

# आभियान

राष्ट्रिय दैनिक



## नेपाल सरकार

### वन तथा वातावरण मन्त्रालय

बागमती प्रदेश चितवन जिल्ला र गण्डकी प्रदेशको तनहुँ र गोरखा जिल्लाको इच्छाकामना गाउँपालिका वार्ड नम्बर ५ आंबुखैरेनी गाउँपालिका वार्ड नम्बर २, ३ र ४ तथा शहीद लखन गाउँपालिकालाई प्रभाव पार्ने गरि स्तरोन्नती तथा नयाँ निर्माणका लागि प्रस्तावित मुग्लिङ्ग आंबुखैरेनी सडक (९.३८४ कि. मि.) आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनमा राय सुभाबको लागि आह्वान गरिएको सम्बन्धमा ।

#### सार्वजनिक सूचना

प्रथम पटक प्रकाशित मिति २०८०/०५/१५

प्रस्तावक श्री सडक विभाग, आयोजना कार्यान्वयन निर्देशनालय (ए.डि.बि.) ले बागमती प्रदेश चितवन जिल्लाको इच्छाकामना गाउँपालिका वार्ड नम्बर ५, गण्डकी प्रदेशको तनहुँ जिल्लाको आंबुखैरेनी गाउँपालिका वार्ड नम्बर २, ३ र ४ र गोरखा जिल्लाको र तथा शहीद लखन गाउँपालिकाको वार्ड नम्बर ३ लाई प्रभाव पार्नेगरी स्तरोन्नती तथा नयाँ निर्माणका लागि प्रस्तावित मुग्लिङ्ग-आंबुखैरेनी सडक (९.३८४ कि. मि.) आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनमा पेस गरेको छ ।

प्रस्तावित मुग्लिङ्ग-आंबुखैरेनी सडक (९.३८४ कि.मि.) आयोजना पूर्वी राजमार्गको मुग्लिङ्ग-पोखरा सडक अन्तर्गत पर्दछ । मुग्लिङ्ग-आंबुखैरेनी सडक (९.३८४ कि.मि.) खण्डको ४.४५६ कि.मि. नयाँ निर्माण कार्य र चेनेज ०००+४७० देखि ००+९२० सम्म राष्ट्रिय राजमार्ग श्रेणीको र चेनेज ००+००० देखि ००+१८० सम्म एकतर्फी, एक लेन, चेनेज ००+१८० देखि ०+३५० सम्म एक तर्फी, दुई लेन, चेनेज ०५+५८० देखि ०८+१०० सम्म दुईतर्फी, ४ लेन गरी ४.९२८ कि.मि. सडकको स्तरोन्नतीको कार्य प्रस्ताव गरिएको सडकमा दुईवटा प्रमुख पुल चेनेज ००+३५० देखि ००+४७० सम्म त्रिशुली नदीमा १२० मिटर लामो र चेनेज ०४+९२६ देखि ०५+०५१ सम्म मर्स्याङ्दी नदीमा १२५ मिटर लामो पुल, क्रस ड्रेनेज र पैदलयात्रीका लागि आवश्यक संरचनाहरूको प्रस्ताव गरिएको छ ।

प्रस्तावित वातावरणीय प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन अनुसार आयोजन निर्माण गर्दा नयाँ निर्माण हुने ४.४५६ कि.मि. सडकको क्षेत्राधिकार ३० मिटर र स्तरोन्नती हुने खण्डको ५० मिटर क्षेत्राधिकार र डिजाईन गति भौगोलिक अवस्थिति अनुसार ४० देखि ६० कि.मि प्रतिघन्टा हुनेछ । आयोजनाको नयाँ निर्माण तथा स्तरोन्नतीको लागि कूल भित्र ३१.३६५ हेक्टर (स्थायी १३.३६५ र अस्थायी १८ हेक्टर) स्थायी जमिन १२.३६५ हेक्टर (वन क्षेत्र ९.५२५ हे. र निजी ३.८४ हे.) र अस्थायी १८ हे. (वन क्षेत्र सरकारी बाँफो ५ हे. र निजी १३ हे.) को भू-उपयोग परिवर्तन हुने गरी प्रस्ताव गरिएको छ ।

वातावरण संरक्षण नियमावली, २०७७ को नियम ९ को उपनियम (६) बमोजिम प्रस्तावित वातावरणीय अध्ययन प्रतिवेदनमा राय सुभाब सङ्कलन गर्नको लागि राष्ट्रिय स्तरको दैनिक पत्रिकामा सूचना प्रकाशन तथा वन तथा वातावरण मन्त्रालयको Web site: [www.mofe.gov.np](http://www.mofe.gov.np) मा समेत सार्वजनिक गरिएको छ । यस प्रतिवेदनमा सरोकारवालाको उपयुक्त राय सुभाब प्राप्त भएमा यस मन्त्रालयले उक्त प्रस्ताव कार्यान्वयनका लागि स्वीकृति दिने क्रममा त्यस्ता राय-सुभाबहरूलाई समेत ध्यानमा राखिनेछ । उक्त प्रतिवेदन सम्बन्धमा सर्वसाधारण व्यक्ति वा संस्थाको कुनै राय-सुभाब भए यो सूचना प्रथम पटक प्रकाशन भएको मितिले सात (७) दिन भित्र आफ्नो राय सुभाब सम्बन्धित प्रस्तावकलाई वा निम्न ठेगानामा पठाई दिनु हुन यसै सूचनाद्वारा आह्वान गरिन्छ ।

#### प्रतिवेदन अध्ययन वा उत्तर गर्न सकिने स्थानहरू:

- श्री भौतिक पूर्वाधार तथा यातायात मन्त्रालय, सिंहदरवार, काठमाडौं ।
- श्री वन अनुसन्धान तथा प्रशिक्षण केन्द्रको पुस्तकालय, बबरमहल, काठमाडौं ।
- श्री नेपाल राष्ट्रिय पुस्तकालय, हरिहरभवन, ललितपुर ।
- श्री त्रिभुवन विश्वविद्यालय, केन्द्रीय पुस्तकालय, कीर्तिपुर, काठमाडौं ।
- श्री पुस्तकालय, संसद सचिवालय, सिंहदरवार, काठमाडौं ।
- श्री आदिवासी तथा जनजाति महासंघ नेपाल, कुसुन्ती, ललितपुर । (फोन नं. कुसुन्ती-५५५५५५५, महाराजगंज-४४१५३७६)
- श्री जिल्ला समन्वय समितिको कार्यालय, भरतपुर, चितवन ।
- श्री जिल्ला समन्वय समितिको कार्यालय, गोरखा, गोरखा ।
- श्री जिल्ला समन्वय समितिको कार्यालय, दमौली, तनहुँ ।
- श्री इच्छा कामना गाउँपालिका, गाउँ कार्यपालिकाको कार्यालय, चितवन ।
- श्री आंबुखैरेनी गाउँपालिका, गाउँ कार्यपालिकाको कार्यालय, तनहुँ ।
- श्री शहीद लखन गाउँपालिका, गाउँ कार्यपालिकाको कार्यालय, गोरखा ।

#### राय सुभाब पठाउने ठेगाना

वन तथा वातावरण मन्त्रालय,

वातावरण प्रभाव अध्ययन शाखा,

सिंहदरवार, काठमाडौं ।

फो.नं. ०१-४२११५६७, ४२११६३८, फ्याक्स नं. ०१-४२११८६८

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Ministry of Physical Infrastructure and Transport  
Singha Durbar, Kathmandu, Nepal

**Environmental Impact Assessment for “Upgrading/New Construction of  
Mugling - Abukhaireni Road Section (9.384 km)”**

Chitwan District, Bagmati Province; Tanahu and Gorkha District, Gandaki Province, Nepal

**Volume I: Main Report**



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**October, 2022**

## EXECUTIVE SUMMARY

### 1. Proponent

The proponent of the proposed Upgrading (4.928 km) and New Construction (4.456 km) of Mugling-Abukhaireni (9.384 km) Road Section is Project Directorate (ADB), Department of Roads, Bishalnagar, Kathmandu, Nepal. The project is located in Chitwan district (Bagmati Province), Gorkha and Tanahu District (Gandaki Province). The Scoping Document and Terms of References of Mugling-Abukhaireni Road were approved from MoFE on BS 2078/08/24.

The proponent has assigned KECC (Korea Engineering Consultants Corp) in association with Soil Test Pvt. Ltd. to conduct the EIA of this project.

### 2. Project Description

The proposed Upgrading/New Construction of Mugling-Abukhaireni (9.384 km) road section starts at about 936 m east from the junction of Mugling-Naranghat (Ch. 00+000) of Ichhakamana RM (Rural Municipality), ward no. 5 of Chitwan district of Bagmati Province and ends at Abukhaireni (Ch.09+384) ward no. 3 of Tanahu district, Gandaki Province, Nepal. The upgrading of the existing road will be carried out from Ch. 00+000 to 00+180 (One-way single lane), Ch. 0+180 to 0+350 (One way-Two Lane), Ch. 05+080 to 08+100 (Two way 4 lanes) and Ch. 08+100 to Ch. 09+384 (Two way four lane with service lanes).

Similarly, the new construction of the road alignment will be carried from Ch. 00+470 – 04+926 (One way two lane). Beyond this, the project comprises construction of two new bridges, i.e. 120m Trishuli Bridge from Ch.00 + 350 to 00+470 and 125 m Marshyangdi Bridge from Ch. 04 + 926 to 05+051 of width 12.16m.

