments can be made.

248. For the benefit of the community, relevant information from the IEE will be translated in the local language and made available at (i) Offices of executing and implementing agencies, (ii) Division offices, (iii) Consultant teams' offices; and (iv) Contractor's campsites. It will be ensured that the hard copies of IEE are kept at places which are conveniently accessible to people, as a means to disclose the document and at the same time creating wider public awareness. An electronic version of the IEE Report will be placed in the official website of executing and implementing agencies and the ADB website after approval of the IEE by ADB.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

249. Environmental Management Plan (EMP) is the key to ensure that the environmental quality of the zone under impact does not deteriorate beyond the expected level due to the construction and operation of the eighteen bridges and its approaches. The EMP comprises a set of measures to be taken in different stages like the design, construction and operation to eliminate, offset or reduce adverse environmental impacts to acceptable levels. Elimination/prevention is possible through elimination of impacts or by avoiding the action. This can also be achieved by reducing the scale of action. Remediation is repairing or restoring particular features of the environment adversely affected by the activity. Offsetting actions means compensating for impacts by providing additions to or substitutes for the affected environment. Mitigation plans generally evolve around remediation and offsetting.

B. Environmental Management Plan Matrix

250. he Environmental Management Plan is meant for mitigation/management /avoidance of the negative impacts and the enhancement of the various environmental components along the project bridges. For each mitigation measure to be taken its location, timeframe, implementation and overseeing/supervising responsibilities are listed in the EMP matrix. The measure adopted and /or to be adopted during the different stages of the project have been detailed in **Table 46** for pre-construction, construction and operation phases respectively.

C. Environmental Budget

251. The environmental budget for the various environmental management measures proposed in the EMP is detailed in **Table 47**. The cost of Compensatory plantation and monitoring is also included in this budget. There are several other environmental issues that have been addressed as part of good engineering practices, the costs for which have been accounted for in the Engineering Costs. The budget reflects this and while retaining the types of enhancement suggested, allows the selection of the locations at the discretion of the Supervision Engineer.

Table 46: Environmental Management Plan for Kanchanpur – Kamala Road including bridges

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Pre-Construction Stage (Documentary Procedures)							
The Contractor shall complete the following activities no later than 30 days upon issuance of Notice to Proceed: 1.) Submit appointment letter and resume of the Contractor's Environmental Focal Person (EFP) to DoR Project Directorate 2.) EFP will engage CSC-Environment Specialist and DoR/PD to a meeting to discuss in detail the EMP, seek clarification and recommend corresponding revisions if necessary 3.) EFC will request CSC-ES copy of monthly monitoring formats and establish deadlines for submission. 4.) EFC will submit for CSC-ES approval an action plan to secure all permits and approvals needed to be secured during construction stage which include but not limited to: i) operation of crushers and hot mix plants, ii) transport and storage of hazardous materials (e.g. fuel, lubricants, explosives), iii) waste disposal sites, iv) temporary storage location, iv) water use, and v) emission compliance of all vehicles. Arrangements to link with government health programs on hygiene, sanitation, and prevention of communicable diseases will also be included in the action plan. 5) EFC will submit for approval of CSC-ES the construction camp layout before its establishment.							
[A] Pre-construction Stage (Activities)							
Land and property acquisition and compensation	Compensation to the owner	• Road and bridges	• Check land acquisition records; design drawings versus land plans • Interview with affected persons • Check status of employment given to local people during construction	**MI:** Payment of compensation and assistance to DPs as per RP Number of complaints/ grievances related to compensation and resettlement **PT:** Minimal number of complaints/grievances. All cases of resettlement and rehabilitation if any are resolved at GRC level. No case referred to arbitrator or court.		Project/PD-ADB	SC/GESU/DoR
Grubbing & levelling	• Removal of remains of trees to facilitate construction and carting away of remains • Contractor will carry out the clearing of stumps and levelling • Carting away will be done by Contractor after the stumps are removed from the ground.	Road, bridges and approach construction sites	Site inspection	**MI:** Presence/absence of cut tree stumps in the construction site **PT:** Tree stumps must be removed soon after tree cutting		SC/Contractor	GESU/PD/DoR

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Siting of construction Camps	• Site will be located at least 500 m from settlements • Supervision Consultant (SC) and PIU will approve the site chosen by the contractors • Conditions will be put in contract document for location of site at above specified distances. • Machinery and equipment area will be protected. • Vehicle refuelling sites will be avoided in the flood plains of Rivers	At least 500 meters from settlements	Spot Inspection	**MI:** Location of camp site and nearby land use **PT:** Campsite is at least 100m away from the river		Contractor	SC/GESU/DoR
[B] Construction Stage							
Physical Environment							
Micro-Climate 5627 (plus 150 trees for approach roads and bridges) trees will be removed along the right of way (RoW)	- 1:25 compensatory plantation - Avoid or minimize clearing of trees, shrubs and bushes as far as possible. - Aware and support of community with regard to plantation of trees in the available spaces	Throughout the road alignment especially at forest areas	Spot inspection	**MI:** Budget amount allocated for compensatory plantation; Survival rate of planted trees; Status of Forestry clearance for felling of trees. **PT:** Adequate budget allocation; At least 80% survival of planted trees; Clearance secured for felling of trees..	NRs 13,926,825.00	Compensatory plantation to be implemented by Forest Department. Funds will come from DoR	SC, DoR/PD
Air Quality Emissions from plants, vehicles, unpaved road travel, and hauling of materials.	- Carryout water sprinkling and fogging, broom sweeping in dust prone locations, unpaved haulage roads, earthworks, stockpiles and asphalt mixing plant areas.	Throughout the road corridor mainly nearby settlements, bazaar, religious, cultural and archaeological sites	**Laboratory results;** Visual observation	**MI:** $PM_{2.5}$, PM_{10}, TSP, SO_2, NO_2, and CO levels; Status of Pollution Under Control Certificate; Status of approval of mixing and asphalt plants, as well as crusher and	Dust and noise control NRS100,000.00	Supervision Consultant and Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	- Prohibit open burning of solid wastes (plastic, paper, organic matters). - Control dust nuisance using covers, spraying water on unpaved road surfaces, or increase moisture content for open materials storage piles. - Include in bid document to avoid use of very old vehicles, emitting gases beyond standards. - Provide masks and personal protective equipment (PPE) to workers to minimize inhalation of respiration of suspended particulate matters. - Locate mixing and asphalt (hot mix) plants, and crushers and batching plants at least 1 km downwind from the nearest settlements only after receiving approval from the SC. - Operate Hot Mix plant with stack of adequate height as prescribed by SC to ensure enough dispersion of exit gases. - Use crushers only licensed by GoN. - As far as possible, use LPG or kerosene as			batching plant operation **PT**: Meet NAAQS and WHO guidelines; Updated Status of Pollution Under Control Certificate; Approved permits to operate plants.			

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	fuel source for cooking purpose. - Restrict tree cutting for use of fuel- wood. - Operate Diesel Generating (DG) sets with adequate height. - Use diesel with low sulphur content in DG sets as well as other machineries.						
Damage to services running parallel or across the alignment of Bridges and approaches during construction leading to interruption in supply (29 electric poles, 7 telephone poles, 2 water supply pipelines, 1 tube well)	• Relocation of any potentially affected services prior to commencement of any construction works, including water supply. • Potentially affected services will be identified in design stage.	Approach roads and bridges	Site inspection and observation	**MI:** No. of utilities that need to be relocated **PT:** Zero damage to utilities that will be affected		Contractor	SC/PD/DoR
Noise Level Temporary increase in ambient noise level in the close vicinity of various construction activities	- Locate temporary construction facilities such as labour camps, vehicle maintenance workshops and earth moving equipment away from settlements and other sensitive areas as far as possible. - Relocate noise sources such as stone crushers, vehicles movements, and operation of quarry and borrow pits to less sensitive areas to take advantages of distance and shielding.	Throughout the road corridor mainly nearby settlements, bazaar, religious, cultural and archaeological sites; Approach roads and bridges	Sound level meter	**MI:** Day and night noise levels in road's corridor of impact; Complaint from people; PPEs for workers; Injury arising from excessive noise. **PT:** Average day and night time noise levels are within permissible limits; Complaints due to ambient noise addressed within the GRM framework; PPEs are properly used by workers; No injury arising from excessive noise.	Included in Engineers' Estimate	Supervision Consultant and Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	- take advantages of natural topography as a noise buffer - Install silencers in construction equipment and machinery, and repair and maintain in time. - Select equipment and machinery with lower sound power levels for the use. - Provide protection devices such as ear plugs/ or earmuffs to workers during operation of high noise generating machines. - Perform construction activities during daytime to avoid disturbance to nearby communities at night. - Use noise barriers such as earth mounds or walls of wood, metal that form a solid obstacle between the road and roadside community, especially in schools and hospitals sites.						
Impact on Land and Soil Contamination from inappropriate construction and management practices	- Preserved top soil for reuse for plantation and restoration purposes. - Restore back to any land taken on lease or used	Throughout the road alignment	Site inspection	**MI:** Borrow pit locations **PT:** Fully restored borrow pits	Included in Engineers' Estimate	Contractor	SC, DoR/PD
Landslide and Soil Erosion	- **Road**: Clear only required vegetation and re-vegetate	Throughout the road COI at	Site inspection. Review	**MI:** Occurrence of slope failure or erosion; Design of road	NRs 71,974,173.81	Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Occurrence of landslide and soil erosion due to construction	eroded bare slopes by the cleared vegetation. - Apply civil and bioengineering techniques to stabilize landslide and soil erosion. Approach roads and bridges: Inclusion of appropriate items in specification for retaining wall or slope stabilisation measures, monitoring of compliance during construction of retaining wall and appropriate administration of contracts will be ensured.	landslide and erosion prone area	engineering drawing for road and retaining walls	embankment and protection wall **PT:** Slope failure and soil erosion addressed through civil and / or bioengineering techniques	(This cost of bio-engineering works is based on Engineers' Estimate)		
Borrow Pits and Quarry Sites Slope failure, sedimentation, water logging, change in the aesthetic values of the landscape, damage to sensitive areas due to improper selection and management of borrow pit and quarry sites for the construction materials	- Avoid protected and sensitive areas, nearby settlements, water sources, forest areas and fertile agriculture lands in siting borrow pit. - Select borrow and quarry sites at waste and low quality of lands. - Obtain approval from authorities of government and private land owners. - Operate borrow pits and quarry sites as per required volume of materials. - Stockpile and preserve top soil to spread for restoration of sites.	Throughout the project road corridor wherever additional soil and stones required	Site inspection. Check estimates for borrow material requirements	**MI:** Borrow pits and quarry sites classified as low-quality lands; Number of accidents; Complaint from people **PT:** Approved borrow pits and quarry sites; Zero accidents; Zero complaints from people.	Included in Engineers' Estimate	Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Soil Contamination and Compaction Contamination of land due to mixing of construction materials and wastes/spoils; and compaction due to movement of heavy construction equipment along haulage roads and workshop areas, and construction camps	- Before operation obtain approval for labour camps, haulage roads, workshop and storage area for different materials through the SC. - Store fuel and lubricants as per the approved plan. The storage area should be paved covered, paved, with interceptor drains, and oil/water separator. Collected fuels and contaminated materials should be re-use, stored and disposed outside. All hazardous materials should be properly labelled. - Restrict movement to the designated haulage route. - Design approach roads through waste/barren land and rocky area to reduce compaction induced impact on soil. - Restore affected farm land after completion of road improvement activity. - Provide temporary latrine pits in labour camps and restore after completion of activity. - Segregate solid wastes generated into biodegradable and non-biodegradable	Throughout the road alignment mainly at haulage roads and labour camp locations	Site inspection	**MI:** Presence of construction materials and wastes that contaminates haulage roads, workshop areas and construction camps. **PT:** Waste management implemented	Included in Engineers' Estimate	Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	wastes. Recycle, re-use, and compost waste accordingly.						
Siltation and Surface Water Quality of Streams Likelihood of increased siltation through soil erosion due to borrow pits and quarry sites operation, and contamination of water due to solid and liquid wastes from the labour camps and construction equipment	- No mitigation measures are proposed for impact on ground water due to deep water table and limited uses. - Orient workers not to throw excavated spoils and wastes into stream water. - Store all chemicals and oil away from water and provide concrete platform with catchments pits for spills collection. - Arrange training programme to all equipment operators, drivers, and warehouse personnel on immediate response for spill contamination and eventual clean-up. Distribute emergency procedures and reports preferably written in easy to understand local dialects to the local people. - Install silt fencing and/or brush barrier for collecting sediments before letting them into the water body. Collect silt/sediment and stockpile for possible reuse as surfacing of slopes for re-vegetation.	Nearby rivers, and water bodies streams, rivulets throughout the road alignment	Water quality sampling. Site observation.	**MI:** Siltation levels in rivers and streams arising from soil erosion from borrow pits and quarry sites operation **PT:** Water quality results with Nepal water quality and WHO standards	Included in Engineers' Estimates	Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	- Dispose of all wastes generating from construction sites in an environmentally acceptable manner so as not to block the flow of water in the channels. Collect, store and transport wastes to dispose at approved sites. - No vehicles or equipment washing, parking or refuelling near streams water, so as to avoid contamination of streams water from fuel and lubricants. - Provide chute drains to drain surface runoff and prevent erosion from slopes. - Avoid large labour camps along the alignment and locate away from settlements and river sides. - Recruit construction labours preferably from the local community. - Manage sewage of labour camps without creating pollution in streams water and other public and private areas. - No untreated sanitary wastewater shall be discharged into streams water.						