The proposed Upgrading/New Construction of road project will affect the Ichhakamana RM, ward no. 5, Shahid Lakhana RM, ward no. 3 and Abukhaireni RM, ward no. 2, 3 and 4. The proposed road alignment passes through many different villages namely; Bhubanitar, Naya Basti, Karantar, Khantok tol, Sundarbasti tol and Siddhi Ganesh tol as well as five community forests namely Triveni Darmik C.F. (0+900-1+500), Salleri C.F. (4+200-4+900), Bhangé C.F. (5+000-6+405), Kukur Gade C.F. (6+405-7+780) and Chisapani C.F. (8+050-8+200). The total project cost is Nrs. 3,974,721,024.97 (Including Contingencies and VAT).

### 3. Relevancy of the Project

The average annual daily traffic of Mugling-Abukhaireni Road Section in year 2018 AD is 5217 Vehicle per day (vpd) and it is expected to be 18,095 vpd in year 2042 AD. The average existing width of Mugling-Abukhaireni road section is 6.7 m which is narrower and might not be enough to handle the vehicles in Prithivi Raj Marga (PRM) in near future. As the proposed Upgrading/New Construction of the road project comprises both new construction of 4.456 km of road and upgrading of 4.928 km of existing road; the proposed project will help to facilitate the traffic flow smoothly in near future.

Due to the unstable hill side slope and component of Marshyangdi Powerhouse in the PRM, the construction of the new road alignment in Gorkha district will help to control the traffic flow without disturbing any component of Marshyangdi Hydropower Project.

Also, the project proposes for construction of 4.456 km of new road in virgin land of Gorkha district, which helps to transform a rural settlement area of Karantar village into a facilitated develop area and provides lots of benefits and opportunities like increment of local market, shops, agricultural product trade efficiency to different districts and overall economic development of Gorkha people. The Triveni Bhagwati temple at Ch. 1+060 can be a centre of attraction to allure local tourists for its religious values, as a picnic spot, park after getting easy and all time transportation service contributing to local income generation.

The construction of the Trishuli and the Marshyangdi Bridge will help to access the people of Gorkha to reach Mugling Bazar and Abukhaireni Bazar and helps in marketing their local products. Therefore, it is very relevant to implement the proposed project.

#### **4. Rationality of the Proposal**

The project has proposed the construction of new road section of 4.456 km from Ch.00+470 to 04+920 of National Highway Category and upgrading of 4.928 km of road from Ch. 00+000 to 00+180 (One-way single lane), Ch. 0+180 to 0+350 (One way-Two Lane), Ch. 05+080 to 08+100 (Two way 4 lanes) and Ch. 08+100 to Ch. 09+384 (Two way four lane with service lanes) including two major bridges i.e. 120 m long Trishuli Bridge from 00+350 to 00+470 and 125 m long Marsyangdi Bridge from Ch.04+926 to 05+051.

According to the Schedule 3 (pertaining to Rule 3) Clause A, Forest Sector – No. 5) of the Environment Protection Rules, 2077, this project requires an EIA since the construction of road requires about 9.525 ha of forest area upto RoW of the Road. Hence, because of this legal rationality, EIA of the proposal is mandatory.

Also, as per EPR 2077, Rule 7(8), the EIA and its associated documents are prepared in English as the project is funded by international funding organization- ADB (ADB Loan No. 3012-NEP).

#### **5. Objectives**

The main objective of this EIA is to identify both beneficial and adverse impacts of proposed implementation on physical, chemical, biological, socio-economic and cultural environment of the project area and to develop and implement the augmentation measures for beneficial impacts and mitigation measures for adverse impacts.

#### **6. Methodology Adopted for EIA**

This EIA report has been prepared following the Rule 7 of Environment Protection Rules, 2077 and the methodology described in the ToR of the proposal (in APPENDIX 1). The Scoping Document (SD) and the Terms of References (ToR) for EIA of the road was approved by the decision of Hon. Minister of MoFE on 2078/08/24.

Relevant literatures were reviewed and Zone of Influence (ZOI) of the project was delineated for EIA. EIA study team made the preliminary field visit in December 2015 to collect the necessary field information on physical, biological, socio-economic and cultural environment and in December 2016 AD to identify the potential environmental impact and pertinent issues. Again, the team made the field visit in February 2022 to ground truths all the baseline data of the study area. For the collection of the datas on physical environment, EIA study team conducted Direct Observation, Field Investigation, Laboratory Analysis, and Study on topographic map and google earth image. Similarly, datas on Biological environment was collected from Field Observation, 10 Key Informant Interview (KII), Consultation with DFO stakeholders and reports and researches related to wildlife, authentic EIA Reports, forest maps, online portal of MoFE, DoF and DNPWC. Along with that datas on Socio-Economic and Cultural Environment were collected from Affected Ward and Municipal Office Survey, 64 household survey, 10 Key Informant Interview (KII) and review of secondary report. As per EPR 2077, Rule 6, Public hearing notice was published on Local Daily Newspaper “Chitwan Post” on 2078/11/12; accordingly, public hearing was conducted in Abukhaireni Rural Municipality Hall on 2078/11/14 and Sahid Lakhani Rural Municipality ward no. 3 premises on 2078/11/14 to collect suggestion of the concerned stakeholders and local people.

Then after, based on the primary and secondary information, impact analysis was carried out and suitable mitigation measures are proposed and Environment management plan was prepared. Finally, the report was finalized.

## 7. Existing Environmental Condition

### a. Physical Environment

The proposed project road starts at coordinates 27°51'30.94"N latitude and 84°34'8.10"E longitude and ends at coordinates 27° 54' 34.724"N and 84° 31' 48.788"E. It is located at an elevation (271.800-322.403) m above sea level and is geographically located in Hilly region of Nepal. The proposed road alignment passes through Lesser Himalayan rocks of Nuwakot complex (kunchha formation). The project area is mainly covered with the rock of bluish grey Phyllite and Whitish coarse-grained quartzite, Fagfog quartzite consist of white, coarse grained quartzite. Climatically, the project area falls on Tropical zone. The average annual rainfall of the Chitwan district is 2145 mm per year, Gorkha district is 2913 mm per year and Tanahu district is 2058 mm. Whereas, the average maximum and minimum temperature of the Chitwan district is 36°C and 5°C, Gorkha district is 20°C and 7°C and Tanahu district is 32° C and 20° C respectively (Source: Department of Hydrology and Meteorology). The road crosses Trishuli River at Ch 00+410m and Marsyangdi River at 04+980m. Topographically, the project area passes through moderate to steep rocky section consisting numerous hill slope terraces. The road alignment from 0+000 to 0+160 km is stable with respect to hill slope. Whereas the slope stability from 6+240 to 7+710 is poor due to joints and partings of Phyllite between joints. Slope instabilities were observed at 1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS). Most of the proposed road (RoW 30m) alignment passes through forest land (9.525 ha). Along with that, it also passes through 2.25 ha private agricultural land.

### b. Biological Environment

The total forest area required within RoW of the road is 9.525 ha. The different community forest found in the proposed road project are Triveni Dharmik C.F. (0+900-1+500), Salleri C.F. (4+200-4+900), Bhanghe C.F. (5+000-6+405), Kukur Gade C.F. (6+405-7+780) and Chisapani (Revised) C.F. (8+050-8+200). These are the best habitat for wildlife flora and fauna.

The tree species found in the project area are: Sal (*Shorea robusta*), Saj (*Terminalia elliptica*), Jamun (*Syzygium cumini*), Simal (*Bombax ceiba*), Aap (*Magnifera Indica*), Khayer (*Acacia catechu*), Siris (*Albizia lebbek*), Sissoo (*Dalbergia sissoo*) and Banmara (*Eupatorium adenophorum*), Kusum (*Schleichera oleosa*), Karma (*Haldina cordifolia*), Kadam (*Anthocephalus chinesis*), Pipal (*Ficus religiosa*), Bhalayo (*Semecarpus anacardium*), Amala (*Phyllanthus emblica*), Bhelar (*Trewia nudiflora*), Bakainya (*Melia azedarach*), Kabro (*Ficus lacor*), Karan (*Adina cordifolia*).

Non-Timber Forest Products (NTFPs) found in the project area are Bel (*Aegle Marmelos*), Bamboo (*Arundinaria bamboos*), Harro (*Terminalia Chebula*), Barro (*Terminalia belerica*), Bayer (*Ziziphus mauritiana*), Amala (*Phyllanthus emblica*), Kurilo (*Asparagus racemosus*), Tite pati (*Artemisia dubia*), Gurjo (*Tinospora cordifolia*), Neem (*Azadirachta indica*), Rajbriksha (*Cassia fistula*), Ghykumari (*Aloe vera*) and Tejpat (*Cinnamomum tamala*)

The common mammals reported in the project area are Leopard cat (*Felis bengalensis*), Jungle cat (*Felis chaus*), Jackal (*Canis aureus*), Monkey (*Macaca assamensis*), Langur monkey (*Presbytis entellus*), Squirrel (*Funambulus pennati*), Fox (*Vulpes bengalensis*), Hare (*Lupus migricollis*) and Porcupine (*Hystrix hodgsoni*)

Similarly, major birds reported in the project area include Sparrow (*Passer domesticus*), Owl (*Tyto alba*), Crow (*Corous macrorhynches*), Kalij (*Lophura leucomelanos*), Cuckoo (*Eudynamus scolopacea*), Jungle fowl (*Gallus gallus*), Red Turtle Dove (*Streptopelia*

*tranquebarica*) and Hill Partridge (*Arborophila hyperythra*), Jungle maina (*Acridotheres fuscus*).

Common species of reptiles and amphibians found in the project area are: Salamander (*Ambystoma spp.*), Frog (*Rana tigrina*), Bengal Monitor lizard (*Varanus bengalensis*), Common krait (*Bungarus caeruleus*), Cobra Snake (*Naja naja*) and Green Tree Viper.

The aquatic animals found in the Trishuli and Marshyangdi rivers are Asala (*Schizothorax propastus*), Raj Bam (*Anguilla bengalensis*), Buhari (*Wallagoatta*), River stone carp (*Psilorhynchida esucatio*), sahar (*Tor tor*) and stone carp (*Psilorhynchus pseudecheneis*).

### c. Socio-Economic Environment

The project area falls under three different rural municipalities i.e. Ichhakamana RM, ward no. 5 of Chitwan district, Sahid Lakhan RM, ward no. 3 of Gorkha district and Abukhaireni RM, ward no. 2, 3 and 4 of Tanahu district. The population distributions of the affected wards are: 4180 of Ichhakamana-5, 3521 of Sahid Lakhan-3 and 4115, 8764, 2356 of Abukhaireni rural municipality-2, 3 and 4 respectively with their average household of 856, 652, 858, 1612 and 434 respectively (*Source: Ward Office Survey, 2022*). The project area is dominated by Brahmin (39.1%), Janajati (54.6%), Chhetri, Gurung, Magar, Newar and Dalits. The people in the project area are Hindus.

The socio-economic survey shows that there are 52 numbers of vulnerable houses. Among them, 40.38 % are below poverty level, 26.93% are indigenous and 15.38 % are female headed houses. More than 78.2% of the total population is literate in the project area with people persuing SLC degree. The nearest schools along the proposed road alignment are Karantar Namuna Prathamik Vidhyala and Active Greenland H.S. School. A total of 60.93% of the population migrated in the project area in last 10 years, in which 53.8% migrated because of employment and 35.9% of the people in the project area migrated because of trade and business. Majority of the population (55.03%) is between age group of 16-45 year. The main source of income of the people relies on business (61.8%), foreign employment (13.9%), services (14.6%) and Livestock farming (12.1%). The survey shows that 42.18 % of the household have Pakho Bari (non-irrigated) land, 18.75 % of the households have Khet (irrigated land) and 7.81% of the household have Kharbari (sloppy land). In the project area, the major source of drinking water is found to be from piped water (96.87%). About 62.5 % of the people use boiling and filter as drinking water purification method, while 12.5% of the people use boiling for drinking water purification. Minority of the people in the project area uses piyush and filter for water purification. About 87.50% of the people use LP-gas for cooking purposes, while 12.50% of the people use firewood for the cooking purposes. Almost all the people of the project area (98.43%) use electricity for the lighting purposes, while 1.56 % of the people use Tukimara for the lighting purposes. There is one private hospital in Abukhaireni and 2 Health Post at Mugling Bazar and Abukahireni. 42.19% of the people have toilet facilities with flush system connection with septic tank while 31.2% people have dui khalde charpi. The survey reveals that about 42.18% people disposed the waste via nearby Marshyangdi River and roadside; While 12.50% dumped the generated wastes in agricultural land, pits, and used for composting. There are five temples in the project affected area. The people of project area carry out various cultural activities including Dashain, Tihar, Janaipurnima, Maghe Sankranti, Lhosar and Buddha Jayanti.

## 8. Beneficial Impacts for Project Implementation

The project will create employment for about 360,000 person days for unskilled manpower (500 persons per day) and 108,000 person days for skilled labors (150 persons per day) for 30 months. Other benefits of the project are that the local people affected by the project will be given first priority in the construction of the project and hence their skills will be developed. The

construction of the project will provide all weathered transportation facility to the local people. The project helps to transform a rural settlement area of Karantar village into a facilitated develop area and provides lots of benefits and opportunities like transportation facilities, increment of local market, shops, agricultural product trade efficiency to different districts. The Triveni Bhagwati temple at Ch. 1+060 can be a centre of attraction to allure local tourists for its religious values, as a picnic spot, park after getting easy and all time transportation service contributing to local income generation.

The project will indirectly contribute to enterprise development like food and tea shop, groceries, lodges and restaurants. This will indirectly help in poverty alleviation of the project's people. One of the main benefits of the up-gradation of the road project is development of the project area due to enhancement in trade, business and reliable transportation facilities.

## **9. Adverse Impacts of the Implementation of the Proposal**

### **a. Physical Environment**

The construction of the road will change in the land use of project area. Construction of the proposed road requires acquisition of 13.365 ha of land within RoW. Out of that, government forest area 9.525 ha and private 3.840 ha will be permanently changed into road area. And 5 ha of government land will be used temporarily for quarry and borrow site, whereas 13 ha of private land will be used for labor camp, stockpiling, spoil disposal site, crusher plant and concrete batching plant. The construction of the road will disturb 153 electrical poles/Telephone poles and 5 no. of transformer. Similarly, the construction of the road may cause landslides and soil erosion in unstable slope at Ch.1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS). The spoil disposal and waste generated from labor camp at different chainage will pollute air and water of Trishuli and Marshyandi River. The acquisition of the arable land in the project may lead to the degradation of Top soil and reduction in agricultural productivity. The construction of the major bridges may impact on surface water hydrology, creating obstruction to the free flow of water. Dust raised by plying of construction vehicles, operation of machineries will cause air pollution. Construction activities such as excavation, blasting, movement of heavy vehicles and construction equipment cause noise pollution. Disposal of the construction waste and spoil, erosion and soil movement due to quarrying and borrowing, improper sanitation of workers, disposal of wastewater from labor camp, unauthorized washing of vehicles, unauthorized garbage dump sites, accidents of tankers carrying oil may cause water pollution. Road accidents and road border encroachment during road operation may be seen in different chainage.

### **b. Chemical Environment**

During road construction, unmanaged piling of bitumen, grease, and oil will degrade the soil quality, loss of agricultural production and water pollution in Trishuli and the Marshyandi River at different chainages and also affects the health of the labor.

### **c. Biological Environment**

The implementation of the project will cause direct loss of 9.525 ha of forest area within RoW. The number of trees to be cut down is 2000. The majority of trees to be cut down are Sal (*Shorea robusta*), Aap (*Magnifera indica*), Kavro (*Ficus lacor*), Karan (*Adina cordifolia*), Padke (*Albizia odoratissima*), Simal (*Bombax ceiba*), Khirro (*Sapium insigne*), Siris (*Albizzia spp.*), Sisoo (*Dalbergia sisoo*), Bakaino (*Melia azedarach*) and Khayer (*Acacia catechu*) Accordingly, the road construction creates ecological impact by habitat fragmentation, affecting free movements of wildlife in forest habitats at Ch 0+900-1+500, 4+200-4+900, 5+00-6+405, 6+405-7+780 and 8+050-8+200. During the construction of road, increase in the demand of firewood, timber and NTFPs creates additional pressure on local forest and may increase forest fire. The protected species Sal (*Shorea robusta*), Simal (*Bombax ceiba*), Khair (*Acacia catechu*) need to be fell down during construction phase. Biological impacts during

operation phase include depletion of forest resources, disturbance to wildlife habitat in above mentioned chainage and impact on aquatic biodiversity due to erosion from poorly constructed, rehabilitated sites and disposal of waste on water bodies.

#### **d. Socio-economic and Cultural Environment**

The upgrading and the new construction of the road require acquisition of 227 private structures and 11 community structures. The private structures include 75 residential structures, 58 residential and commercial structures, 78 commercial structures, 11 shed and 5 private toilets. Among these, 227 private structures, 119 are fully affected structures and 108 are partially affected structures. Similarly, the community structures include 2 resting place, 2 police building and post, 4 temples, 1 aama samuha structure, 1 canteen and 1 public toilet. Along with that the proposed Upgrading/New-Construction of the road project requires 2.25 ha of private agricultural land. During construction phase, influx of construction crew will exert pressure on existing local service facilities such as water supply, food transportation, medicine and public communication. Typical health hazards such as eye related disease, skin related disease and respiration related diseases will be encountered during rock cutting, slope cutting, handling of the hazardous material, machinery movements, bitumen works, tree felling, soil erosion etc. The unmanaged construction activities may cause injuries, fatal accidents, disabilities among the labors, road and bridge users. The proposed Upgrading/New Construction of the road project will cause loss of 4 small/medium size temples at Ch. 0+050, 0+505, 5+080 and 7+850 of road alignment.

### **10. Adverse Impact Mitigation Measures**

The total 3.840 ha of private land acquired during the construction of the road will be compensated as per Land Acquisition Act, 2034. Relocation of 153 electrical poles/Telephone poles and 5 no. of transformer as per resettlement plan report of Mugling Abukhaireni road project. Soil erosion along the road will be mitigated by using bioengineering methods like construction of the check dams, retaining walls and gabion walls at Ch.1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS). Construction spoil will be disposed at Ch. 2+500, Ch. 6+800, Ch. 5+400, Ch. 5+650, Ch. 7+470, Ch. 7+100, Ch. 7+350 and Ch. 7+550 away from the water sources and the settlement area. The top soil excavated during the construction work will be safely store and reinstate it later. Water sprinkling will be done twice a day during the construction phase of the road in other to prevent air pollution. Construction work will be done far from the settlement area to prevent local people from noise pollution and provision of ear muffs, masks and other safety materials to protect the workers. The unsafe disposal of the waste generated in the water resources will be strictly prohibited. The road encroachment will be strictly controlled by the Local Municipal Officer.

The chemical use for the construction of the road will be placed in the leakage safe places to prevent soil and water resources.

The government land required for the construction of the road will be compensated as per Forest Regulation 2079 and will plant 1600 no. of plant species per hectare as per Forest Act 2076. The compensation of the 2000 no. of trees will be done by planting the trees in the ratio of 1: 10 and take care for 5 years as per Forest Act, Rule (42). Provision of the signboard for slow speed of the vehicles at Ch. 0+900-1+500, 4+200-4+900, 5+00-6+405, 6+405-7+780 and 8+050-8+200 which are use as wildlife corridor. Contractor will be responsible to strictly prohibit the illegal cutting of trees in the project area.