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Hydrology and Drainage Modification of the surface water due to intersection of the drainage basin by the road	- Retain existing natural drainage system without disturbing them. - Provide causeways in each perennial and seasonal streams as well as rivulets. - Consider adequate cross drainage structures to avoid natural flow of water especially for unusual rainfall. - Maintain channels used by the farmers for irrigation purpose as they are.	Throughout the road COI especially rivers, streams, rivulets and bridge site areas	Visual observation	**MI:** Natural drainage pattern of water **PT:** No flooding	Included in Engineers' Estimate	Contractor	SC, DoR/PD
Management of Construction Spoils/Wastes Generation of spoils due to the excavation of existing road that constitute subgrade and pavement materials	- All disposal sites shall have consent of local community, municipality/Rural municipality representatives. - Use spoils/wastes for construction purposes as far as possible.	Throughout the road COI wherever spoils need to be managed	Site inspection	**MI:** Presence of construction wastes and spoils **PT:** Proper management of wastes and spoils; Zero complaint from people	Included in Engineers' Estimate	Contractor	SC, DoR/PD
Natural Hazard Possibility of damage to road due to natural hazard such as flooding and siltation, and earthquake	- Road embankment level has been designed to be higher than the highest flow level and/or flood level of the streams and rivulets. - Sub-project structures are designed with the consideration of probability of earthquakes.	As required at the road alignment			Included in Engineers' Estimate	Contractor	SC, DoR /PD
Biological Environment							
Forestry and Biodiversity	- The Contractor shall determine number and types of trees to be	Throughout the road alignment	Site inspection	**MI:** Budget amount allocated for clearing of trees.	NRs 42,806,480.00	Contractor	SC, DoR/PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Likely impact from clearance of 5627 (plus 150 trees from approach roads and bridges) trees, shrubs and bushes along the roadside	felled through the detailed design/or its verification and shall coordinate with CFUGs then apply to DFO for clearance process - The Contractor shall seek necessary help with SC to obtain approval for clearing trees, if needed - Trees shall be felled only after receiving permissions from the concerned authorities. - The Contractor shall coordinate with CFUGs and manage felled trees. - Clear only necessary hillside slopes with vegetative covers in connection with road improvement. - Prohibit throwing spoils including bitumen containers and other wastes/spoils generated from roads excavation in and around the forest areas.	especially at forest areas		**PT:** Adequate budget allocation	for tree cutting and managem ent		
Aquatic Biodiversity Possibility of destructive fishing activities by the construction workers	- Discourage destructive fishing by the construction workers.	All areas of water bodies throughout the alignment	Site inspection	**MI:** Orientation on protection of aquatic biodiversity for workers **PT:** Adequate budget allocation; Orientation for all workers on importance of aquatic biodiversity	-	Contractor	SC, DoR/PD
Chemical Environment							

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Transportation and Storage of Materials Likely impact due to transportation and storage of materials such as oils, fuel, bitumen, construction materials, etc.	- Proper storage (paved, covered, with interceptor drains and oil/water separator) and labeled for storage. - Equip with fire extinguishers and first aid kit all storage and transporter of hazardous materials. - Avoid the use of haulage trucks higher than the carrying capacity of the haulage roads and existing roads. The contractor will be responsible for repair and maintenance of damaged existing road by the haulage trucks.	Construction camp and approved temporary storage areas	Site inspection	MI: Spillage of hazardous materials in road and storage areas PT: Proper waste management, storage and transportation of hazardous wastes; Zero spillage of hazardous wastes	Included in Engineers' Estimate	Contractor	SC, DoR/ PD
Presence of contractor's workforce increasing pressure on already strained local facilities including health & medical facilities	• Contractor will provide own suitably equipped and staffed site emergency medical facilities. • Inclusion of appropriate clauses in construction contracts; monitoring of compliance during construction and proper administration of contracts will be ensured.		Observation and site inspection.	**MI:** Medical facilities availability on site **PT:** Patients who availed of health facilities treated or referred to other hospitals.	Included in Engineers' Estimate	Contractor	SC/PD/DoR
Sanitation and disposal facilities at construction workers' camp	• Proper availability of • drinking water and sanitation facilities at workers' camp • Contractor will install temporary toilets with septic tank/soak pits.		Site inspection. Review of Environment, Health and Sanitation practices and solid waste	**MI:** Sanitation and solid waste management plans **PT:** No water-borne diseases reported within the camp.	Included in Engineers' Estimate	Contractor	SC

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	• Contractor will provide suitable collection and • disposal system for domestic refuse. For collection of domestic refuse dustbins will be provided. The collected waste may be disposed off at the nearest municipal land fill site. • Hazardous waste will be stored, transported and disposed based on existing regulations.		management system	No overflowing of septic tanks. No foul odour emanating from toilets. Wastes are segregated, recycled and properly disposed.			
Cooking fuel at workers' camp	Workers' will be prohibited from using fuel wood for cooking. Contractor will ensure availability of kerosene oil/LPG. Inclusion of the above conditions in contract document will be ensured.	Workers' camp	Site inspection	**MI:** Indoor air quality **PT:** No fuel wood gathered and used for cooking No respiratory diseases reported arising from use of fuel wood.	Included in Engineers' Estimate	Contractor	SC/PIU
Health facilities at workers' camp	The contractor will ensure first aid boxes in adequate numbers and make shift dispensary at camp. The above condition will be put in contract document.	Workers' camp	Site inspection.	**MI:** Log book of patients who availed of health facilities. Log book of available medicines. **PT:** Patients who availed of health facilities treated or referred to other hospitals.	Included in Engineers' Estimate	Contractor	SC/Proponent
HIV/AIDs awareness campaign at workers' camp	Workers to be made aware of HIV/AIDs and protection measures. To organize awareness	Workers' camp	Observation and checking attendance of workers who attended campaign	**MI:** Number of workers who attended HIV / AIDS seminars. **PT:** Zero HIV/AIDS incidence	Included in Engineers' Estimate	Contractor	SC/Proponent

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	programme every month		/awareness programmes.				
Presence of contractor's workforce increasing pressure on already strained local facilities including health & medical facilities	• Contractor will provide own suitably equipped and staffed site emergency medical facilities. • Inclusion of appropriate clauses in construction contracts; monitoring of compliance during construction and proper administration of contracts will be ensured.	Workers' camp	Observation and site inspection.	**MI:** Medical facilities availability on site **PT:** Patients who availed of health facilities treated or referred to other hospitals.	Included in Engineers' Estimate	Contractor	SC/PD/DoR
Accidents Hazards and Safety	The contractor will prepare a safety manual for all activities of construction as well as activities at construction camps. This manual will have safety measures to be adopted. The safety procedure for transportation of construction materials will also be detailed. Condition will be included in the contract document	Workers' camp	Safety Manual provisions Observation	**MI:** Safety protocols; Number of EHS related incidents and accidents **PT:** Zero incidents and accidents.	Included in Engineers' Estimate	Contractor	SC/PD/DoR
Road safety hazards associated with temporary traffic diversions	• Contractor will take all reasonable measures to minimise interference with traffic flow at bridge locations and to provide safe transit at diversions. The contractor will maintain two way traffic at diversions	Throughout road alignment, including approach roads and bridges	Observation. Traffic management plan Observation: Monitoring of traffic accidents	**MI:** Presence of signages relevant to contractor's work Presence of traffic personnel to manage the traffic, Number of accidents **PT:** Zero accidents or incidents Smooth flow of traffic	Included in Engineers' Estimate	Contractor	SC/PD/DoR

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	and will inform the local traffic police about the traffic diversion • Monitoring of compliance during construction and strict administration of contracts will be ensured.						
Impact on common Property Resources Likely damage of common properties such as public utilities and facilities, religious, historical and cultural sites etc.	- Implement mitigation measures to control dust, noise, and traffic - Chance find of archaeological artefacts importance, the Contractor shall immediately inform SC and DoR to seek further guidance. - Avoid any actions that bear the risk to destroy the sites or alter their scientific or aesthetic or social values. - In the case of accidental damage of infrastructure of archaeological importance, the contractor will be obliged to inform DoR immediately through SC. Further, he (the Contractor) shall also be obliged to carry out immediate corrective and repair measures, as suggested by concerned authority.	Throughout the road COI	Observation	**MI:** Damages to common property resources **PT:** Zero damage to common properties	NRs. 22,861,172.00	Contractor	SC, DoR /PD

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
Relocation of common property resources	• 1 Tube well is falling in the proposed RoW (Ch. 221+190). This needs to be relocated/rebuild • Condition will be included in contract document	Throughout road alignment, approach road and bridges	Site inspection.	**MI:** Affected stakeholders consultation; Coordination with appropriate agencies **PT:** Zero complaint from affected stakeholders. Resettlement plan followed.	Included in Engineers' Estimate	Contractor	SC/PD/DoR
[B] Operation Stage							
Physical Environment							
Micro-Climate Change in the micro-climate due to emission of GHG from operation of vehicles	- As part of transport rules, condition of vehicles will be monitored regularly and rules will be enforced effectively. In addition, reduction in emission of GHG is also anticipated due to the reduced travel time and improved road condition.	Throughout the road corridor	Air quality sampling	**MI**: CO_2 equivalent level **PT:** Reduced GHG due to reduced travel time and improved road condition vs. baseline condition	To be determined by DoR	DoR	DoR
Air Quality Emission of GHG from the operation of vehicles	- Shifting cropping /land use patterns from traditional cereals to high value horticultural crops along the ROW in the cultivated area could be one of the preferred solutions to maintain environmental and economic sustainability. - DOR will maintain roadside planted trees especially nearby settlements and other public places. - GON will control and enforce Nepal vehicle mass emission standard, 1999 and will	Throughout the road corridor	Air quality sampling	**MI:** $PM_{2.5}$, PM_{10}, TSP, SO_2, NO_2, and CO levels; Status of Pollution Under Control Certificate; Status of approval of mixing and asphalt plants, as well as crusher and batching plant operation **PT**: Meet NAAQS and WHO guidelines; Updated Status of Pollution Under Control Certificate; Approved permits to operate plants.	To be determined by DoR	DoR	DoR

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	stipulate vehicle owners to engage in proper and regular vehicle maintenance. - Local petrol pump stations will make aware to ensure proper use and sale of clean fuel. - Air pollution by dust will be controlled with provision of paved shoulders, especially in the sensitive/built-up areas. - Road signs will be provided reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment. - Development organizations (NGO, INGO and CBOs) can motivate the local communities to maintain greenery along the road apart from their houses by planting fodder, fuel wood and fruit trees including flowering plants.						
Noise Level Likelihood of increase in ambient noise level due to operation of vehicles and use of horns	- Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch. - Speed limitation and honking restrictions	Throughout the road corridor especially nearby, wildlife habitat, settlements, bazaar areas, religious, cultural	Sound level sampling	**MI:** Day and night noise levels in road's corridor of impact; **PT:** Average day and night time noise levels are within permissible limits; noise.	To be determined by DoR	DoR	DoR

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	shall be enforced near sensitive locations, like hospitals, schools etc. - Effectiveness of the multi-layered plantation shall be monitored. - Awareness will be created amongst the residents about likely noise levels from road operation at different distances.	and archaeological sites					
Soil Erosion Occurrence of landslide and soil erosion due to both natural and induced phenomena.	- DOR has established a system to check roads employing Length-Persons and their supervisor. They are responsible for routine and recurrent maintenance of roads like cleaning up drains, soil deposited on the roads due to minor slope failure and erosion.	Along the road corridor, especially near bridges where embankment level is high	Visual observation	**MI:** Occurrence of slope failure or erosion; Design of road embankment and protection wall **PT:** Slope failure and soil erosion addressed through civil and / or bioengineering techniques	To be determined by DoR	DoR	DoR
Borrow Pits and Quarry Sites Likelihood of landslide and soil erosion due to incomplete restoration of borrow pits and quarry sites along the road alignment	- DOR shall orient supervisor in order to check and maintain drains and erosion and also to protect vegetative covers on the restored sites of borrows and quarries.	Especially at borrow pits and quarry sites used areas throughout the alignment	Visual observation	**MI:** Presence of landslide and soil erosion due to incomplete restoration **PT**: Complete restoration of borrow pits to prevent further landslide	To be determined by DoR	DoR	DoR
Siltation and Surface Quality of Rivers Possibility of contamination of surface water by oil and lubricants during monsoon season	- As provisioned, DoR will engage road Length-Persons. They will check road condition including cleaning up soils deposited on roads by erosion and slides drain blockade/	All areas nearby streams and rivulets throughout the road alignment	Visual observation	**MI:** Water quality levels **PT**: Meet Nepal guidelines on water quality	To be determined by DoR	DoR	DoR

Environmental Issues / Component	Mitigation Measures	Location	Monitoring Method	Monitoring Indicator (MI) / Performance target (PT)	Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	chocking. The Length-Persons supervisor will inform to Regional Engineer in case of large landslide and major road blockade.						
Natural Hazard Likely impact of natural hazard such as flooding, siltation and earthquake	- Development organizations will play role in awareness raising about the risk of natural hazards including preventive cure and preparedness on safety measures to local communities.	All sites nearby streams and rivulets throughout the road alignment	Visual observation	**MI:** Flood levels, occurrence of natural hazards **PT**: Adaptation measures implemented to lessen impacts of natural hazards	To be determined by DoR	DoR	DoR
Ecological Resources							
Forestry and Biodiversity Increased possibility of poaching and logging due to improved access	- The project shall involve local people in maintaining of planted trees and their management activities.	All forest areas along the road Corridor	Visual observation	**MI:** Activity level of poaching and logging **PT**: Zero complaint from people	To be determined by DoR	DoR	DoR
Socio-economic Environment							
Accident Risks to Local Community Increased risk of road accident	- Monitoring and supervision by DoR is required, to ensure the safe travelling.	Throughout the road alignment	Visual observation	**MI:** Number of traffic accidents **PT**: Road safety measures implemented throughout road corridor	To be determined by DoR	DoR	DoR
Impact on Common Property Resources Increased noise, vibration and air pollution	- The DOR will install traffic signals such as “NO HORN” and “SPEED LIMIT” nearby the archaeological sites.	Throughout the road COI especially at sensitive locations	Monitoring	MI: Noise, vibration and air pollution levels PT: All parameters within Nepal quality standards	To be determined by DoR	DoR	DoR

Table 47: Environmental Management Plan Budget

Items	Quantity	Unit Rate (NRs.)	Cost (NRs.)	Remarks
Capacity building • Pre-construction orientation (senior level road builders, mid-level road builders) • Training (labour force leaders) • Refreshing workshop (senior level road builders, mid-level road builders)		LS	300,000.00	Part of Environmental Safeguard Cost provisioned in project cost estimate
Safety Gadgets/facilities	36 month	40,230	1,448,280.00	Item of BoQ
Relocation of public utilities (Drinking water supply lines, electric poles, telephone poles etc.)			22,861,172.00	Item of BoQ
Tree cutting and safe management	5627 nos.		42,806,480.00	Item of BoQ
Supply and planting trees with tree guards	5,822	1,226.00	7,137,524.96	Item of BoQ
Compensatory plantation (at the ratio of 1:25 and 5 years maintenance cost)	140,675	99.00	13,926,825.00	Provisional sum
Bioengineering measures			71,974,173.81	Item of BoQ
Environmental Monitoring Cost			500,000.00	Part of Environmental Mitigation Cost provisioned in project cost estimate
Total Cost (NRs.)			**160,954,455.77**	
Total Cost (US$)			**1.5 million**	1US$ = NRs. 107.34

Source: Engineers' Estimate, Kanchanpur – Kamala Road, 2018

D. Environmental Monitoring Programme (EMoP)

252. Environmental monitoring is an essential component of the implementation of IEE recommendation. The environmental monitoring programme (EMoP) is prepared to monitor the implementation performance of the EMP. Environmental monitoring plan is prepared focussing the following objectives:

- To ensure that impacts do not exceed the established legal standards
- To check the implementation of mitigation measures in the manner described in the IEE report
- To monitor implementation of the EMP.
- To provide an early warning of potential environmental damage
- To check whether the proposed mitigation measures have achieved the intended results, and / or other environmental impacts occurred

253. The monitoring plan will be used for performance monitoring of the project. A monitoring plan defining all parameters to be monitored, with tentative location, project stages for measurements, implementation and institutional responsibility for different environmental components is prepared for all stages of project and presented in Appendix C**.** In case unanticipated impacts are found during project implementation, the significance of impacts will be assessed and corrective measures will be agreed between ADB and the government.

E. Institutional Setting and Proposed Implementation Arrangement

1. Project Organisation

254. The overall organization structure of the project is shown in the succeeding **Figure 16**. MoPIT will be the Executing Agency (EA) and DoR will be the Implementing Agency (IA) for the project. More specifically, the PIU under Project Directorate will be the key institution for the successful implementation of the project and ensure compliance to ADB safeguards as contemplated in the environmental management and monitoring plans.

255. The GESU will provide both technical advisory and independent audit roles to the Project Directorate to ensure the project stays in compliance. The GESU, after reviewing and approving the EMP will review monitoring reports submitted by the SC. On an annual basis, the GESU is authorized to conduct environmental audits of road projects.

256. In the road infrastructure component the detailed design has been completed by an international consulting firm as part of Project Preparatory Consultant under SASEC Road Connectivity Project (SRCP-PPC) while the construction supervision will be done by an international construction Supervision Consultant as part of the project. The civil works will be awarded to international Contractors. DoR's Geo-Environment and Social Unit (GESU) will be responsible for environmental and social impact monitoring.

257. In the capacity development component, the formal training will be managed by DoR. The Sector Skills Development Unit and the technical assistance support for environmental and social impact monitoring will be given to DoR's GESU. The Supervision Consultant will provide support to GESU for environmental monitoring through their Environmental Specialist and to RSSDU for selection of training courses through their Project Management Specialists.

2. Project Management

258. Both the EA and the IE have extensive experience in implementing ADB-financed road projects. The Project Directorate (ADB), established in 1987, will be maintained within DoR and serve as the Project Implementation Unit (PIU). The Project Director will have overall responsibility for all aspects of project implementation and management including procurement, contract administration, progress monitoring, financial management, reporting, land acquisition and resettlement.

3. Consulting Services

259. It is envisaged that consulting services in four areas will be required. Under SRCP a Supervision Consultant firm (SC) will be recruited for construction supervision and to assist DoR in procurement. The SC will be an international consulting engineering company working in association with one or more national consulting engineering companies with relevant experience.

260. In order to reduce the number of consultant contracts, for the capacity development component, it is recommended that the SC will provide environmental specialist technical support to the GESU in environmental monitoring and contract and project management technical support in the selection of formal training to the RSSDU. These services can be included in the SC's terms of reference.

4. Environmental and Social Safeguards Monitoring

261. It is proposed that DoR's GESU with the support of the supervision consultants is given responsibility for monitoring implementation of the Environmental Management Plan (EMP) in the construction contract, the Resettlement Plan and the poverty reduction programme. GESU has developed technical capacity to carry out these functions on behalf of DoR and has completed environmental monitoring in several DoR projects. The project should support the sustainability of this capacity in DoR by involving GESU in the project implementation. It is proposed that project will provide support for transport, field visits and acquiring national environmental and social consultant support.

262. The project shall have six (6) months intermittent annual input of Environmental Monitoring Consultant. The Consultant shall coordinate and report PIU and GESU. Project Directorate shall submit Semi-annual environmental compliance monitoring report to DoR and ADB.

5. Capacity Building

263. Capacity building encompasses a range of activities in addition to training including enactment of enabling legislation, provision of budget support, and organization of appropriate government agencies. One vital prerequisite for building capacity is public awareness of environmental problems and support for measures necessary to address those problems. The capacity building will need to address adequate public concern for the environment, which is often the underlying cause of depletion of natural resources and deterioration of the environment. In this regards, to enhance the capacity of staff for effective implementation of proposed mitigation measures and monitoring the resultant effect, as well as create awareness amongst workers and public the trainings and awareness programmes will be prepared by the Supervision Consultant-Environmental Specialist in consultation with the GESU/DoR.

6. Reporting

264. Following reports shall be prepared and submitted for ADB approval and disclosure:

- Environmental Safeguards Matrix for Quarterly Country Program Review
- Environmental Safeguards Monitoring Chapter in the Quarterly Project Progress Report
- Semi-annual Environmental Compliance Monitoring Report (Jan-June in July, and July-Dec in January next year)
- Analytical Project Completion Report on Environmental Performance of the Project

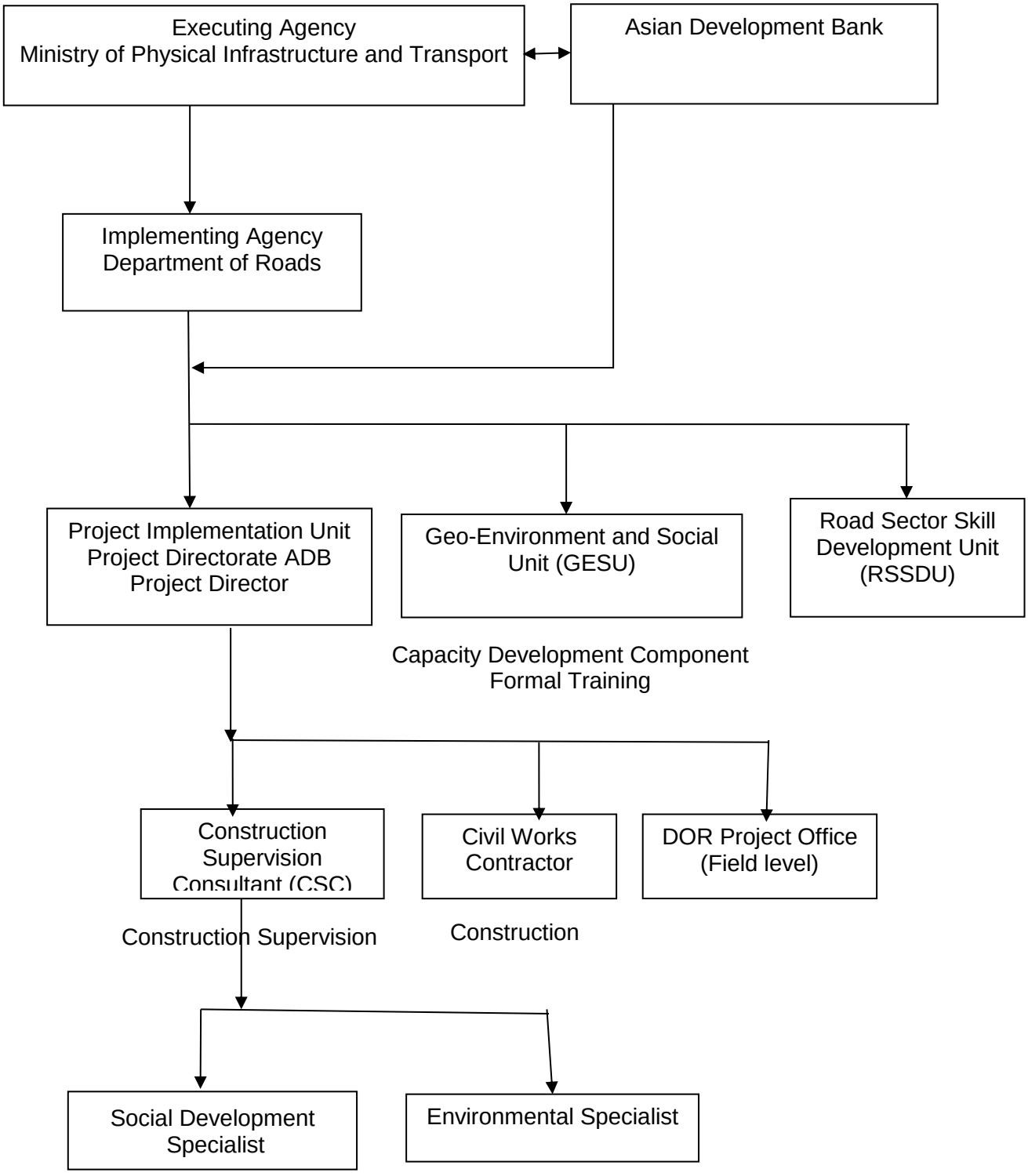


Figure 15: **Project Organisation Structure for EMP Implementation**

VIII. GRIEVANCE REDRESS MECHANISM

265. The concern/grievances from local/affected people may come up related to inappropriate implementation of various components of EMP or the overall road upgrading itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns. The GRM for the project is outlined below and consists of three levels with time-bound schedules and specific persons to address grievances.

A. First Level GRM

266. The first level and most accessible and immediate contact for the fastest resolve of grievances are the contractors, and design and supervision consultants on site. Prior to construction of any works, the PIU (PD-ADB) and Site Project Office (Project Manager) will ensure local community meetings are held to notify local residents and businesses of any temporary disturbances, and to inform them of the Project. If any complaints arise, the contractors, consultants, and Project Office can immediately resolve the complaint on site. The PIU can also be involved in grievance redress at this stage. The PIU and Project Office office phone number will be posted in public areas within the project area and construction sites. Any person with a grievance related to the project works can contact the project to file a complaint. The Project Office office will have a safeguards focal person to field and resolve complaints. The safeguards (environment and resettlement) focal person will document the complaint, and immediately address and resolve the issue with the contractor within 1-2 days if the complaint remains unresolved at the field level. The Project Office may seek the assistance of the consultant safeguards specialists (the environmental specialist or social safeguards specialist) to resolve the issue. The Project Office safeguards focal person will notify the PIU safeguards focal person that a complaint was received, and whether it was resolved. The Project Office safeguards focal person will fully document the following information: (i) name of the person; (ii) date complaint was received; (iii) nature of complaint; (iv) location, and (v) how the complaint was resolved.

B. Second Level GRM

267. Should the grievance remain unresolved; the Project Office will forward the complaint to the PIU safeguards focal person. The person filing the grievance will be notified by Project Office safeguards focal person that the grievance was forwarded to the PIU safeguards focal person. The PIU will address the grievance. Grievances will be resolved through continuous interactions with affected persons, and the PIU will answer queries and resolve grievances regarding various issues including environmental or social impacts. Corrective measures will be undertaken at the field level by the PIU safeguards focal person within 7 days. He/she will fully document the following information: (i) name of the person; (ii) date complaint was received; (iii) nature of complaint; (iv) location and (v) how the complaint was resolved.

C. Third Level GRM

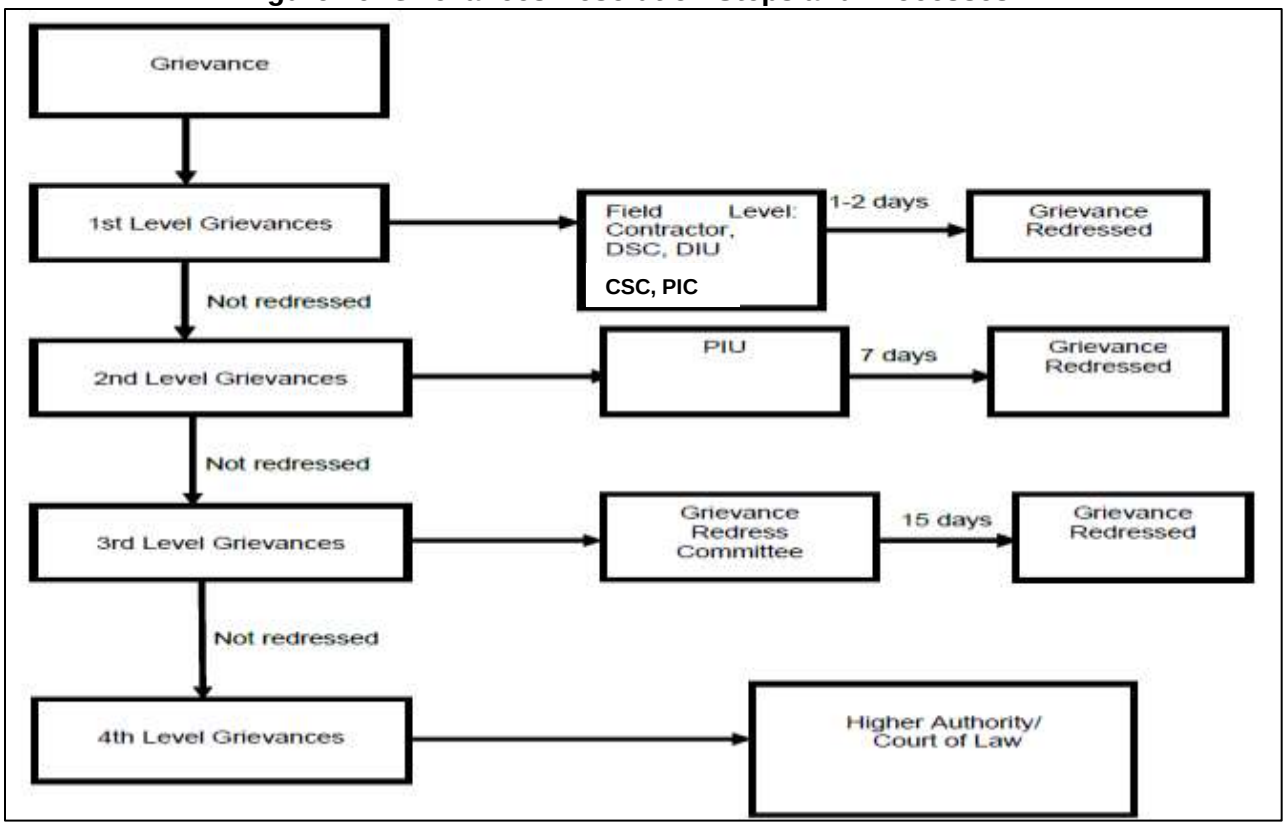
268. Should the grievance remain unresolved, the PIU's project director will activate the third level of the GRM by referring the issue (with written documentation) to a Grievance Redress Committee (GRC) constituted by the EA, which will, based on review of the grievances, address them in consultation with the PIU, Project Office and affected persons. The GRC will consist of

Project Office leadership, affected persons, and local area committee, among others—determined to provide impartial, balanced views on any issues. The GRC should consist of at least five persons. A hearing will be called with the GRC, if necessary, where the affected person can present his/her concern and issues. The process will promote conflict resolution through mediation. The GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days. The functions of the GRC are as follows: (i) to provide support to affected persons on problems arising from environmental or social disruption, asset acquisition (where required), and eligibility for entitlements, compensation, and assistance; (ii) to record grievances of affected persons, categorize and prioritize them, and provide solutions within 15 days; and (iii) to report to the aggrieved parties development regarding their grievances and decisions of the GRC. The Project Office safeguards focal person will be responsible for processing and placing all papers before the GRC, recording decisions, issuing minutes of the meetings, and taking follow-up action to see that formal orders are issued and the decisions carried out.