The projects will compensate 227 private structures, 11 community structures and 2.25 ha of agricultural land according to the resettlement plan of Mugling-Abukhaireni road project, decision from compensation Committee and as per ongoing rule. Awareness and provision of PPE to the construction workers during construction of the road. In other to minimize the road



accidents at different section of the road, safety measures like delineator, speed limits signboards and traffic signals will be adopted. Good demarcation of the RoW will be done to control encroachment of RoW during the operation of the road. And relocation of 4 temples in suitable places and as per land provided by local people.

### **11. Environment Management Plan**

The Environmental Management Plan for the new construction and upgrading of the road has been proposed. Environmental mitigation measures, monitoring methods, monitoring schedule, responsible agency for monitoring and monitoring indicators on physical, biological, socio-economic and cultural environment has been prepared in the proposed EMP.

### **12. Cost for Implementing Environmental Management Plan**

The social enhancement cost of the project is NRs. 66,80,000.00. Similarly, the compensation cost of the project is NRs. 5,27,27,950.00 while mitigation measures cost is NRs. 13,08,74,295.00 and Environment Monitoring cost is NRs. 1,87,45,000.00. As per Environment Protection Act, 2076, (Section 12, sub-sub-section-1), Ministry of Forests and Environment will audit the proposed Mugling-Abukhaireni Road Section within six months, after 2 years completion of project implementation. Similarly, the cost of environmental auditing is estimated as NRs. 25,11,575.00. Therefore, the total Environment Management Cost of the Project is found to be NRs. **21,15,38,820.00**.

### **13. Conclusion**

The EIA for Upgrading/New Construction of Mugling-Abukhaireni (9.384 km) road project reveals that benefits from the implementation of the proposed road project provides employment opportunities for about 360,000 person days for unskilled manpower and 108,000 person days for skilled manpower for 30 months. Other major benefits of the project are enhancement of skills with trainings such as bioengineering, mason, tailoring and carpentry with higher priority to the project affected people. The project will contribute in economic opportunities of local people from enterprises development like food, tea shop, groceries, lodges and restaurant and social development such as education, health, communication, market and banking services and The major benefit of the construction of the project is facility of all weathered transportation facility to the local people.

The construction of the road project needs to acquire 13.365 ha of the land within RoW. Out of that, government land 9.525 ha under MoFE and private land 3.840 ha will be permanently transformed in road area. And 5 ha of government land will be used temporarily for quarry and borrow site, whereas 13 ha of private land will be used for temporary purposes. The construction of the road will disturb 153 electrical poles/Telephone poles and 5 no. of transformer. The construction of the road causes instability of the slope at Ch.1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS) and which can be mitigated and avoided applying bioengineering methods like construction of the check dams, retaining walls and gabion walls.

Similarly, the biological impact cause by the construction of the road includes direct loss of 9.525 ha of the forest area within RoW and loss of 2000 no. of tress.

The majority of trees to be cut down are Sal (*Shorea robusta*), Aap (*Magnifera indica*), Kavro (*Ficus lacor*), Karan (*Adina cordifolia*), Padke (*Albizia odoratissima*), Simal (*Bombax ceiba*), Khirro (*Sapium insigne*), Siris (*Albizia spp.*), Sisoo (*Dalbergia sisoo*), Bakaino (*Melia azedarach*) and Khayer (*Acacia catechu*). Other biological impacts during operation phase include depletion of forest resources, disturbance to wildlife habitat, impact on aquatic biodiversity due to erosion from poorly constructed, rehabilitated sites and disposal of waste on water bodies.

The socio-economic impact includes 75 residential structures, 58 residential and commercial, 78 commercial, 11 shed and 5 private toilets (Private Structures) and 2 resting place, 2 police building and post, 4 temples, 1 aama samuha structure, 1 canteen and 1 public toilet (Community Structures). Among, 227 private structures, 119 are fully affected structures and 108 are partially affected structures. The proposed Upgrading/New Construction of the project requires acquisition of 2.25 ha of the agricultural land causing loss of top soil. The other major effects are health hazards such as eye related disease, skin related disease and respiration related diseases during rock cutting, slope cutting, handling of the hazardous material, machinery movements, bitumen works, tree felling, soil erosion etc. The proposed Upgrading/New Construction of the road project will cause loss of 4 small/medium size temple at above mentioned chainage along road alignment.

The mitigation measures for the above adverse impact have been proposed to reduce and avoid the impacts. Some of the mitigation measures are compensation for the acquisition of private land as per Land Acquisition Act, 2034 and compensation of the private structures as per Compensation Committee and as per the prevailing law, relocation of the affected public utilities and structures. Soil erosion along the road can be mitigated by using bioengineering methods like construction of the check dams, retaining walls and gabion walls in above mentioned unstable slope. Similarly, the government land required for the construction of the road will be compensated as per Forest Regulation 2079 and will plant 1600 no. of plant species per hectare as per Forest Act 2076. The compensation of the 2000 no. of trees will be done by planting 20,000 no. of the trees in the ratio of 1: 10 in the ROW of the road with taking care for atleast 5 years as per Forest Act, Rule 42. Compensation of 227 private structures, 11 community structures and 3.840 ha of private land according to the resettlement plan of Mugling-Abukhaireni road project, decision from compensation Committee and as per ongoing rule. And relocation of 4 temples in suitable places and as per land provided by local people. Monitoring of adverse impacts and evaluation of effectiveness of its mitigation measures will be done. The total Environment Management Cost of the Project is found to be NRs. **21,15,38,820.00.**

From the above project, beneficial impacts are more significant and long term in nature against the adverse impacts most of which could be mitigated or avoided. The adverse environmental impact identified from the project is localities within the project area and within the construction phase. The construction of the road can be carried out after assuring the entire Environmental Management plan to decrease the adverse impacts on physical, biological and social environment. As well as, the new construction and upgrading of the road will be done according to the proposed Environmental Management Plan; hence this proposed project is appropriate for implementation.

## कार्यकारी सारांश

### १) प्रस्तावक

प्रस्तावित मुग्लिङ्ग - आँबुखैरेनी (९.३८४) कि.मि. लम्बाई सडक खण्ड स्तरोन्नति (४.९२८) कि.मि. तथा नयाँ निर्माण कार्य (४.४५६) की.मी. को प्रस्तावक सडक विभाग, आयोजना निर्देशनालय (ए.डी.वी), विशाल नगर, काठमाडौं, नेपाल रहेको छ। यो आयोजना नेपालको चितवन जिल्ला (बागमती प्रदेश), गोरखा र तनहू जिल्ला (गण्डकी प्रदेश) मा पर्दछ। मिति २०७८।०८।२४ गतेका दिन, वन तथा वातावरण मन्त्रालयबाट, प्रस्तावित मुग्लिङ्ग - आँबुखैरेनी (९.३८४) कि.मि. लम्बाई सडक खण्डको क्षेत्र निर्धारण प्रतिवेदन र कार्यसूची प्रतिवेदन पारित भएको हो।

यस सडकको प्रस्तावकले (के.ई.सि.सि.) र स्वाइल टेस्टलाई यस सडकको वातावरण प्रभाव मूल्याङ्कनको जिम्मेवारी दिएको हो।

### २) आयोजना विवरण

प्रस्तावित मुग्लिङ्ग - आँबुखैरेनी (९.३८४ कि.मि. लम्बाई) सडक खण्डको स्तरोन्नति तथा नयाँ निर्माण कार्य मुग्लिङ्ग-नारायणघाट चोक (चे. ००+०००) को करीब ९३६ मी. पूर्व नेपालको बागमती प्रदेशको चितवन जिल्ला, इच्छाकामना गाँउपालिका, वडा नं. ५, बाट सुरु भई आँबुखैरेनी (चे. ०९+३८४), वडा नं. ३ को तनहू जिल्ला, गण्डकी प्रदेशमा गई समाप्त हुन्छ।

अवस्थित सडक खण्डको स्तरोन्नतिको सुरुवात चे. ००+००० देखि चे. ००+१८० सम्म (एक तर्फि, एक लेन), चे. ००+१८० देखि चे. ० +३५० सम्म (एक तर्फि, दुइ लेन), चे. ०५+०८० देखि चे. ०८+१०० सम्म (दुइ तर्फि, चार लेन सम्म) र चे. ०८+१०० देखि चे. ०९+३८४ सम्म (दुइ तर्फि, चार लेन र सेवा लेन सम्म) हुनेछ।

त्यसैगरी, सडकको नयाँ निर्माण संरक्षण कार्य चे. ००+४७० बाट सुरु भई चे. ०४+९२६ (एकतर्फि बाटो, दुई लेन) सम्ममा टुङ्गिन्छ। यसबाहेक, आयोजनाले दुई पुलको निर्माण गर्ने सम्झौता गरे अनुसार, जसमध्ये १२० मि. लम्बाइको त्रिशुली पुल चे. ००+३५० देखि चे. ००+४७० सम्म र १२५ मि. लम्बाइको मर्स्याडदी पुल चे. ०४+९२६ देखि चे. ०५+०५९ सम्म १२.९६ मि. चौडाइ रहेको कुरा पनि प्रतिवेदनमा उल्लेखित गरिएको छ।