D. Fourth Level GRM

269. In the event that a grievance is not addressed by the contractor, CSC, Project Office, PIU or GRC, the affected person can seek legal redress of the grievance in the appropriate courts, the fourth level of the GRM, which is the formal legal court system. The GRM however does not prevent affected persons from seeking legal redress at any time. The grievance redress mechanism and procedure is depicted in **Figure 17.**

Figure 16: Grievances Resolution Steps and Processes



Note: CSC-Construction supervision consultant, PIU= project implementation unit

IX. CONCLUSION AND RECOMMENDATION

270. The proposed subproject has been categorized as Category 'B' based on environmental screening and assessment of likely impacts while the initial environmental examination ascertains that it is unlikely to cause any significant environmental impacts. Few impacts have been identified attributable to the proposed project, all of which are localized and temporary in nature and easy to mitigate.

271. The project area does not fall under any national park, wildlife reserve, and conservation area, hunting area, buffer zone and world heritage site of historical, archaeological, paleontological or architectural significance. The land use patterns of the corridor of impact cover agriculture lands, settlements, grazing lands and others (stream beds). Around 5627 roadside trees will be required to be felled which will have minor impact on micro-climate. But to ameliorate this impact compensatory plantation has been proposed in the IEE study Report.

272. The significant impacts during construction stage are temporary disruption of public utilities and existing services as electrical poles/line, telephone poles/line, water supply pipeline etc. These services include: transformer (34), power supplying lines (526 electric poles, 240 lamp post etc.); 179 telephone poles and public tubewell (5). Labours and local people will be prone to adverse health effects and accidents relating to construction activities.

273. Other impacts include air quality deterioration due to increase in fugitive dust emissions from materials hauling and unloading, ground shaping, and unpaved road travel. Nuisance to nearby residents due to increase in noise from heavy equipment operation, hindrance in accessibility to common property resources and increase in traffic on road sections will cause where construction is on-going. Land use conversion from agricultural or residential to built-up area (road) will take place due to expansion of road width. Surface water quality of the rivers and rivulets will be deteriorated, and result in siltation of waterways from silt-laden surface runoff coming from the construction sites. Health and safety risk due to increase in heavy equipment traffic particularly to children and near pedestrian crossing points. During operation stage, the main impact may be on the surface water hydrology since the construction of a bridge across several river/rivulets in the flood-affected sections can act as impediment to natural flow of water.

274. All identified impacts are of short-duration and co-terminus with the construction stage,and are easy to mitigate. All private lands and structures that will be disturbed will be compensated in compliance to existing laws.

275. It is recommended that noise level should be monitored at least once every 5 years during operation particularly near sensitive receptors (see Table 5.13). If the noise levels are found to be higher than the projected levels and exceeding 3 dBA, mitigation measures such as noise barriers maybe put up to minimize the impacts on affected people.

276. The initial environmental examination of the project ascertains that the project is unlikely to cause any significant environmental impacts. No additional studies or need of undertaking detailed EIA is envisaged at this stage. The Executing Agency shall ensure that EMP and EMoP is included in Bill of Quantity (BOQ) and forms part of bid document and civil works contract. The same shall be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB.

BIBLIOGRAPHY

1. Proposed Loan and Technical Assistance Grant Nepal: South Asia Subregional Economic Cooperation Highway Improvement Project; Project Number: 52097-001 February 2018, Asian Development Bank

2. Climate Change 2007, Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Fourth Assessment Report on Intergovernmental Panel on Climate Change (IPCC), 2007
https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf

3. Nepal, National Adaptation Programme of Action (NAPA) 2010; Ministry of Science, Technology and Environment, Government of Nepal.

4. Climate Change Policy, (Approved by Government of Nepal, 2011), unofficial translation;

5. Climate and Disaster Resilient Transport System and Infrastructure Development for Nepal; (Background Paper for Plenary Session 2 of the Programme at – Ninth Regional Environmentally Sustainable Transport Forum in Asia, Nov 2015, Kathmandu.

6. Flooding and Inundation in Nepal Terai: Issues and Concerns; B.R. Adhikari, Hydro Nepal, Issue No. 12, 2013

7. Report on Hydrological/Hydraulic and Drainage Study for The Phase-I Roads/Bridges; Kanchanpur – Kamala Road, Nepal, May 2018.

8. FLOODFREQ Cost Action ESO901; European Cooperation in Science and Technology, Center for Ecology and Hydrology, 2013; http://www.cost-floodfreq.eu

APPENDIX A – RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Country/ Project Title : Project Preparatory Consultant under SASEC Roads Connectivity Project (SRCP-PPC)
Mahendra Highway: "Kachanpur – Kamala Road (85 km)"
Sector Division : Department of Roads (DoR/ADB)
Category of Road : National Highway Standard
Project Districts : Saptari and Siraha

S.N	SCREENING QUESTIONS	YES	NO	REMARKS
1	**Project Siting:** Is the project area adjacent to or within any of the following environmentally sensitive area?			The project area does not fall inside or adjacent to any of the following area
	Cultural heritage site		√	
	Protected area		√	
	Wetland		√	
	Mangrove		√	
	Estuarine		√	
	Buffer zone of protected area		√	
	Special area for protecting biodiversity		√	
2	**Potential Environmental impacts**			
	Will the project cause ….			
	Encroachment on historical/ cultural areas; disfiguration of landscape by road embankments, cuts, fills and quarries?		√	No encroachment on the historical places. However, some religious structures are present along the proposed road construction width which needs to be relocated.
	Encroachment on precious ecology?		√	There is no National Parks, wildlife sanctuaries or similar eco-sensitive areas along the project road
	Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by construction site?	√		The proposed project road crosses over rivers, streams and canals. Impacts will be minor, short term and site specific. Mitigation measures are: - Provision of sufficient drains for easy drainage flow - Prevention of dumping of construction spoil and debris in streams and rivers - Slope stability in the embankment near waterways
	Deterioration of surface water quality due to silt runoff and sanitary wastes from work-based camps and chemicals used in construction?	√		The impacts will be minor, short term and site specific. Mitigation measures are - Storage of construction stock piles away from the water courses. - Cover the stockpile with plastic sheet (tarpaulin) when not in use

S.N	SCREENING QUESTIONS	YES	NO	REMARKS
				Construct a barrier around the storage yard such that erosion does not take place by wind and rain Provide adequate and proper sanitary facilities in the labour camps Storage of chemicals away 100 m from permanent water courses and apply sealing or binding materials
	Increased local air pollution due to rock crushing, cutting and filling works and chemicals from asphalts processing?	√		Air pollution level is likely to be increased for short duration during the construction period from cutting & filling works and chemicals from asphalts processing. Sprinkling water at regular interval will help to reduce air pollution.
	Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological and radiological hazards during project construction and operation?	√		Impact is short terms and insignificant. Mitigation measures are Provide adequate PPEs to the workers during the construction phase Provision of adequate traffic signs and signals
	Noise and vibration due to blasting and other civil works?		√	Blasting is not required in this proposed project. - Ambient noise level is expected to be increased due to various construction activities, road maintenance works. But the occurrence will be intermittent during the construction phase. - Use of silent construction machine and equipment including generator - Operation of the construction machine and equipment during day hours
	Dislocation or involuntary resettlement of people?		√	However, extent of impact will be assessed
	Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		√	Deterioration in ambient air quality will be localized and temporary during the construction phase. Mitigation measures are - Sprinkling water during construction activities - Plantation along the road corridor - Regular maintenance of the road
	Hazardous driving conditions where construction interferes with pre-existing roads?	√		Mitigation measures are - Take necessary permit prior to construction works

S.N	SCREENING QUESTIONS	YES	NO	REMARKS
				- Provide traffic signs and signals at appropriate location - Planning of traffic management during construction phase - Inform locals about construction activities via local media
	Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to locals populations?	√		Mitigation measures are - Provision of proper and adequate sanitary facilities - Proper solid waste disposal sites - Awareness among the workers about the transmission of communicable diseases
	Creation of temporary breeding habitats for mosquitoes vectors of disease?		√	There may have possibility of transmission of water borne vector diseases from proposed project. Mitigation measures include: - Filling of pit holes where there is possibility of water stagnant - Stagnant water bodies and unhygienic conditions harboring rodents and other pests will be avoided. - Mosquito nets and insect repellents will be provided. - Awareness program among the workers and locals on mosquito breeding habitats - Ensure Cleanliness and hygiene in the surroundings areas.
	Dislocation and compulsory resettlement of people living in Right of Way?		√	The RoW is declared as 25m both side from center of the road. However, extent of impact will be assessed.
	Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?		√	Adequate safety measures will be adopted to avoid the situation. - Speed limit of the vehicle carrying the toxic materials - Sticking the message like “toxic chemical in the container” the information on the vehicle carrying the toxic material
	Increased noise and air pollution resulting from traffic volume?	√		Mitigation measures are Regular maintenance of the vehicle plying on the road No honking signs on the road Road side plantation

S.N	SCREENING QUESTIONS	YES	NO	REMARKS
	Increased risks of water pollution from oil, grease and fuel spills and other materials from vehicles using the road?	√		Mitigation measures are Avoid washing of vehicles near water courses Adopt adequate safety measures like regular maintenance, servicing of the vehicles using the road
	Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups?		√	Not observed along the road, however, extent will be assessed
	Social conflicts if workers from other religious or countries are hired?		√	Most of the workers will be hired from the locals communities during the construction phase
	Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?	√		Mitigation measures Provide employment opportunity to the locals Construct the workers camps away from the settlement area Provision of adequate facility at the worker camps
	Risks to community health and safety due to the transport, storage and use and or disposal of materials such as explosives, fuels and other chemicals during construction and operation?	√		Mitigation measures are Cover the material on the transportation vehicles Proper sealing of the chemical containers Speed limit for the transportation, vehicles carrying explosives, fuels and other chemicals during construction and operation Proper storage area for chemicals storage Proper identification of the disposal site of the materials
	Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	√		Mitigation measures are Provide adequate safety signs and signals at the construction site Provide adequate traffic safety signs and signals Aware community about the project through public consultation and information disclosure

Based on the above assessment the project may be categorized as "B" as per SPS, 2009.
The following questions are not for environmental categorization. They are included in this checklist to help identify potential Climate and Disaster risks.

Screening Questions		Score	Remarks[1]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	The project site is at low from landslides and flooding.
	Would the project design need to consider any hydro-meteorological parameters level, (e.g., sea-peak river flow, reliable water level, peak wind speed etc)?	1	The project road has a low risk for flooding.
Materials and Maintenance	Would weather, current and likely future climate conditions(e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters) affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	The increase in temperature, precipitation, and flooding will not likely affect the selection of construction materials.
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	1	Increased precipitation in future may require more maintenance works of the project road to ensure they are usable particularly during incidents of heavy rain and flash floods
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	The design life of the project, particularly the approach roads will be shortened if the required maintenance works are not undertaken.

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include

providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): **MEDIUM**
Other Comments:_____
_____

Prepared by:

[1] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

APPENDIX B – ENVIRONMENTAL MONITORING PLAN

Environmental Indicators	Project Stage	Parameters	Methods/Guidelines	Tentative Location	Frequency and duration	Standards	Cost	Implementation	Supervision
Air Quality	Construction Stage	TSPM, PM_{10}, NOx, SOx, COx	Stack emission testing	Crusher, hot mix plants, diesel generator	Annual in line with permit renewal	National Ambient Air Quality Standards (NAAQS)	Part of permit renewal	Contractor	SC, /DoR
			Emission testing for all vehicles	Construction camp	Annual as part of permit renewal			Contractor	SC, /DoR
			Ambient air quality sampling and analysis at selected sites/sensitive spots using through High Volume Sampler 24-hour	5 major settlements	Baseline: 1 sampling each before construction		5 sites x 35,000/sampling = NRs 175,000.00	SC	DoR
	Operation			Major settlements				DoR	
Water Quality	Construction	BOD, Turbidity, pH, *E.Coli*, TSS, Oil and Grease	•Collect and analyze sample from source Observation of blockage of waterways - extent and secondary impacts Water pollution incidents due to unsafe disposal of waste and spoil, analyzing effects on local fisheries Observations on vehicle and equipment washing practices in rivers	Major rivers (Sundari River, Mahuli River, Khando River, Balan River, Kamala River)	Quarterly	Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems	5 sites x 2 x 5,000/sampling = NRs 50,000.00	SC	PD/DoR
				Construction camp final discharge effluent				SC	PD/DoR
		Drinking water quality parameters	Water sampling	Construction camp		National Drinking Water Quality Standards (NDWQS)		Contractor	PD/DoR

Environmental Indicators	Project Stage	Parameters	Methods/Guidelines	Tentative Location	Frequency and duration	Standards	Cost	Implementation	Supervision
		Clogging of drains from silt with oil	Visual				Agency budget		
	Operation			All drains	Annually before the on-set of rainy season			DoR	
	Operation Stage			Agricultural Land, oil spillage locations and other probable hazardous materials contamination location or as suggested by SC (3 Locations)	Continuing		Clean up of spills is responsibility of polluter	DoR	
Noise Levels	Construction Stage	(1 hr Leq dB(A)) WHO Standards	Point source measurements in dB (A) at settlement sites/sensitive spots for noise level at 2, 5 and 15 m from road shoulder Traffic volume measurements	Camp site and major settlement sites	Twice a year during the construction	Nepal Ambient Noise Level as per NHRC	10 sites x 2 x 15,000/sampling = NRs 300,000.00	Contractor	SC, PD/DoR
	Operation			Major residential, commercial and sensitive receivers along the project corridor or suggested by SC (6 Locations)	Once during the first year of operation		Part of agency budget	DoR	
Landslide and Soil Erosion	Construction	Magnitude, extent and location	Visual	Along the entire stretch	Regular	None	Part of construction cost	Contractor	SC, PD/DoR
	Operation	Magnitude, extent and location		Throughout the road alignment	Regular		Part of agency budget	DoR	

Environmental Indicators	Project Stage	Parameters	Methods/Guidelines	Tentative Location	Frequency and duration	Standards	Cost	Implementation	Supervision
Siltation by rivers and drainage congestion	Construction	Siltation and presence of construction spoils and wastes Blockage of waterways - extent and secondary impacts	Direct Observation	Throughout the road alignment, especially at the drainage congestion areas as mentioned in the IEE report or as suggested by SC	Continuing during construction phase	Visual Observation	Construction contract	Contractor	SC, PD/DoR
	Operation	Siltation Blockage of waterways - extent and secondary impacts			Annual		DoR Length Person System	DoR	
Borrow Areas and Quarry Sites	Construction	Location, drainage condition, siltation, erosion, spoil management, etc	Site observation, discussion with workers and local people	Borrow areas, quarry sites location	Quarterly during construction period	Visual Observation	Construction Contract	Contractor	SC, PD/DoR
	Operation	Restoration as recommended in the EMP	Site observation, discussion with workers and local people		Once immediately after the completion of construction		DoR	DoR	
Labour Camps	Construction	Proper siting of food stalls, camp sanitation facilities	Site observation, discussion with workers and local people	Construction and camp sites	Quarterly during construction period	Visual Observation	Construction Contract	Contractor	SC, PD/DoR
	Operation	Restoration of construction camp as recommended in the EMP	Site observation and discussion with local people	Construction sites and camps	Once immediately after the completion of construction		DoR	DoR	

Environmental Indicators	Project Stage	Parameters	Methods/Guidelines	Tentative Location	Frequency and duration	Standards	Cost	Implementation	Supervision
Tree Plantation	Construction	Maintenance of saplings planted as compensation for trees felled	Direct Observation, discussion with workers and local people	Throughout the project corridor	Once a month for one year immediately after plantation	Visual Observation	Included in environmental mitigation cost	DFO	DFO, DoR
	Operation	Maintenance of saplings planted during construction Survival rate of trees Growth and development of saplings	Direct Observation and discussion with local people		Once a month for one year for saplings that are less than a year old Once in a year for 5 years			DFO	DFO, DoR
Road Safety and Accidents	Construction	Accidents (Major and minor) Safety	Record numbers and types of road accidents recorded by the traffic police and the local health service centres Suitability of signs at construction sites Direct observation and discussion with workers and local people	Throughout the road alignment	Once after the construction begins	Visual Observation, Verification and discussion with workers and local people	Construction contract	Contractor	SC, PD/DoR
	Operation		Record numbers and types of road accidents recorded by the traffic police and the local health service centres Suitability of local road signs Records on public road safety awareness campaigns Direct observation and discussion with local people Speed measurements at selected spots	Throughout the road alignment	Once a year		DoR	DoR	

APPENDIX C – AMBIENT NOISE LEVEL LIMITS

(in Leq dB (A), Nepal)

Environmental Setting	Typical Range of Ldn, dBA	Average Ldn, dBA
High Traffic Area	64-86	74.36
Old Residential Area	59-73	66.28
New Residential Area	48-69	62.00
Commercial Cum Residential Area	69-75	72.75
Commercial Cum Tourist Area	59-76	69.25

Source: Nepal Health Research Council, 2003

Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAmax fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate	35	16	
	annoyance, daytime and evening			
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor	45	8	60
	values)			
School class rooms	Speech intelligibility, disturbance of	35	during	-
and pre-schools,	information extraction, message		class	
indoors	communication			
Pre-school	Sleep disturbance	30	sleeping	45
Bedrooms, indoors			-time	
School, playground	Annoyance (external source)	55	during	-
outdoor			play	
Hospital, ward	Sleep disturbance, night-time	30	8	40
rooms, indoors	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment	Interference with rest and recovery	#1		
rooms, indoors				
Industrial,	Hearing impairment	70	24	110
commercial,				
shopping and traffic				
areas, indoors and				
Outdoors				
Ceremonies, festivals	Hearing impairment (patrons:<5 times/year)	100	4	110
and entertainment				
events				
Public addresses,	Hearing impairment	85	1	110
indoors and outdoors				
Music through	Hearing impairment (free-field value)	85 #4	1	110
headphones/				
Earphones				
Impulse sounds from	Hearing impairment (adults)	-	-	140 #2
toys, fireworks and				
firearms	Hearing impairment (children)	-	-	120 #2
Outdoors in parkland	Disruption of tranquility	#3		
and conservation				
areas				

Source: WHO, 1999

APPENDIX D – NATIONAL AMBIENT AIR QUALITY STANDARDS (NNQS) FOR NEPAL

Parameters	Units	Averaging Time	WHO Guideline	Concentration in Ambient Air, maximum	Test Method
TSP (Total Suspended Particulates)	µg/m^3	Annual	120-230	-	HVS 24 hour sampling(one weak sample on 2 road side station
		24-hours*		230	
PM10	µg/m^3	Annual	70	-	Light Volume Sampling
		24-hours*		120	
Sulphur Dioxide	µg/m^3	Annual	125	50	Diffusive sampling based on weekly average
		24-hours**		70	
Nitrogen Dioxide	µg/m^3	Annual	150	40	Diffusive sampling based on weekly average
		24-hours**		80	
Carbon Monoxide	µg/m^3	8 hours**	100000	10,000	To be determined before 2005
		15 minute		100,000	Indicative sampler
Lead	µg/m^3	Annual	0.5-1.0*	0.5	Atomic absorption spectrometry analysis of PM_{10} samples
		24-hours		-	
Benzene	µg/m^3	Annual	-	20****	Diffusive sampling based on weekly average
		24-hours		-	

Notes:

*24 hourly values shall be met 95% of the time in a year. 18 days per calendar year the standard may be exceeded but not on two consecutive days,

**24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005,

***If representativeness can be proven, yearly averages can be calculated from PM_{10} samples from selected weekdays from each month of the Year,

****To be re-evaluated by 2005.

Source: Nepal Gazette B.S. 2060/4/19 (4 August, 2003)

APPENDIX E – NEPAL'S DRINKING WATER QUALITY STANDARDS AND WATER QUALITY FOR IRRIGATION

Nepal`s Drinking Water Quality Standards

Group	Parameter	Unit	Maximum Concentration Limits
	Turbidity	NTU	5 (10)**
	pH		6.5-8.5*
	Color	TCU	5 (15)**
	Taste & Odor		Would not be objectionable
	Total Dissolved Solids	mg/l	1000
	Electrical Conductivity	µc/cm	1500
	Iron	mg/l	0.3 (3)**
Physical	Manganese	mg/l	0.2
	Arsenic	mg/l	0.05
	Cadmium	mg/l	0.003
	Chromium	mg/l	0.05
	Cyanide	mg/l	0.07
	Fluoride	mg/l	0.5-1.5*
	Lead	mg/l	0.01
	Ammonia	mg/l	1.5
	Chloride	mg/l	250
	Sulphate	mg/l	250
	Nitrate	mg/l	50
	Copper	mg/l	1
Chemical	Total Hardness	mg/l	500
	Calcium	mg/l	200
	Zinc	mg/l	3
	Mercury	mg/l	0.001
	Aluminum	mg/l	0.2
	Residual Chlorine	mg/l	0.1-0.2*
	E-Coli	MPN/100ml	0
Micro Germs	Total Coli form	MPN/100ml	95 % in sample

Notes:

* These standards indicate the maximum and minimum limits.

** Figures in parenthesis are upper range of the standards recommended.

Source: Ministry of Physical Planning and Works (Nepal Gazette (B.S. 2063/03/12)

Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystem

S.N.	Parameter name		Target Water Quality Range	Chronic Effect Value	Acute Effect Value
1.	Aluminum (mg/l)		At pH <6.5: 5	10	100
			At pH >6.5:10	20	150
2.	Ammonia (µg/L)		< 7	< 15	< 100
3.	Arsenic (µg/L)		< 10	< 20	< 130
4.	Atrazine (µg/L)		< 10	< 19	< 100
5.	Cadmium				
	Soft water	(60 mg/l CaCO3)	< 0.15	0.3	3
	Medium water	(60 – 119 mg/l)	< 0.25	0.5	6
	Hard water	120 – 180 mg/l	< 0.35	0.7	10
	Very Hard	> 180 mg/l	< 0.40	0.8	13
6.	Chlorine (Residual) µg/L		< 0.2	0.35	5
7.	Chromium (VI) µg/L		7	10	200
8.	Chromium (III) µg/L		< 12	24	340
9.	Copper µg/L				
	Soft water	(60 mg/l CaCO3)	< 0.3	0.53	1.6
	Medium water	(60 – 119 mg/l)	< 0.8	1.5	4.6
	Hard water	120 – 180 mg/l	< 1.2	2.4	7.5
	Very Hard	> 180 mg/l	< 1.40	2.8	12
10.	Cyanide µg/L		1	4	110
11.	Dissolved Oxygen (% saturation)		80 – 120	> 60	> 40
12.	Endosulphan (µg/L)		< 0.01	0.02	0.2
13.	Fluoride (µg/L)		< 750	1500	2540
14.	Iron		The iron concentration should not be allowed to vary by more than 10 % of the background dissolved iron concentration for a particular site or case, at a specific time.		
15.	Lead µg/L				
	Soft water	(60 mg/l CaCO3)	< 0.2	0.5	4
	Medium water	(60 – 119 mg/l)	< 0.5	1.0	7
	Hard water	120 – 180 mg/l	< 1.0	2.0	13
	Very Hard	> 180 mg/l	< 1.2	2.4	16
16.	Manganese (µg/L)		< 180	370	1300
17.	Mercury (µg/L)		< 0.04	0.08	1.7
18.	Nitrogen (inorganic)		Inorganic nitrogen concentrations should not be changed by more than 15 % from that of the water body under local unimpacted conditions at any time of the year; The trophic status of the water body should not increase above its present level, though a decrease in trophic status is permissible (see Effects); The amplitude and frequency of natural cycles in inorganic nitrogen concentrations should not be changed.		
19.	pH				
	All aquatic ecosystems		pH values should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, orby > 5 %, and should be assessed by whichever estimate is more conservative.		
20.	Phenols (µg/l)		<30	60	500

S.N.	Parameter name	Target Water Quality Range	Chronic Effect Value	Acute Effect Value
21.	Phosphorus (inorganic) All surface waters	Inorganic phosphorus concentrations should not be changed by > 15 % from that of the water body under local, unimpacted conditions at any time of the year;		
		The trophic status of the water body should not increase above its present level, though a decrease in trophic status is permissible (see Effects);		
		The amplitude and frequency of natural cycles in inorganic phosphorus concentrations should not be changed.		
22.	Selenium (µg/l)	< 2	5	30
23.	Temperature (All aquatic ecosystems)	Water temperature should not be allowed to vary from the background average daily water temperature considered to be normal for that specific site and time of day, by > 2 oC, or by > 10 %, whichever estimate is the more conservative.		
24.	Total Dissolved Solids (All inland waters)	TDS concentrations should not be changed by > 15 % from the normal cycles of the water body under un impacted conditions at any time of the year; The amplitude and frequency of natural cycles in TDS concentrations should not be changed.		
25.	Total Suspended Solids (All inland waters)	Any increase in TSS concentrations must be limited to < 10 % of the background TSS concentrations at a specific site and time.		
26.	Zinc (µg/l)	< 2	3.6	36

Source: Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, B.S., 2065-03-02)

APPENDIX F – GUIDELINES FOR BORROW AND QUARRY AREAS MANAGEMENT

Datasheet for Quarry Management and Restoration Plan

(i) Datasheet

Name of Subproject:
Contract No:
Locations of Civil Works:

Type of Structure: Slab culvert / Pipe culvert / RRM wall / Gabion wall (Chainage wise).

Required Type of Material from Local Sources: Stone / Gravel / Sand / Soil

Required quantity of material from local quarry (in cum):
(Write qty. from different sources in serial order)

Parameter for quarry site selection: (e.g. unsuitable land for cultivation, stable slope, minimum environmental hazard etc.).

Sources of Material: Within RoW / Private land / Public land / Forest (community/ private/government/religious/leasehold)/Surplus material extracted by workers / River / Stream / Borrow pit / Roadway

Available quantity in Selected Source (in cum**)**:

Approval for Quarry site: GON Organizations/ Private Party/ Community / Land Owner (Attach agreement herewith).