प्रस्तावित सडक खण्डको स्तरोन्नति तथा नयाँ निर्माण कार्यको आयोजनाले इच्छाकामना गाँउपालिका वडा नं. ५, शहिद लखन गाँउपालिका वडा नं. ३ र आँबुखैरेनी गाँउपालिका वडा नं. २, ३ र ४ मा प्रभाव पार्नेछ। उक्त प्रस्तावित सडक विभिन्न गाउँ जस्तै भुवनीटार, नयाँ वस्ती, करनटार, खानतोक टोल, सुन्दरीवस्ती टोल, र सीद्धीगणेश टोल तथा पाँच वटा सामूदायिक वन त्रिवेणी धार्मिक सा.व.(चे. ०+९०० देखि १+५००), सल्लेरी सा.व.(चे. ४+२०० देखि ४+९००), बाङ्गे सा.व.( चे. ५+००० देखि ६+४०५), कुकुर गडे सा.व.(चे. ६+४०५ देखि ७+७८०) र चिसापानी सा.व.(चे. ८+०५० देखि ८+२००) हुदै जान्छ। यस आयोजनाको कूल लागत रु ३,९७४,७२९,०२४.९७ (भ्याट सहित) रहेको छ।

### ३) आयोजनाको सन्दर्भिकता

सन् २०१८ मा मुग्लिङ्ग - आँबुखैरेनी सडक खण्डको औसत वार्षिक दैनिक यातायात प्रति दिन ५,२९७ सवारी साधन रहेको छ भने सन् २०४२ सम्ममा प्रति दिन १८,०९५ सवारी साधन हुन सक्ने अनुमान गरिएको छ। हाल मुग्लिङ्ग - आँबुखैरेनी सडक खण्डको औसत चौडाई ६.७ मि. रहेको जुन साधुरो छ र निकट भविष्यमा पृथ्वी राजमार्गमा सवारी साधन चलाउन पर्याप्त नहुन सक्छ। प्रस्तावित स्तरोन्नति तथा नयाँ निर्माण सडक परियोजना, ४.४५६ कि.मि. सडकको नयाँ निर्माण र हालको ४.९२८ कि.मि. सडकको स्तरोन्नतिले; प्रस्तावित परियोजना निकट भविष्यमा ट्राफिक प्रवाहलाई सहज बनाउन मद्दत गर्नेछ।

पृथ्वी राजमार्गमा रहेको मर्स्याङ्दी जलविद्युत आयोजनाको कम्पोनेन्टका कारण र अस्तव्यस्त पहाडी भिरालो जमिनका कारण, गोरखा जिल्लाको नयाँ सडक संरक्षण निर्माणले मर्स्याङ्दी जलविद्युत आयोजनाको कुनै पनि भागमा बाधा नपर्ने गरि सवारी आवगमन नियन्त्रण गर्न मद्दत पुग्नेछ। साथै गोरखा जिल्लाको कुनै पनि कार्यमा प्रयोग नभएको जमिनमा ४.४५६ कि. मि. नयाँ सडक निर्माणको प्रस्ताव पनि आयोजनाले गरेको छ, यसले ग्रामिण बस्तीको करणटार गाउँ क्षेत्रलाई शहर विकास क्षेत्रमा परिणत गर्न मद्दत गर्छ र यातायात सुविधा, स्थानिय बजार, पसल, लघु-उद्दम र गोरखाबासीको आर्थिक विकास जस्ता धेरै फाइदाहरु र अवसरहरु प्रदान गर्दछ। चे. १+०६० मा रहेको त्रिवेनी भगवती मन्दिर आफ्नो धार्मिक मूल्यताका कारण, पिक्निक स्थलका लागि, पार्कका लागि, सहज र सदाबहार यातायात सेवा पाएपछि, स्थानीय पर्यटकलाई आकर्षित बनाई आय आर्जनमा योगदान पुर्याउँछ। त्रिशूली र मर्स्याङ्दी पुल निर्माणले गोरखाबासीलाई मुग्लिन बजार र आँबुखैरेनी बजार सम्म पुग्न र स्थानिय उत्पादनको बजारीकरणमा सहयोग पुग्ने छ। तसर्थ, यो प्रस्तावित परियोजना कार्यान्वयन गर्न धेरै सान्दर्भिक छ।

#### ४) प्रस्तावको औचित्यता

आयोजनाले राष्ट्रिय राजमार्ग श्रेणीको नयाँ सडक खण्ड चे. ००+४७० देखि ०४+९२० सम्म को ४.४५६ कि. मि. निर्माण गर्ने र चे. ००+००० देखि चे. ००+१८० सम्म (एक तर्फि, एक लेन), चे. ००+१८० देखि चे. ०+३५० सम्म (एक तर्फि, दुइ लेन), चे. ०५+०८० देखि चे. ०८+१०० सम्म (दुइ तर्फि, चार लेन सम्म) र चे. ०८+१०० देखि चे. ०९+३८४ सम्म (दुइ तर्फि, चार लेन र सेवा लेन सम्म) स्तरोन्नतिको प्रस्ताव गरेको छ, साथै दुई ठूला पुल चे. ००+३५० देखि ००+४७० सम्म १२० मि. लामो त्रिशूली पुल र चे. ०४+९२६ देखि ०५+०५१ सम्मको १२५ मि. लामो मर्स्याङ्दी पुल निर्माण गर्ने प्रस्ताव गरेको छ।

वातावरण संरक्षण नियमावली, २०७७ को अनुसूचि ३ (दफा क, वन क्षेत्र नं. ५) अनुसार सडक निर्माणका लागि सडकको RoW सम्म करिब ९.५२५ हेक्टर वन क्षेत्र आवश्यक पर्ने भएकाले यस परियोजनालाई EIA आवश्यक छ। तसर्थ, यस कानुनी औचित्यका कारण, यस प्रस्तावलाई वातावरणीय प्रभाव मूल्याङ्कन अनिवार्य छ।

साथै, वातावरण संरक्षण नियमावली २०७७, नियम ७ (द) अनुसार वातावरणीय प्रभाव मूल्याङ्कन र यससंग सम्बन्धित कागजातहरु अग्रेजीमा तयार गरिएका छन् किनभने यो परियोजना अन्तर्राष्ट्रिय कोष संगठन – ADB (ADB Loan No. 3012- NEP) द्वारा लगानी गरिएको हो।

#### ५) उद्देश्य

वातावरणीय प्रभाव मूल्याङ्कनको मुख्य उद्देश्य प्रस्तावित आयोजनाको कार्यान्वयनबाट आयोजना क्षेत्रको भौतिक, रासायनिक, जैविक, आर्थिक, सांस्कृतिक रूपले वातावरणमा पर्न सक्ने सकारात्मक तथा नकारात्मक प्रभावहरुको अध्ययन गरी सकारात्मक प्रभावको बढोत्तरी तथा नकारात्मक प्रभावको न्यूनीकरण गर्नु हो।

#### ६) अध्ययन विधि

यो अध्ययन प्रतिवेदन वातावरण संरक्षण नियमावली २०७७ नियम ७ र प्रस्तावको कार्यसूची (परिशिष्ट १) मा वर्णन गरिएको विधि अनुसार तयार गरिएको हो। सडकको वातावरणीय प्रभाव मूल्याङ्कनको स्वीकृत क्षेत्र निर्धारण र कार्यसूची मिति २०७८।०८।२४ गतेको माननीय मन्त्री स्तरको निर्णयबाट वन तथा वातावरण मन्त्रालयले स्वीकृत गरेको हो।

यस अध्ययनका लागि सान्दर्भिक साहित्य सामग्रीहरुको पुनरावलोकन तथा आयोजना प्रभावित क्षेत्र निर्धारण गर्ने काम गरियो। अध्ययन टोलीद्वारा सामूहिक रूपमा भौतिक, जैविक, सामाजिक, आर्थिक र सांस्कृतिक वातावरण सम्बन्धी सूचना संकलन गर्न सन् २०१५ डिसेम्बर मा प्रारम्भिक स्थलगत सर्वेक्षण गरियो र सन् २०१६ डिसेम्बर मा सम्भावित वातावरणीय प्रभाव र प्रासंगिक मुद्दाहरु पहिचान गर्न प्रारम्भिक स्थलगत सर्वेक्षण गरियो। पुनः

अध्ययन टोलीले सन् २०२२ फेब्रुअरी मा अध्ययन क्षेत्रको सबै आधारभूत सत्यको लागि स्थलगत भ्रमण गरियो । भौतिक वातावरणमा तथ्याङ्क संकलन गर्नका लागि, वातावरणीय प्रभाव मूल्याङ्कनको अध्ययन टोलीले प्रत्यक्ष अवलोकन, क्षेत्र अनुसन्धान, प्रयोगशाला विश्लेषण र स्थलाकृतिक नक्शा र गुगल अर्थ छविमा अध्ययन गरे । त्यसैगरी, जैविक वातावरण सम्बन्धी तथ्याङ्क क्षेत्र अवलोकन, १० प्रमुख सूचनादाता अन्तर्वार्ता (KII), DFO सरोकारवालाहरुसँगको परामर्श र वन्यजन्तुसँग सम्बन्धित प्रतिवेदन र अनुसन्धानहरु, वातावरणीय प्रभाव मूल्याङ्कनको रिपोर्टहरु, वन नक्शाहरु, वन तथा वातावरण मन्त्रालय, वन विभाग र राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभागको वेबसाइटहरुबाट संकलन गरिएको थियो । यससँगै सामाजिक, आर्थिक तथा सांस्कृतिक वातावरण सम्बन्धि तथ्याङ्कहरु प्रभावित वडा तथा नगरपालिका कार्यालयबाट संकलन गरिएको सर्वेक्षण, ६४ घरपरिवार सर्वेक्षण, १० वटा प्रमुख सूचनादाता अन्तर्वार्ता (KII) र माध्यमिक प्रतिवेदनको समिक्षा गरि संकलन गरिएको थियो । वातावरण संरक्षण नियमावली २०७७, नियम ६ अनुसार, मिति २०७८ साल फाल्गुन १२ मा स्थानिय दैनिक पत्रिका “चितवन पोस्ट” मा सार्वजनिक सुनुवाइको सूचना प्रकाशित भएको थियो ; सोहि अनुसार आँबुखैरेनी गाउँपालिका हलमा मिति २०७८ साल फाल्गुन १४ मा र शहिद लखन गाउँपालिका, वडा नं. ३ को प्राङ्गणमा मिति २०७८ साल फाल्गुन १४ मा सम्बन्धित सरोकारवाला र स्थानिय जनताको सुभावा संकलन गरियो । त्यस पश्चात्, प्राथमिक र माध्यमिक जानकारीको आधारमा प्रभाव विश्लेषण गरियो र उपयुक्त न्यूनीकरण उपायहरु प्रस्ताव गरियो र वातावरण व्यवस्थापन योजना तयार गरियो । अन्ततः प्रतिवेदनलाई अन्तिम रूप दिइयो ।

## ७) विध्यमान वातावरणीय अवस्था

### भौतिक वातावरण

प्रस्तावित आयोजना क्षेत्रको सुरुको विन्दुको कोओर्डिनेट  $२७^{\circ} ५१' ३०.९४''$  उत्तरी आक्षांश,  $८४^{\circ} ३४' ८.१०''$  पूर्वी दिशान्तर र अन्तिम विन्दुको कोओर्डिनेट  $२७^{\circ} ५४' ३४.७२४''$  उत्तरी आक्षांश र  $८४^{\circ} ३१' ४८.७८८''$  पूर्वी दिशान्तर रहेको छ । प्रस्तावित क्षेत्र समुद्री सतहबाट न्यूनतम (२७१.८०० मि र उच्चतम ३२२.४०३ मि. उचाईमा रहेको छ । प्रस्तावित सडक सरैखण नुवाकोट कम्प्लेक्सको कम हिमालयन चट्टान (कुन्चा संरचना) हुँदै जान्छ । परियोजना क्षेत्रमा मुख्यतया नीलो खैरो फिलाइट र सेतो-मोटो दाना क्वार्टजाइटको चट्टानले ढाकिएको छ, फ्यागफोग क्वार्टजाइटमा सेतो-मोटो दाने क्वार्टजाइट हुन्छ । यस क्षेत्रमा उष्ण हावापानी पाइन्छ । चितवन जिल्लाको वार्षिक औषत वर्षा २१४५ मिलिमिटर, गोरखा जिल्लाको २९१३ मिलिमिटर र तनहुँ जिल्लाको २०५८ मिलिमिटर रहेका छ । जबकि जल तथा मौसम विज्ञान विभाग अनुसार चितवन जिल्लाको औसत अधिकतम तापक्रम ३६ डिग्री सेल्सियस र न्यूनतम तापक्रम ५ डिग्री सेल्सियस, गोरखा जिल्लाको अधिकतम तापक्रम २० डिग्री सेल्सियस र न्यूनतम तापक्रम ७ डिग्री सेल्सियस र तनहुँ जिल्लाको अधिकतम तापक्रम ३२ डिग्री सेल्सियस र न्यूनतम तापक्रम २० डिग्री सेल्सियस रहेको छ । उक्त सडकले त्रिशुली नदी (चे. ०० + ४१० मि) र मर्स्याडदी नदी (चे. ०४ + ९८० मि.) पार गर्दछ । स्थलाकृतिक रूपमा, परियोजना क्षेत्र धेरै पहाडी ढलान टेरेसहरु मिलेर मध्यम देखि ठाडो चट्टानी खण्ड बाट गुज्रन्छ । पहाडी ढलानको सन्दर्भमा चे. ०० + ००० देखि ० + १६० किलोमिटर सम्मको सडकको पंक्तिबद्धता स्थिर छ । जबकि चे. ६ + २४० देखि ७ + ७१० सम्मको ढलान स्थायित्व जोर्नीहरु र जोर्नीहरु बीचको फिलाइटको विभाजनका कारण कमजोर हुन्छ । भिरालो जमिनमो अस्थिरता १ + ३६० (दायाँ साइड), १ + १७५ (दायाँ साइड), १ + ३२५ (दायाँ साइड), ६ + ०२५ (बायाँ साइड), ६ + १०० (बायाँ साइड), ६ + ८०० (बायाँ साइड) र ६ + ९२५ (बायाँ साइड) मा देखियो । प्रस्तावित सडकको क्षेत्राधिकार (३० मिटर) को अधिकांश पंक्तिबद्धता वन जग्गा ( ९.५२५ हे.) मा जान्छ । यससँगै २.२५ हे. कृषि जमिन र ०.३६ हे. मा जान्छ ।

## जैविक वातावरण

प्रस्तावित सडक निर्माणको लागि कुल ९.५२५ हे. वन क्षेत्र आवश्यक पर्दछ। उक्त सडक त्रिवेणी धार्मिक सा.व. (चे. ० + ९०० देखि १ + ५००), सल्लेरी सा.व. (चे. ४ + २०० देखि ४ + ९००), बाङ्गे सा. व. (चे. ५ + ००० देखि ६ + ४०५), कुकुर गडे सा.व. (चे. ६ + ४०५ देखि ७ + ७८०), र चिसापानी सा.व. (चे. ८ + ०५० देखि ८ + २००) हुँदै जान्छ। यस आयोजना क्षेत्रमा पाईने मुख्य रुखहरूका प्रजाति साल (*Shorea robusta*), साँज (*Terminalia elliptica*), जामून (*Syzygium cumini*), सिमल (*Bombax ceiba*), आँप (*Magnifera indica*), खयर (*Acacia catechu*), सिरिस (*Albizia lebbeck*), सिसौ (*Dalbergia sisoo*), वनमारा (*Eupatorium adenophorum*), कुसुम (*Schleichera oleosa*), कर्मा (*Haldina cordifolia*), कदम (*Anthocephalus chinesis*), पिपल (*Ficus religiosa*), भलायो (*Semecarpus anacardium*), अमला (*Phyllanthus emblica*), भेलर (*Trewia nudiflora*), बकाईनो (*Melia azedarach*), काब्रो (*Ficus lacor*) र करण (*Adina cordifolia*) आदि हुन्। यस आयोजना क्षेत्रमा पाईने गैर-टिम्बर वन उत्पादनहरू (NTFPs) बेल (*Aegle Marmelos*), बाँस (*Arundinaria bamboos*), बाँस (*Terminalia Chebula*), हरो (*Terminalia belerica*), बरो (*Terminalia belerica*), बयर (*Ziziphus mauritiana*), अमला (*Phyllanthus emblica*), कुरिलो (*Asparagus racemosus*), तितेपाती (*Artemisia dubia*), गुर्जो (*Tinospora cordifolia*), नीम (*Azadirachta indica*), राजवृक्ष (*Cassia fistula*), घिउकुमारी (*Aloe vera*) र तेजपात (*Cinnamomum tamala*) आदि हुन्।

आयोजना क्षेत्रमा रिपोर्ट गरिएका सामान्य स्तनधारी जनावरहरूमा चितुवा (*Felis bengalensis*), जंगली बिरालो (*Felis chaus*), ब्वाँसो (*Canis aureus*), बाँदर (*Macaca assamensis*), लंगुर बाँदर (*Presbytis entellus*), लोखर्के (*Funambulus pennati*), स्याल (*Vulpes bengalensis*), हरे (*Lupus migricollis*), पोक्कुर्युपिन (*Hystrix hodgsoni*) आदि हुन्।

त्यसैगरी आयोजना क्षेत्रमा रिपोर्ट गरिएका प्रमुख चराहरूमा भँगेरा (*Passer domesticus*), उल्लु (*Tyto alba*), काग (*Corous macrorhynches*), कालीज (*Lophura leucomelanos*), कोयल (*Eudynamus scolopacea*), जंगली लुईचे (*Gallus gallus*), सानो तामे दुकुर (*Streptopelia tranquebarica*), पहाडी तितर (*Arborophila hyperythra*) र जंगली मैना आदि हुन्।

आयोजना क्षेत्रमा पाईने सरीसृप र उभयचरहरूको साझा प्रजातिहरू समन्दर (*Ambystoma spp.*), भ्यागुता (*Rana tigrina*), बेंगाल मोनिटर छेपारो (*Varanus bengalensis*), कमन क्रेट (*Bungarus caeruleus*), कोब्रा (*Naja naja*) र हरियो रुख सर्प (*Hariyo Sarpa*) आदि हुन्।

त्रिशुली र मस्याङ्दी नदीमा पाईने जलीय जनावरहरूमा असला (*Schizothorax propastus*), राज बाम (*Anguilla bengalensis*), बुहारी (*Wallagoatiao*), रिभर स्टोन कार्प (*Psilorhynchida esucatio*), सहर (*Tor tor*) र स्टोन कार्प (*Psilorhynchus pseudecheneis*) आदि हुन्।

## सामाजिक-आर्थिक वातावरण

प्रस्तावित आयोजना क्षेत्र इच्छाकामना गाँउपालिका, वडा नं. ५ चितवन जिल्ला, शहिद लखन गाँउपालिका वडा नं. ३ गोरखा जिल्ला र आँबुखैरेनी गाँउपालिका, वडा नं. २, ३ र ४ तनहुँ जिल्लामा पर्दछ। वडा कार्यालय सर्वेक्षण, २०२२ अनुसार प्रस्तावित आयोजनाले प्रभाव पार्ने गाँउपालिको कुल जनसंख्या : इच्छाकामना गाँउपालिका वडा नं ५ मा ४९८०, शहिद लखन गाँउपालिका वडा नं ३ मा ३५२९ र आँबुखैरेनी गाँउपालिका वडा नं. २ मा ४९९५, आँबुखैरेनी गाँउपालिका वडा नं. ३ मा ८७६४ र आँबुखैरेनी गाँउपालिका वडा नं. ४ मा २३५६ रहेका छन्। साथै प्रभावित गाँउपालिको कुल घरधूरी इच्छाकामना गाँउपालिका वडा नं ५ मा ८५६, शहिद लखन गाँउपालिका वडा नं. ३ मा ६५२ र आँबुखैरेनी गाँउपालिका वडा नं. २ मा ८५८, आँबुखैरेनी गाँउपालिका वडा नं. ३ मा ९६९२ र आँबुखैरेनी गाँउपालिका वडा नं. ४ मा ४३४ रहेको छ। आयोजना क्षेत्रमा ब्राह्मण (३९.९%), जनजाती (