Method of extraction and transportation: Depth of cut / Height of cut / and Tractor / Tipper / Manually or any means.

Precaution measures during excavation:

Likely negative environmental impacts:

(ii) Restoration Plan

Restoration Plan: Trimming of slope/Filling of quarry/Need of check wall/Toe wall/Plantation/Benching etc.
Any special safety arrangement required:
Mitigation measures for negative environmental impacts:
Verification of Restoration Work as Planned by the Supervision Consultant Engineer/ES:
Certification of the Restoration Plan at the end of work at each location
Annex:
Quarry plan:
X-section @ of 5-10m intervals (where appropriate)
Quantity estimation sheets
Restoration design on X-section and plan

Submitted by: Checked by: Approved by:

Note: The payment of each structure will be made only after filling of the data by the contractor for Quarry Management and Restoration Plan. Final payment will be dependent on verification and approval by SC at the end construction of each respective structure.

Guideline for Quarries and Borrows Management and Restoration Plan Preparation

Introduction

1. The guideline makes effort to highlight points to be considered in preparing quarry management and restoration plan. The purpose of this document is to provide reference to select quarry and borrow sits and check the quarry management and restoration plan submitted by the Contractor. The guideline has been prepared taking into consideration to the works mentioned in contract and EIA/EMP.

Quarry Site

2. Quarry is a place from which construction materials (soil, stone, sand, gravel, etc.,) are extracted. Quarry site potential depends upon availability of sources (quantity) and suitability of materials.

Parameter to be considered for Quarry Site Selection

3. Quarry site should be located 1 km away from the villages/settlement area, drinking water supply sources, community infrastructure such as school, health post, bridge, etc., religious sites, cultivated land, protected forests, natural drainage systems. Quarry will not be located at wildlife conservation area. River gravel will not be extracted from flowing water due the disturbance of raising sediment and danger of resulting oil/fuel leaks.

4. Quarry sites should be selected in stable area, in agriculturally unsuitable land and away from the abovementioned sites. In addition to this, local communities will be consulted and take approval from respective owner before selecting the place for quarry operation.

Likely Negative Environmental Impacts

5. The potential negative impacts are disruption of natural landscape and vegetation, accelerated erosion and landslides, slope stability, disturbance in natural drainage patterns, siltation due to surface water, water pollution and dust pollution. In case of riverbeds, scouring of riverbeds resulting endangerment of bridges and continuous degradation of river regime and detrimental effects on aquatic lives and their habitats.

Quarry Operation

6. Prohibition to work during the night time

7. Barricade to site to control free movement of local people

Points to be considered in Restoration Plan

8. In order to prepare quarry management and restoration plan the following points should be taken into consideration:

9. The plan must contain site restoration measures such as spoil management, slope stabilisation, drainage pattern, etc.

10. Suitability of proposed mitigation measures for negative environmental impacts is needed to be conformed and verified.

11. Provision of drainage system during operation and no risk of likelihood of depositions of debris from quarry to lower catchments are important.

12. The plan must contain provision of spoil collection and appropriate management during operation, if necessary.

13. The plan should mention use of safety gears during working hours in the quarry site, and appropriate means of safeguarding for passer-by and nearby households.

14. The plan should include suitable bioengineering techniques where appropriate.

15. **Acceptance of Restoration Work:** The Supervision Consultant should satisfy himself and accept the restoration works carried out by the Contractor. The mentioned teams` engineer/ES will make sure that quarries are operated and closed according to the submitted plan.

16. The payment of each works structure should only be made after filling of the data by the Contractor for quarry management and restoration plan and acceptance by the Supervision Consultant. Final payment will be dependent on verification and approval by SC at the end construction of each respective structure.

17. **Site Supervision:** The Supervision Consultant Engineer/ES shall supervise the following parameters and indicators:

- Implementation of mitigation measures as per design plan;
- No evidence of water ponding or presence of fresh gullies;
- Proper site closure;
- Natural contours and vegetation restoration;
- Engineers report testifying to completion of restoration work.

APPENDIX G – GUIDELINES FOR WORKERS' SAFETY DURING CONSTRUCTION

S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
	Excavation in soft, loose & slushy soil above 2m depths sliding of earth or collapsing of sides.	The Excavation beyond 1.5m to 2m to be done in steps of minimum 500mm offsets and also planking and strutting should be done.
	Excavation in slippery area (water logged) -the labour may fall or machinery on site may slip.	Try to dewater the area and spread minimum 150mm thick sand layer to avoid slipping
	Excavation in rock where chiseling involved – The fall of hammer may injure the hand, small rock pieces may injure the eyes and legs.	For hammer work, only experienced and skilled labour should be employed. Chisel should not be allowed to be held by hand, while hammering but chisel holding clamp should be provided. The labour should be provided with goggles and leg cover to protect eyes and legs, from injuries due to small rock pieces.
	Excavation in Rock where blasting is involved – careless handling may lead to injury to worker or a passerby.	The work of blasting should be entrusted to only experienced persons. Provide sufficient length of fuse to give ample margin of time from the time of lighting to the time of explosion. A danger zone at least 180m diameter is to be flagged off 10 minutes before actual firing. All workmen should be sent way from danger zone except the firing man, who should be provided with a whistle.
	Excavation for drain across road or manhole adjacent to a road – chances of a passer by falling into the excavated portion.	The area should be well barricaded & a red lamp provided at night. A watchman should be deputed to prevent any movement of persons or vehicles.
	Centering and scaffolding – formwork collapse while concreting or just before concreting or just before concreting especially when wooden ballies are used.	Many a times ballies joined together give way due to weak joint. Hence the use of joined ballies should be restricted. Only 2 joined ballies out of 8 ballies should be allowed. In case of double staging for a slab at a height, utmost care should be taken to see that the top balli rests on the bottom balli. Particular care that should be taken during each concreting, operating of slabs and beams is that one carpenter and two helpers with spare ballies, nails etc. should be deputed below the slab/beam that is being concreted to watch any disturbance in the supports of the form-work below, during concreting and in case of any doubt concreting should be stopped immediately and the form work to be strengthened. Never allow bricks below a balli to make up the required height. This is most dangerous.
	Form- work for beams and slabs – opening the form – work accident due to fall of materials during removing the forms.	In fact, this is a most dangerous work. One should be very careful while formwork is removed. Only trained carpenters should be deputed for the work. A safe resting place outside the area of slab as a temporary measure should be constructed from where the slab can be removed safely. Removal of form-work during night should not be permitted under any circumstances.

S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
	Scaffolding – Fall of work–man, supervision staff, standing on challis not tied properly or toed only at one end. (Challis mainly made of Bamboos)	This is a very common negligence on the part of labour who does scaffolding work. The Challis on which they work either span over its complete length or is tied loosely and many a times at one end only. Hence, care must be taken that the challis do not span over the full length but some middle support should be provided and also the same is tied properly on both ends.
	Ladders - Balli or bamboo ladders – The horizontal member breaks and the person falls. Sometimes the top face just rests on wall and the whole ladder tilts causing an accident.	The ladders should be strong enough to bear the weight of a labour with materials on head. As for as possible a hand rail should be provided at one end. The horizontal member should be preferably fixed with bolt & nuts or strong nails. When the ladder is placed across a wall the top portion should be tied firmly to a strong support so that the ladder does not move laterally.
	Dismantling – Dismantled materials may fall on passerby or the person engaged in dismantling work may fall due to slipping. The dismantled materials may fall on persons working below.	When work of demolition is to be taken up the area should be closed for all outsiders. No one should be allowed up to 50m from the place of demolition. The workers engaged in demolition should be asked to wear safety belts. Helmets must be worn by all the workers engaged in dismantling work. The place should be strictly guarded at night with red lights at prominent places, and watchman should be posted.
	Electrical connections/ cables etc., - HT / LT electric wire passing near the slab structure – while bending, lifting or tying reinforcements the bar benders may sustain the electric shock, causing fatal injury.	The work in such places should not be allowed to the workers themselves, but in such position the work must be executed under the strict supervision of a responsible Foreman or a Supervisor.
	Electric- connections/cables, etc., - cables below ground may get punctured during excavation & thus electrocute the labour working. Similarly when connecting is in progress the punctured cable may prove to be fatal to the labour.	Before taking up the work all available drawings should be studied, local enquiry to be made to know the position of cables and work in such area should be got executed under strict supervision of an experienced Foreman or a supervisor.
	Electric connections/cables etc.,- Temporary Electric lines near damp walls, near joinery stretched on a considerable length – There is every chance that the wire may get cut due to usage and may develop short circuits/leakages etc., and may electrocute the person touching the wire accidentally.	The Electric wires should be maintained by an electrician who should regularly check up the insulation of wires especially placed near steel items & damp areas. The temporary wiring should be supported properly. As far as possible a good quality wire should be used which may not get damaged easily.
	Electric and gas welding work – Drilling, polishing work – Done by temporary cables used on a number of works – Due to the fact that the wires are old & when they come in contact with water even in the process of curing the	All wiring works to be inspected by experienced electrician. All wires to be properly insulated and fixed at height on temporary poles. No welding work should be permitted near damp area. The welders to be provided with welder‟s goggles &

S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
	surrounding area may get affected due to leakage in the electric current thus causing damage to the workers & supervision staff.	gloves. As far as possible machine in good condition should be used.
	Construction machinery – Concrete mixers – Safety precautions. A mixer with hopper tried to be operated by a helper could not release brake in time thus causing injury to the person near hopper – sometimes fatal one.	The Mixers with hopper should be operated by an experienced mixer operator and such mixers should not be allowed to be handled by a helper or a labour.
	Water storage Tank for general use and curing - chances of children of workers falling in the tank with fatal accident.	The water tanks constructed on site should be protected by at least 1.0m high walls on four sides, so that the children do not fall.
	Site cleaning – Cleaning top floors of buildings – Upper portion of any structure – throwing waste materials broken concrete pieces, brick bats, sand etc., straightway from top to ground injuring person below or even a passerby.	This dangerous practice should not be allowed at all. The materials should be brought to the ground with the help of lift or the use of rope over pulley with a bucket, thus bringing down materials safely.
	Bar bending work – Helpers of bar benders to follow short cut method, throw surplus steel pieces from top floors to ground and may cause fatal injuries.	This is a very bad practice. The helpers should bring the rods to ground with help of lift or rope and pulley.

APPENDIX H – WORKERS' SAFETY IN COMMON OPERATION DURING CONSTRUCTION

HOUSEKEEPING PRACTICES

- Maintain washrooms and canteens clean
- Keep all walkways clear and unobstructed at all times
- Ensure that no spillages of oil and grease occurs in the construction camp
- Stack raw materials and finished products clear of walkways or out of roads
- Do not leave tools on the floor or in any location where they can be easily dislodged
- Keep windows and light fittings clean
- Maintain the workplace floors dry and in a non-slippery condition
- Provide and maintain proper drainage system to prevent stagnant water.
- Use metal bins for oily and greasy rags and store all flammable materials in appropriate bins, racks or cabinets. Ensure that the meal bins for storing oily and grease rags should be covered with lids.
- Ensure that protruding nails in boards or walls are removed or bent over so that they do not constitute an hazard to people
- Make sure that hazardous/dangerous chemicals are kept in the stores with the appropriate labeling, display of the material-safety-data-sheet (MSDS) and other precautionary measures
- Display "no smoking" signs in areas with high fire risks such as paint stores, wood working areas, etc.

SAFE LAYOUT IN THE CONSTRUCTION PLANT, CAMP AND QUARRY AREAS

- Arrange perimeter fencing for construction plant
- Ensure good visibility and safe access at site entrances
- Provide adequate warning signs at the entrance and exit and where ever necessary
- Provide adequate space/area for loading, unloading and storage of materials, plant and machinery
- Display emergency procedure and statutory notices at conspicuous locations
- Consider provision of welfare facilities required
- Provide areas for dumping garbage and other waste materials, and also arrange their regular clearance and safe disposal
- Arrange storage, transport and use of fuel, other flammable materials and explosives in lines with the license requirements to be obtained from appropriate authorities
- Plan emergency assembly points, fire escape routes and location of fire-fighting equipment
- Provide access roads and plant movement areas within the site.
- Ensure the availability of first aid facilities and display notices to show the location of these facilities
- Provide proper drainage and sewage facilities

TREE FELLING

- Use hard hats during tree felling works
- Ensure that tools such as axes are in good condition
- Determine proper foot and body position while using the axe
- Wear appropriate foot protection while felling trees
- Carry a first aid kit to the site

- Determine possible hazards in the area, with reference to electrical or telephone or other utility lines
- Determine the safest direction for the tree fall prior to felling
- Determine the proper hinge size before directing the tree fall.

NOISE HAZARDS AND ITS CONTROL

- Observe the indications of noise levels
- Use sound level meters to measure. If the sound level exceeds 85 dB(A), then preventive and protective measures should be taken
- Make personnel aware of noisy areas by using suitable warning signs and insisting that ear protective devices should necessarily be worn.
- Reduce noise at source by improved maintenance, replacing noisy machines, screening with noise absorbing material, making changes to the process/equipment, controlling machine speeds, ensuring that two noise-generating machines are not running at the same time, using cutting oils and hydraulic breakers.
- Appoint a competent person to carry out a detailed noise assessment in the site, designate ear protection zone, and give instructions on the necessary precautionary measures to be observed by site personnel, including the use of suitable type of ear protections.
- Wear and maintain ear muffs and ear plugs as required
- In construction or repair works, noise should be kept to a low-level bearing in mind the disturbance to local residents.

ROAD WORKS

- The use of signage is most important to caution the road users of possible unsafe conditions due to the road works.
- Use appropriate signage devices as required by the site conditions/situation. The devices include regulatory signs, delineators, barricades, cones, pavement markings, lanterns and traffic control lights.
- While using signs, make sure that they are (i) simple, easy-to-understand and convey only one message, (ii) luminescent and with reflective properties and (iii) prominent and of appropriate size.
- While using barricades, make sure that you keep traffic away from work areas and you guide the drivers to keep along a safe and alternative path.
- Ensure that proper personal protective equipment (PPE) is provided to all the workers.
- Cover existing road signs and install new ones at appropriate locations taking into account the distances that would be required and reaction times.
- Plan layout and traffic management so that hazards do not occur.
- Deploy flagmen to control traffic at the work areas. The flag should be 600mm x 600mm fastened to a 1m length staff.
- Flagmen should wear reflective safety vests along with hard hats.
- If required, use wireless devices for flagmen to co-ordinate form either ends of the road, where works are being carried out.

ELECTRICAL HAZARDS IN CONSTRUCTION AREAS

- Treat all wires as live wires
- Never touch dangling wires but report them to the manager

- Unless you are a qualified electrician do not attempt electrical repairs
- Never use electrical equipment if your hands are wet or you are standing in water
- If electrical equipment is sparking or smoking, turn the power off and report the condition to the supervisor
- Never use electrical wires having physical damage
- Never allow equipment or traffic to run over the electrical wires.

USE AND STORAGE OF GAS/LPG

- Store filled gas/LPG cylinder in an open area or outside the building
- Transport, store, use and secure cylinders in upright position
- Ensure proper ventilation at the ground level where the gas/LPG is in use
- Avoid physical damage to the cylinder
- Never weld or cut on or near the cylinder
- Store empty cylinders secured and in upright position.
- Make sure that the cylinder is closed immediately after use.
- Investigate immediately if there is the smell of LPG or gas.
- Never use destenched gas/LPG on site.
- Make sure that there is no fire in the vicinity of the cylinder.

OPERATION OF EXCAVATORS

- Ensure that excavators are operated by authorized persons who have adequately trained.
- Prevent unauthorized movement or use of excavators
- Check regularly and maintain the machine thoroughly
- Ensure that all relevant information, including those related to instruction, training, supervision and safe system of work are provided to the operators.
- Ensure that the operation and maintenance manuals, manufacturer's specifications, inspection and maintenance log books are provided for the use of machines to service engineers or other safety personnel during periodic maintenance, inspection and examination.
- During tipping or running along the trenches, excavators must be provided with stop blocks.
- Excavators must be rested on firm ground during operation.
- Avoid operating the machine too close to an overhand, deep ditch or slope.
- Locate and identify underground utility services by checking with all utility companies before the excavations.
- Ensure that all excavations are supervised by experienced and competent persons.
- When reversing or in case the operator's view is restricted, adequate supervision and signaling should be provided.
- Ensure that the type and capacity of the excavator are properly chosen for the intended purposes and site conditions. Never use a machine for any purposes other than it is designed for.
- Check and report for excessive wear and any breakage of the bucket, blade, edge, tooth and other working tools of the excavator.
- Check that all linkages/hinges are properly lubricated and ensure that the linkage pins are secured. Never use the improper linkage pins.
- Never get down or climb a moving machine
- Ensure adequate ventilation and lighting in the working place.

- Ensure that the protective front screen of the driving cabin is fixed in position during excavations to avoid eye injury to the operator.
- Ensure to switch-off the unattended vehicle.

OPERATION OF TRUCKS AND DUMPERS

- Ensure that only trained, authorized and licensed drivers operate the vehicles.
- Provide the help of another worker before reversing the vehicle.
- Switch-off the engine of an unattended vehicle.
- Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall.
- Wear safety boots or shoes to avoid injuries during loading and unloading.
- Carryout periodic servicing to the manufacturer's requirements. All records of maintenance and repairs should be in writing and kept in the site.
- Keep the vehicle tidy and its cabin free from tools and materials which might obstruct the controls.
- Do not exceed speed limits.
- No passenger should be carried on a dumper except the driver
- Never drive the vehicle across a slope
- Provide stop blocks when the vehicle is tipping into or running towards excavations
- Do not overload the vehicle.
- Carry only well secured loads.
- Park only on level ground, in neutral with the parking brake applied.
- Never climb or get down from a moving vehicle.

GAS WELDING

- Use the following personal protective equipment during welding
  a. Face or hand shield fitted with filters,
  b. Goggles, particularly while chipping slag,
  c. Gloves long enough to protect wrists and forearms against heats, molten metal and radiation,
  d. High-top boots to prevent sparks from burning foot.
- Screen the work area with sturdy opaque or translucent materials as glare can cause eye injury.
- Key for opening the acetylene cylinder valve must be kept ready while the cylinder is in use so that the cylinder valve may be immediately shut-off in an emergency.
- Ventilate the workplace using air blowers and exhaust fans to remove poisonous fumes and gases that are being used during welding
- Take precautions against flying spark and hot slag where welding is being done near flammable materials and check the area before leaving.
- Do not weld the material degreased with solvents until it is completely dry.
- Do not use gas cylinders for supporting work or as rollers.
- Do not use oil/grease on oxygen cylinder fittings.
- Do not use cylinders with damaged valves.
- Do not use too much force if valves are stuck.
- Replace valve caps after use
- Search for leaks in equipment by using a solution of soap water.
- Shut the cylinder valve if acetylene from a cylinder catches fire at the valve or regulator due to leakage at a connection.
- Treat all gas cylinders as "full" unless you are sure otherwise.

- Never attempt to transfer acetylene from one cylinder to another or attempt to refill an acetylene cylinder.
- Keep portable fire extinguishers near the welding area
- Secure all cylinders against accidental displacement.
- Always lift gas cylinders. Do not slide them along the ground or drop them from trucks.
- Keep gas cylinders in vertical position both in store and when it is in use.
- Keep the work place dry, secure, free from combustible materials and obstruction.
- Store the acetylene and oxygen cylinders separately and in a proper store.
- Keep the gas cylinders away from source of heat, flammable materials, corrosive chemicals and fumes.

MANUAL HANDLING AND LIFTING

- Use mechanical equipment in place of manual handling as far as possible.
- Assess the manpower required to handle or lift the load safely and arrange the manpower accordingly.
- While handling hazardous materials, the workers shall be informed of the hazards and safety precautions.
- All relevant persons shall be trained on proper methods of lifting and carrying.
- Where team work is required, select the persons whose ages and physical builds are compatible for teaming up. Coordinate the actions of the team members by giving necessary instructions.
- Always lighten or suitably shape the load for manual handling. As far as possible keep a look for splinters, sharp edges, loose banding and nails.
- Clear path or obstruction and tripping hazards.
- Stack and secure goods safely on trucks, otherwise they fall off and injure passers-by.
- Use personal protective equipment such as gloves, safety shoes, etc.
- Adopt the following procedure when you lift a load.
- Stand close to the object, have a firm footing with feet spread on either side of the road.
- Bend the knees and keep your back as straight as you can.
- Grasp object firmly & be sure grip will not slip
- Breathe in and throw the shoulder backwards.
- Straighten the legs, continuing to keep the back as straight as you can.
- Hold the object firmly & close to the body
- Always lift smoothly, avoid jerky motions and turn with feet instead of twisting the back.

FIRST AID

- Provide first aid boxes at every site.
- Ensure that training on the use of first aid box is provided to a handful of staff working in the site.
- Display the list of persons who are trained on providing first aid.
- Ensure that every first aid box is marked plainly “First Aid” in English and local language.
- The responsible person or first aider should replenish the contents of the first aid box as necessary.

PERSONAL PROTECTIVE EQUIPMENT

List of personal protective equipment (PPE)

	Part of the body	**Personal protective Equipment**
	Eye	Safety glasses, Goggles
	Face	Face shields
	Nose	Nose masks
	Head	Helmets
	Feet	Safety shoes
	Hands and Arms	Gloves
	Body	Vests
	Hearing	Earplugs, Earmuffs

General:

- Ensure that sufficient personal protective equipment are provided and that they are readily available for every person who may need to use them.
- The management should ensure that all persons make full and proper use of the personal protective equipment provided.
- Provide instruction and training on the proper use and care of protective equipment.
- Do not willfully misuse, interfere with or ill-treat any protective clothing and equipment provided.
- Ensure that the personal protective equipment are in good condition. Report immediately any damage to the management for replacement. Always keep the personal protective equipment as clean as possible.

Eye Protection

- Issue eye protection equipment where there is a foreseeable risk of eye injury.
- Ensure an adequate supply of goggles/shields is available.
- Keep the goggles clean and make sure they fit well.
- Do not watch welding operations unless your eyes are protected.

Head Protection

- No person shall enter a construction site unless he is wearing a suitable safety helmet
- Wear a safety helmet:
- When there is the risk of being hit by falling objects
- While on or near a construction site
- During adverse weather conditions
- When in any area designated as a “hard hat” area.
- Provide identification labels to all helmets in some way to prevent random exchange among wearers, with one helmet exclusive to each person.
- Inspect helmets for cracks, sign of impact or rough treatment before each usage and replace defective or damaged helmets.

Hearing Protection

- Provide ear plugs or ear muffs as required. Use re-usable ear plugs when the reduction required (15-25 dB (A) is not excessive. Use ear muffs where a large attenuation of up to 40 dB (A) is demanded.

- Do not use dry cotton wool for hearing protection because it cannot provide protection.
- Provide disposable ear plugs for infrequent visitors and ensure that they are never re-used.
- Provide re-usable ear plugs for those who need to work continuously for a long period in a high noise area.
- Use ear muffs with replaceable ear cushions because they deteriorate with age or may be damaged in use.
- Avoid wearing spectacles with ear muffs.
- Use soap and water or the recommended solvent for cleaning ear muffs.
- Provide ear muffs for those who may need to get in and out of a high noise area frequently.

RESPIRATORY PROTECTIVE EQUIPMENT

- Wear suitable respirable mask for protection against small particles entering the lungs, e.g. while emptying of cement bags.
- Provide training to all persons using the respirators for their correct fitting, use, limitations and symptoms of exposure.
- Clean and inspect all respirators before and after use.
- Store respirators properly when it is not in use.

Safety Footwear

- Wear suitable footwear while working.
- Use safety footwear on site or in dangerous areas.
- 3) Wear suitable safety shoes or ankle boots when working where there is a high risk of foot injuries from slippery or uneven ground, etc.
- All Safety footwear including safety shoes, ankle boots and rubber boots should be fitted with steel toecaps.
- Avoid wearing flip flops, high heeled shoes, slippers, light sport shoes in situations where there is a risk of foot injury.
- Keep shoe lace knots tight.

Hand Protection

- Wear suitable gloves for activities such as welding & cutting and manual handling of materials & equipment.
- Do not wear gloves where there is a risk of them becoming entangled in moving parts of machinery.
- Wash hands properly with disinfectant soap before eating & drinking. Wash hands immediately after each operation on site & when the situation warrants.

FIRE PREVENTION, FIGHTING AND EQUIPMENT

Before fire breaks out

- Store flammable material in proper areas having adequate fire protection systems.
- Display sufficient warning signs.
- Train selected personnel to use these fire extinguishers.
- Inspect fire extinguishers regularly and replace as necessary.
- Fire escape route should be kept clear at all times and clearly indicated.
- Know the escape route and assembly point.

- Display escape route maps prominently at prominent places.
- Carryout fire drill regularly. Designate fire Officers.
- Install fire alarm wherever required and test regularly.
- Provide sufficient exit signs at prominent locations for directing people to the escape route.

When fire breaks out

- Alert all persons.
- Put off the fire with appropriate fire extinguishers when you are sure that you are safe to do so.
- Escape if you are in danger through the fire escape route to assembly point.
- Fire officers should carryout head count at the assembly point.

APPENDIX I – TRAFFIC MANAGEMENT AND SAFETY DURING CONSTRUCTION

I. Introduction

1. Construction zones are an integral part of any road system. Road construction and maintenance work is hazardous for both the site operatives and the road users. In addition, speeding vehicles create a whirlwind of dust around the work place and noise from the traffic and maintenance equipment often masks the sound of an impending accident. Under the present system, the traffic operations and safety provisions during improvement/maintenance works depend entirely upon the expertise of the engineer. Besides, non-uniformity in the methods of traffic control and placement of signs and other traffic control devices at various locations increases confusion for road users.

2. The current techniques of road improvement wherein traffic is allowed to use part of the existing carriageway create considerable problems for traffic. Sometimes delays can leads to driver's frustration and then tendency of over speeding to make up time. All this is detrimental to road safety.

3. Proper education, training programme and clear specifications/requirements in the contract for the site operatives would assist in creating and maintaining a safer environment for construction workers and for road users. Training could cover the personal safety of workers, safe use of construction equipment in confined spaces and on ‘live’ roads and the correct use of traffic signs and other control devices. The construction workers should be provided with high visibility use of traffic signs and other control devices. The construction workers should be provided with high visibility jackets with reflective tapes especially during night time working. The alertness of the site operatives would also be improved if they were properly equipped for the work with safety helmets, gloves, boots and safety spectacles. A greater safety consciousness can also be ensured if some of the supervisors and senior site operatives have first aid training. The guidelines of safety at construction zones shall be as per IRC: SP: 552001.

II. Traffic Management Plan

4. A detailed traffic management plan shall be worked out by the Contractor in consultation with the Engineer and got approved prior to implementation.

A. Guiding Principles

5. The guiding principles for safety in road construction zones are to:

i) Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.
ii) Warn the road user clearly and sufficiently in advance;
iii) Provide safe and clearly marked lanes for guiding the road users;
iv) Provide safe and clearly marked buffer and work zones; and
v) Provide adequate measures that control driver behavior through construction zones.

B. Components of the Construction Zone

1. Traffic Control Zone

6. It includes all those areas of carriageway in advance of the actual work site which are required for advanced warning of the hazard as well as safety zones, the transition zones and the working zone itself.

7. The Traffic Control Zone can be divided into three components, which are the Advance Warning Zone, the Transition Zone, and Working Zone. Figure No. 1 shows the elements of traffic control zone. All construction zones will have a working zone, which is flanked by a Transition Zone for each direction of approaching traffic, and an advance warning zone will precede these in turn.

2. Advance Warning Zone

8. The "advance warning zone", is the area to warn the road user of the approaching hazard and to prepare them for the change in driving conditions. It is essential for traffic control in the construction zone. It should provide information on:

i) The presence of the hazard through the 'Men at Work" sign, accompanied by the distance to the hazard;
ii) Any changes affecting traffic arrangements (such as a reduction in the number of lanes and/or in the speed limit) within the traffic control zone;
iii) Extent of the hazard (for example; the length of restriction); and for general information;
iv) The type of hazard.