५४.६%), क्षेत्री, गुरुड, मगर, नेवार र दलित जातीहरुको बाहुल्यता रहेको पाईन्छ। आयोजना क्षेत्रका अधिकांश मानिसहरु हिन्दु धर्मावलम्बी रहेका छन्।

सामाजिक - आर्थिक सर्वेक्षणले ५२ संख्यामा जोखिममा रहेको देखाएको छ। ती मध्य ४०.३८ % गरिबीको स्तर मुनि, २६.९३ % आदिवासी र १५.३८ % महिला प्रधान घर रहेका छन्। आयोजना क्षेत्रमा कुल जनसंख्याको ७८.२ % भन्दा बढी साक्षर छन् र एस.एल.सी डिग्री लिएका मानिसहरु छन्। प्रस्तावित सडक पंक्तिबद्धताका नजिकका विद्यालयहरु करन्तर नमुना प्राथमिक विद्यालय र एक्टिभ ग्रीनल्याण्ड एच. एस. विद्यालय हुन्। आयोजना क्षेत्रमा दश वर्षको अन्तरालमा कूल ६०.९३ % जनसंख्या बसाइँ सरेका छन् जसमा ५३.८ % रोजगारीका कारण र ३५.९ % आयोजना क्षेत्रका मानिसहरु व्यापार तथा व्यवसायका कारण बसाइँ सरेका छन्। अधिकांश जनसंख्या (५५.०३ %) १६-४५ वर्षको उमेर समूहका छन्। जनताको आयको मुख्य स्रोत व्यवसाय (६९.८ %), वैदेशिक रोजगारी (१३.९ %), सेवा (१४.६ %) र पशुपालन (१२.९ %) मा निर्भर छ। सर्वेक्षणले ४२.९८ % घरपरिवारसँग पाखो बारी (सिँचाइ नहुने) जग्गा, १८.७५ % घरपरिवारसँग खेत (सिंचित जमिन) र ७.८९ % घरपरिवारसँग खरबारी (ढिलो जमिन) रहेको देखाएको छ। आयोजना क्षेत्रमा खानेपानीको प्रमुख स्रोत पाइपबाट हुने पानी (९६.८७ %) रहेको पाइएको छ। करिब ६२.५ % जनताले पिउने पानी शुद्धीकरणका लागि उमालेर र फिल्टर प्रयोग गर्छन् भने १२.५ % जनताले पिउने पानी शुद्धीकरणका लागि उमालेको प्रयोग गर्छन्। आयोजना क्षेत्रका अल्पसंख्यक जनताले पानी शुद्धीकरणका लागि पियुष र फिल्टर प्रयोग गर्छन्। लगभग ८७.५० % मानिसहरुले खाना पकाउन एल.पी. ग्याँस प्रयोग गर्छन्, जबकि १२.५० % मानिसहरुले खाना पकाउन दाउरा प्रयोग गर्छन्। आयोजना क्षेत्रका लगभग सबै (९८.४३ %) जनताले बत्ती बाल्ने प्रयोजनका लागि विद्युत प्रयोग गर्छन् भने तृकिमाराका १.५६ % जनताले बत्तीको प्रयोग गर्छन्। आँबुखैरेनीमा एक निजी अस्पताल र मुग्लिङ्ग बजार र आँबुखैरेनीमा २ वटा स्वास्थ्य चौकी छन्। ४२.९९ % जनतासँग सेप्टिक ट्याङ्कीमा फ्लस सिस्टम जडान भएको शौचालयको सुविधा छ भने ३९.२ % जनतासँग दुइ खाल्डे चर्पी छन्। सर्वेक्षणले भण्डै ४२.९८ % ले फोहोर नजिकैको मर्स्याङ्दी नदी र सडक छेउमा विसर्जन गरेको देखाएको छ। जबकि १२.५० % ले उत्पादन भएको फोहोर खेतीयोग्य जमिन, खाडलमा फ्याँक्ने र कम्पोस्टिङको लागि प्रयोग गरियो। आयोजना प्रभावित क्षेत्रमा ५ वटा मन्दिर रहेको छ। आयोजना क्षेत्रका बासिन्दाले दशैं, तिहार, जनैपूर्णिमा, माघे संक्रान्ति, ल्होसार, बुद्ध जयन्ती लगायतका सांस्कृतिक कार्यक्रम गर्ने गर्दछन्।

#### ८) आयोजना कार्यान्वयनबाट पर्ने सकारात्मक प्रभावहरु

आयोजनाले अदक्ष जनशक्तिका लागि करिब ३ लाख ६० हजार व्यक्ति (प्रतिदिन ५०० व्यक्ति) र दक्ष कामदारका लागि १ लाख ८ हजार व्यक्ति (प्रतिदिन १५० व्यक्ति) ३० महिनासम्म रोजगारी सिर्जना गर्नेछ। आयोजनाको अन्य फाइदा भनेको आयोजनाबाट प्रभावित स्थानीय बासिन्दालाई आयोजना निर्माणमा पहिलो प्राथमिकतामा राखेर उनीहरुको सीप विकास हुनेछ। आयोजना निर्माणले स्थानीय बासिन्दालाई सबै मौसमी यातायात सुविधा उपलब्ध गराउनेछ। यस आयोजनाले ग्रामिण बस्तीको करणटार गाउँ क्षेत्रलाई सुविधाजनक शहर विकास क्षेत्रमा परिणत गर्न मद्दत गर्छ साथै यातायात सुविधा, स्थानिय बजार, पसल, लघु-उद्दम, कृषि व्यापारमा दक्षता र गोरखावासीको आर्थिक विकास जस्ता धेरै फाइदाहरु र अवसरहरु प्रदान गर्दछ। चे. १+०६० मा रहेको त्रिवेनी भगवती मन्दिर आफ्नो धार्मिक मूल्यताका कारण, पिक्निक स्थलका लागि, पार्कका लागि, सहज र सदाबहार यातायात सेवा पाएपछि, स्थानीय पर्यटकलाई आकर्षित बनाई आय आर्जनमा योगदान पुर्याउँछ।

आयोजनाले अप्रत्यक्ष रूपमा खाना र चिया पसल, किराना सामान, लज र रेस्टुरेन्ट जस्ता उद्दम विकासमा योगदान गर्नेछ। यसले आयोजनाका जनताको गरिबी निवारणमा अप्रत्यक्ष रूपमा मद्दत गर्नेछ। व्यापार, व्यवसाय र भरपर्दो यातायात सुविधामा वृद्धि हुनुका कारण सडक आयोजनाको स्तरोन्नतिको मुख्य लाभ भनेको आयोजना क्षेत्रको विकास हो।

## ९) आयोजना कार्यान्वयनबाट पर्न सक्ने नकारात्मक प्रभावहरू

### (क) भौतिक वातावरण

प्रस्तावित सडक निर्माणले आयोजना क्षेत्रको भू-उपयोगमा परिवर्तन आउनेछ। प्रस्तावित सडक निर्माणका लागि RoW भित्र १३.३६५ हे. जग्गा अधिग्रहण गर्नुपर्नेछ। त्यसमध्ये सरकारी वन क्षेत्र ९.५२५ हे. र निजी ३.८४० हे. सडक क्षेत्रमा स्थायी रूपमा परिवर्तन हुनेछ। सरकारी जग्गाको ५ हे. जग्गा उत्खनन तथा ऋण स्थलका लागि अस्थायी रूपमा प्रयोग गरिनेछ भने १३ हे. निजी जग्गा श्रम शिविर, भण्डारण, स्पोइल डिस्पोजल साइट, क्रसर प्लान्ट र कंक्रीट ब्याचिङ प्लान्टका लागि प्रयोग गरिनेछ। सडक निर्माणले १ सय ५३ बिजुलीको पोल /टेलिफोन पोल र ५ वटा ट्रान्सफर्मरमा बाधा पुग्ने छ। त्यसैगरी सडक निर्माण गर्दा चे. १ + ३६० (दायाँ साइड), १ + १७५ (दायाँ साइड), १ + ३२५ (दायाँ साइड), ६ + ०२५ (बायाँ साइड), ६ + १०० (बायाँ साइड), ६ + ८०० (बायाँ साइड) र ६ + ९२५ (बायाँ साइड) मा अस्थिर ढलानमा पहिरो र माटो क्षरण हुन सक्छ। विभिन्न चेनेजमा रहेको श्रम शिविरबाट निस्कने फोहोरले त्रिशूली र मर्स्याङ्दी नदीको हावा र पानीलाई प्रदूषित बनाउने छ। आयोजनामा कृषि योग्य जग्गा अधिग्रहण गर्दा माथिल्लो माटोको क्षय र कृषि उत्पादकत्वमा ह्रास आउन सक्छ। ठूला पुलहरूको निर्माणले सतहको पानीको जल विज्ञानमा असर पार्न सक्छ, पानीको स्वतन्त्र प्रवाहमा अवरोध सिर्जना गर्न सक्छ। निर्माणका सवारी साधन चलाउँदा, मेसिनरी संचालन गर्दा उड्ने धुलोले वायु प्रदूषण निम्त्याउँछ। निर्माण गतिविधिहरू जस्तै उत्खनन, ब्लास्टिङ, भारी सवारी साधन र निर्माण उपकरणहरू ध्वनि प्रदूषण निम्त्याउँछ। उत्खननका कारण निर्माणको फोहोर र माटोको विसर्जन, क्षरण र माटोको आवतजावत, श्रमिकहरूको अनुचित सरसफाइ, श्रम शिविरको फोहोर पानीको विसर्जन, अनाधिकृत रूपमा सवारी साधन धुने, अनाधिकृत रूपमा फोहोर फाल्ने ठाउँ, तेल बोक्ने ट्याङ्करको दुर्घटनाले जल प्रदूषण निम्त्याउँछ। सडक संचालनका क्रममा सडक दुर्घटना र सडक सीमा अतिक्रमण विभिन्न चेनेजमा देखिने गरेको छ।