9. The advance warning zone is also where the reduction in speed of vehicles should be notified.

10. The drivers should be advised to reduce their speed so as to achieve the desired approach speed before reaching the approach transition zone. The information in this zone is conveyed through a series of traffic signs along the length of the zone.

3. Transition Zone

11. The transition zone is the area in which the traffic is guided into the altered traffic flow pattern around the working zone. This is one of the most crucial zones as far as traffic safety aspects are concerned because most of the movements involved are merging / turning in nature. The transition zone has two components; The Approach Transition Zone and Terminal Transition Zone.

12. The initial part of the transition zone called Approach Transition Zone should further reduce the approach speed of vehicles and channelize them into the narrower and /or restricted number of lanes, if this is necessary.

13. At other construction zones, it may be necessary to divert traffic away from the original carriageway and the design of the temporary road geometry through the transition zone should take into account the following factors:

i) The turning radius of the longest vehicle that generally uses the road should be the ruling radius for curves;

ii) Where changes in vertical profile are required these should be shallow enough to allow safe passage of animal drawn vehicles (if these are present in significant numbers);
iii) The zone should have a good drainage to avoid any stagnation of water on the road surface.
iv) Sources of dust should be minimized. This is not only essential for good visibility but also for proper maintenance of signs and barricades in the zone.

14. The traffic is taken across the transition zone mostly with the help of signs, barricades, channelisers and pavement markings.

4. Working Zone

15. The working zone is the zone where actual construction is being undertaken. It contains the work area and a working space, as well as lateral and longitudinal buffer zones to create the safety zone to protect both the workforce from wayward vehicles entering the area of actual work and the road users from construction equipment areas.

16. Speeds should continue to be controlled in this zone because of the close proximity of moving construction plant and site operatives. Further, there may also be a difference in the elevation of the road and the diverted path in the zone.

17. The path of the traffic must be very clearly delineated through the traffic control zone to avoid vehicle intruding into the work area. Delineators and channelisers discussed further below must be used effectively for this purpose. Where the work site uses machinery with revolving booms like cranes or excavators the intrusion of moving parts must be taken into account when determining the lateral clearances for the buffer or safety zone.

5. Terminal Transition Zone

18. The Terminal Transition Zone (TTZ) provides a short distance to clear the work area and to return to normal traffic lanes. It extends from the downstream end of the work area to the sign indicating the end of works.

19. A downstream or closing taper may be placed in the TTZ. It may be useful in smoothening of the flow of traffic. However, it may not be advisable when the trucks carrying material move into the work area by reversing from the downstream end of working zone. The length of the downstream taper may be 25-30 m.

C. Other Aspects

20. The distance between two traffic control zones should be such that the flow of traffic can return to normal stream between them. Separation should permit fast moving traffic to overtake slow vehicles so that platoons can be dissipated and traffic normalized. These distances could vary from 2 Km on urban roads to 5 Km or 10 Km on rural roads according to gradients, traffic levels or traffic operation schemes.

Recommended Length of Traffic Control Zones

Average Approach Speed (Km/h)	Length of Advance Warning Zone (m)	Length of Approach Transition Zone (m)	Length of Working Zone (m)
50 or less	100	50	2 Km Urban 5 Km Rural
51 - 80	100 - 300	50-100	
81- 100	300 - 500	300-500	
Over 100	1000	1000	

D. Traffic Control Devices

1. General

21. Traffic control devices are the equipment and installations over and on the road, which individually and collectively perform the following tasks:

i) Warn the road user;
ii) Inform the road user;
iii) Guide the road user;
iv) Modify road user behaviour;
v) Protect the road user and the vehicle;
vi) Ensure safe passage to the road user; and
vii) Provide a safe working area.

22. The primary traffic control devices used in work zones are signs, delineators, barricades, cones, Pylons, pavement markings and flashing lights.

2. Signs

23. The road construction and maintenance signs fall into the same three major categories as do other traffic signs, that is Regulatory signs, Warning Signs and Direction (or Guidance) Signs. The IRC: 67: 2001 (Code of Practice for Road Signs) provides a list of traffic signs. Size, colours and placement of signs shall conform to IRC: 67:2001. Each sign should be well located so that its message is seen and is clear, which will be assisted if the surroundings are devoid of "unnecessary" sign and other clutter. These signs should be of retro-reflective sheeting of high intensity grade or engineering grade depending upon the importance of the road as directed by the engineer.

24. The correct positioning and size of sign will ensure that it can be observed and recognized, thereby providing the driver with more time to react and take action.

25. The following principles should govern the positioning of sign:

i) Location should have clear visibility;
ii) They should be so placed that driver would have adequate time for responses;
iii) As a general rule, signs should be placed on the left-hand side of the road. Where special emphasis is required, duplicate signs should be installed on the left and right side of roadway. In case of hill roads, the signs shall generally be fixed on the valley side of the road unless traffic and road conditions warrant these to be placed on the hill side; and
iv) The signs should be covered or removed when they are not required.

26. On the kerbed roads, the extreme edge of the sign adjacent to the road shall not be less than 600 mm away from the edge of the kerb. On the un-kerbed roads, the extreme edge of the sign adjacent to the road shall be at a distance of two to three meters away from the edge of the carriageway/paved shoulder depending on local conditions but in no case, shall any part of the sign come in the way of vehicular traffic.

27. **Regulatory Signs.** Regulatory signs impose legal restriction on all traffic. Therefore, it is essential that they are used only after consulting the local police and traffic authorities. The most likely type of regulatory signs to be used in traffic control zones are: STOP, Give Way, Do Not Enter, One Way, Straight Prohibited, Vehicles Prohibited in Both Directions, Left Turn Prohibited, Right Turn Prohibited, 'U' Turn Prohibited, Overtaking Prohibited, No Parking, No Stopping and No Standing, Keep Left, Compulsory Straight or Left Turn, Priority to Vehicles in Other Direction, Priority to Vehicles in this Direction, Weight Limit, Axle Limit, Height Limit, Length Limit, Restriction Ends, Speed Limit.

28. **Warning Signs.** Warning signs in the traffic control zone are utilized to warn the drivers of specific hazards that may be encountered. Drivers should be alerted to potential hazards in sufficient time to adjust their movement and speed. The most common type of warning signs for the use in the traffic control zone are: Men At Work, Road Narrows (Single File Traffic), Right Lane Diverted, Left Lane Diverted, Right Lane Closed, Left Lane Closed, Right Lane Closed, Median closed, Diversion to other Carriageway, Traffic Signal Ahead, Two Way Traffic, Rough Road, slippery Road, Loose Chippings, Divided Road and Divided Road Ends.

Minimum Sightline Distances and the Minimum size of the Signs

Average Speed (Km/h)	Distance of First Sign in Advance of the First Channelising Device (m)	Size of Warning Sign (mm)	Minimum Number of Signs in Advance of the Hazard
Under 50	100	600	3
51 - 60	100 - 300	750	3
61 - 80	120 - 300	900	3 or 4
81 - 100	300 - 500	1200	4
Over 100	1000	1200 to 1500	4

29. **Direction Signs.** Direction or Guide signs are required at traffic control zones to provide the necessary information and guidance for the alternative route and work being done. These signs shall have black letters, arrows on yellow (Indian Standard Colour No. 368: Traffic Yellow, of IS: 5-1978) background. The commonly used guide signs are: Diversion, Detour and Diverted Traffic.

3. Delineators

30. The delineators are the elements of a total system of traffic control and have two distinct purposes:

i) To delineate and guide the driver to and along a safe path.
ii) As a taper: to move traffic from one lane to another.

31. These channelizing devices such as cones, traffic cylinders, tapes drums are placed in or adjacent to the roadway to control the flow of traffic. These shall be retro-reflectorised and the design shall conform to IRC: 79.

32. **Traffic Cones and Cylinders.** Traffic cones are 500 mm, 750 mm and 1000 mm high and 300 mm to 500 mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorised red and white band. Their advantages are that they:

i) cause minor impediments to traffic flow and capacity;
ii) are well recognized and understood, without damaging vehicle when hit:
iii) can be easily stored and transported; and
iv) can be fastened to the pavement and self-restoring when hit.

33. The cones should be placed close enough together to give an impression of continuity. The spacing of cones should be 3 m (close) or 9 m (normal) or 18 m (wide). Where cones have to be used at between 450 and 900 to the line of traffic, their spacing should be 1.2 m.

34. **Drums.** Drums about 800 mm to 1,000 mm high and 300 mm in diameter can be used as either channelizing on warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.

35. The drums are normally metal drums e.g. empty bitumen drums cut to the required height. They can be made of plastic also. Plastic drums are lighter, pose fewer hazards to vehicles, workers and easy for transportation and storage and generally have one or more flat sides to preclude rolling. Drums may be filled up with earth or sand for stability. They should be painted in circumferential stripes of alternate black and white of 100 mm to 150 mm width. Drums should be retro-reflectorised for use at night and should never be placed in the roadway without advance warning signs.

4. Barricades

36. Barricades are intended to provide containment without significant deflection or deformation under impact and to redirect errant vehicles along the barrier. They are designed to be easily relocated and have four specific functions to:

i) prevent traffic from entering work areas, such as excavations or material storage sites;
ii) provide protection to workers;
iii) separate two-way traffic; and
iv) protect construction such as false work for culverts and other exposed objects.

37. Barricades can be portable or permanent. Portable barricades should be stable under adverse weather conditions and appear substantial but not so much as to cause excessive damage to the vehicle if they are struck.

E. Traffic Management Practices

1. Introduction

38. The traffic management strategies to be used at traffic control zones must include the following fundamental principles:

i) Make traffic safety an integral and high priority element of every project;

ii) Avoid inhibiting traffic as much as possible;
iii) Guide drivers in a clear and positive way;
iv) Perform routine inspection of traffic control elements and traffic operations; and
v) Give care and attention to roadside safety.

2. Works at Junctions

39. The two way traffic should be kept flowing past the works if possible. If this is not possible, a diversion route may be required and should be identified by the road authority. Men at works signs with arrow plates will be required on the main route if the works are located on a side road. At works like these the taper of cones should be taken up to the approach side of the junction but that any cones near the junction mouth help drivers turn left smoothly.

3. Works on Construction of Additional Carriageway

40. The Improvement of existing 2-lane carriageway to 4 lane divided carriageway facility on arterial roads is a major project activity. The planning of traffic and safety management should be carefully planned in advance before taking up the execution of the project, preferably with the advice of a traffic expert. There could be two situations requiring different plan for traffic control.

41. The central line of the road shifted (eccentric widening) while constructing the additional carriageway, the centre line of new road/highway gets shifted to a new location. It would have two stages of construction:

- **The Centre Line of the Road shifted (Eccentric Widening)**

a) The new carriageway shall be constructed in the first stage, adjacent to the existing one and the shoulder in between would become part of the central median of the improved divided carriageway facility. The traffic would continue to ply in both directions on the existing carriageway and an approached diversion would be taken out of the works zone for the movement of construction and supervision vehicles. The location of signs for 'works traffic' shall be governed by the location of base camp. The construction zone of new carriageway shall be properly barricaded either by reflectorised delineators or barricades.
b) In the second stage of improvement, the strengthening of the existing carriageway shall be taken up and the traffic would be allowed on the newly constructed carriageway. This would involve crossing of the traffic from existing to the new carriageway and then again from the new carriageway to old carriageway.

- **No Shift in Central Line of the Road (concentric widening)**

42. This activity would be mostly required to be taken up in the stretches of the road/highway passing through built up portions where there may be constraints of land availability. At such locations service roads would also be necessarily constructed for the segregation of the local traffic. Typically it would have three stages.

a) Stage I shall be construction of service roads or diversion road and the traffic moving on the existing carriageway in both direction. Stage II of the construction activity shall be strengthening of the existing carriageway and the construction of the median. The traffic shall move in one direction only on the service/diversion road constructed on both sides in stage I.

b) In stage Ill, the work zone shall be shifted to take up the co-centric widening to the adjacent stretch of the road / highway. Figure No. 4.8 shows the layout for signs and traffic control devices for this stage.

43. These methods should be adopted at most of the stretches on the project corridor. At all the places on project corridor where vehicular underpasses are proposed there is provision of service roads. Thus as indicated above first service road can be constructed and traffic can be allowed on service roads and construction activity can be carried out as mentioned above. At Mugling – Pokhara Road, since there is provision of service road this approach can be adopted. Places where realignment of road is under consideration construction activity can continue to take place on existing road with proper traffic safety signs and arrangements as discussed.

F. Temporary Diversions

44. Where the construction zone would close the road completely, the remaining carriageway space would be insufficient for the traffic and create large delays, and there is no suitable alternative route, it will be necessary to construct a temporary carriageway for all or part of the traffic. This is most common situation in the cases of any major repair or reconstruction of cross drainage works and of pavement failure due to, for example, floods.

45. The temporary carriageway must satisfy the following requirements:

i) It should have smooth horizontal and vertical profile with smooth vertical and horizontal curves;
ii) It should not get overtopped by flood or drainage discharge under any conditions;
iii) It should have adequate capacity to cater to the expected traffic;
iv) It should be dust free and should ensure clear visibility at all times of day and night; and
v) Barricading should be provided to prevent construction material falling on the diversion.

G. Precautions at Night

46. Adequate lighting arrangements should be carried out for the night. Flashing beacons at traffic switches are mandatory. Due to poor lighting arrangements there can be accidents. Appropriate road danger lamps can be made available at the construction sites.

H. Speed Control

47. The maximum length of a lane closure would depend upon the traffic volume and number of remaining lanes and normally it should not exceed 5 Km where speed control is in operation.

APPENDIX J - PHOTOGRAPHS

Photo 1: Start point (00+000), Kanchanpur

Photo 2: Roadside Vegetation

Photo 3: Temple within RoW (54+600)

Photo 4: Artificial pond within RoW (81+000)

Photo 5: School alongside the road (48+200)

Photo 6: Bazaar area at Km 50+000

Photo 7: Barren land

Photo 8: Agricultural land

Photo 9: Maruti Cement Factory (73+100)

Photo 10: Brick kiln alongside the road

Photo 11: Canal crossing at Ch. 84+700

Photo 12: End point of Road (87+000)