### (ख) रासायनिक वातावरण

सडक निर्माणको क्रममा रासायनिक सामग्रीहरू जस्तै अलकत्रा, ग्रीज, तेलको अव्यवस्थित ढंगले प्रयोगका कारण जमिनमा ह्रास आउने हुनाले कृषि उत्पादनमा नोक्सानीका साथै त्रिशूली र मर्स्याङ्दी नदीका विभिन्न चेनेजमा जल प्रदूषण हुनुका साथै कामदारहरूको स्वास्थ्यमा प्रतिकूल प्रभाव पर्ने गरेको छ।

### (ग) जैविक वातावरण

यस आयोजनाको कार्यान्वयनले RoW भित्रको ९.५२५ हे. वन क्षेत्रको प्रत्यक्ष नोक्सान हुनेछ। काटिने रुखहरूको संख्या २००० रहेको छ। काटनुपर्ने अधिकांश रुखहरू साल (*Shorea robusta*), आँप (*Magnifera indica*), काभ्रो (*Ficus lacor*), करण (*Adina cordifolia*), पडके (*Albizia odoratissima*), सिमल (*Bombax ceiba*), खिरो (*Sapium insigne*), शिरिष (*Albizia spp.*), सिसौँ (*Dalbergia sisoo*), बकाइनो (*Melia azedarach*) र खयर (*Acacia catechu*) आदि हुन्। सडक निर्माणले बासस्थान खण्डीकरण गरेर पर्यावरणीय प्रभाव सिर्जना गर्दछ र वन बासस्थानमा वन्यजन्तुहरूको स्वतन्त्र आवतजावतलाई चे. ० + ९०० देखि १ + ५००, चे. ४ + २०० देखि ४ + ९००, चे. ५ + ०० देखि ६ + ४०५, चे. ६ + ४०५ देखि ७ + ७८० र चे. ८ + ०५० देखि ८ + २०० मा असर गर्छ। सडक निर्माणको क्रममा दाउरा, काठ र गैर-काठ वन उत्पादन (NTFPs) को माग बढ्दा स्थानीय वनमा थप दबाव सिर्जना हुन्छ र जंगलमा आगलागी बढ्न सक्छ। संरक्षित प्रजाति साल (*Shorea robusta*), सिमल (*Bombax ceiba*), खैर (*Acacia catechu*) निर्माणको क्रममा ढाल्नु पर्छ। संचालनको चरणमा जैविक प्रभावहरूमा वन स्रोतको ह्रास, माथि उल्लेखित श्रृंखलामा वन्यजन्तुको बासस्थानमा गडबडी र खराब निर्माण, पुनर्स्थापना स्थलहरू र जल निकायहरूमा फोहोरको विसर्जनका कारण जलीय जैविक विविधतामा असर पर्न सक्छ।



**(घ) आर्थिक-सामाजिक तथा सांस्कृतिक वातावरण**

सडकको स्तरोन्नति र नयाँ निर्माणका लागि २२७ वटा निजी र ११ सामुदायिक संरचना अधिग्रहण गर्नुपर्ने हुन्छ । निजी संरचनामा ७५ वटा आवासीय संरचना, ५८ वटा आवासीय र व्यवसायिक संरचना, ७८ व्यवसायिक संरचना, ११ वटा गोठ र ५ वटा निजी शौचालय पर्नेछ । २२७ वटा निजी संरचना मध्य, ११९ वटा संरचनाहरू पूर्ण क्षति हुने र १०८ वटा संरचनाहरूको आंशिक क्षति हुने देखिएको छ । त्यसैगरी सामुदायिक संरचनामा २ वटा विश्रामस्थल, २ प्रहरी भवन तथा चौकी, ४ वटा मन्दिर, १ आमा समूह, १ क्यान्टिन र १ सार्वजनिक शौचालय पर्दछ । यसका साथै सडक आयोजनाको प्रस्तावित स्तरोन्नति / नयाँ निर्माणका लागि २.२५ हे. निजी कृषि जमिन आवश्यक पर्दछ । निर्माण चरणको समयमा, निर्माण दलको आगमनले पानी आपूर्ति, खाद्यान्न यातायात, औषधि र सार्वजनिक संचार जस्ता अवस्थित स्थानीय सेवा सुविधाहरूमा दबाव दिनेछ । ढुङ्गा काट्ने, ढलान काट्ने, हानिकारक पदार्थको ह्यान्डलिङ, मेसिनरी चलाउने, बिटुमिनको काम, रुख काट्ने, माटोको कटान आदि गर्दा सामान्य स्वास्थ्य जोखिमहरू जस्तै आँखा सम्बन्धी रोग, छाला सम्बन्धी रोग र श्वासप्रश्वास सम्बन्धी रोगहरू देखा पर्छन् । अव्यवस्थित निर्माण गतिविधिले चोटपटक, घातक दुर्घटना, मजदुरशरू, सडक र पुल प्रयोगकर्ताहरूमा अपाङ्गता निम्त्याउन सक्छ । सडक आयोजनाको प्रस्तावित स्तरोन्नति / नयाँ निर्माणले चौमासका सडक पंक्तिबद्धताको चे. ० + ०५०, ० + ५०५, ५ + ०८० र ७ + ८५० का ४ वटा साना / मध्यम आकारका मन्दिरहरू गुमाउने छन् ।

**१०) नकारात्मक प्रभाव न्यूनीकरणका उपायहरू**

सडक निर्माणका क्रममा अधिग्रहण गरेको कूल ३.८४० हे. निजी जग्गा भूमि अधिग्रहण ऐन, २०३४ बमोजिम मुआब्जा दिइनेछ । १ सय ५३ बिजुलीका पोल/टेलिफोनका पोल र ५ वटा ट्रान्सफर्मर सार्ने छ । चे. १+३६० (दायाँ पति), चे. १+१७५ (दायाँ पति), चे. १+३२५ (दायाँ पति), चे. ६+०२५ (बायाँ पति), चे. ६+१०० (बायाँ पति), चे. ६+८०० (बायाँ पति) र चे. ६+९२५ (बायाँ पति) मा चेकड्याम, रिटेनिड पर्खाल र ग्याबियन पर्खालहरू जस्ता बायोइन्जिनियरिङ विधिहरू प्रयोग गरेर सडकको माटोको क्षयलाई कम गरिनेछ । निर्माणका फोहरहरू पानीको श्रोत र बस्ती क्षेत्रबाट टाढा चे. २+५००, चे. ६+८००, चे. ५+४००, चे. ५+६५०, चे. ७+४७०, चे. ७+१००, चे. ७+३५० र चे. ७+५५० मा विसर्जन गरिनेछ । निर्माण कार्यको क्रममा उत्खनन गरिएको माथिल्लो माटो सुरक्षित रूपमा भण्डार गरिनेछ र पछि यसलाई पुनर्स्थापित गरिनेछ । पुल निर्माणको क्रममा माछा सिँढीको निर्माणले माछा पलायनमा मद्दत गर्दछ । वायु प्रदुषण हुन नदिन सडक निर्माणको क्रममा दिनमा दुई पटक पानी छर्किने छ । स्थानिय बासिन्दालाई ध्वनी प्रदुषणबाट जोगाउन बस्ती क्षेत्रभन्दा टाढा निर्माण कार्य गरिनेछ र मजदुरको सुरक्षाका लागि कानमा लाउने, माक्स र अन्य सुरक्षा सामग्रीको व्यवस्था गरिनेछ । परियोजना क्षेत्रमा उत्पादन हुने फोहरको असुरक्षित विसर्जन जलस्रोतमा कडाइका साथ निषेध गरिनेछ । सडक अतिक्रमणलाई स्थानीय नगरपालिका अधिकारीबाट कडाइका साथ नियन्त्रण गरिनेछ ।

सडक निर्माणमा प्रयोग हुने रासायनिक पदार्थलाई चुहावट नहुने सुरक्षित स्थानमा राखेर माटो र जलस्रोतलाई जोगाइनेछ ।

सडक निर्माणका लागि आवश्यक पर्ने सरकारी जग्गालाई वन नियमावली २०७९ बमोजिम मुआब्जा दिइनेछ । काटिएका २,००० वटा रुखहरूको क्षतिपूर्तिको लागी वन ऐन, दफा (४२) बमोजिम १:१० अनुपातमा २०,००० वटा बोटबिरुवाहरू सडक क्षेत्रधिकारमा रोपिनेछन् र ५ वर्ष सम्म हेरविचार गरिनेछ । चे. ०+९००- १+५००, चे. ४+२००- ४+९००, चे. ५+०००- ६+४०५, चे. ६+४०५- ७+७८०, चे. ८+०५०- ६+२००, वन्यजन्तु कोरिडोरमा सुस्त गतिको सवारी साधनका लागी साइनबोर्डको प्रावधान गरिनेछ ।

२२७ निजी संरचना, ११ सामुदायिक संरचना र २.२५ हे. कृषि जग्गाको मुआब्जा पुनर्वास योजना, मुआब्जा समितिको निर्णय र चलिरहेको नियम अनुसार उपलब्ध गराइनेछ । सडक निर्माणको क्रममा मजदुरहरूलाई पीपीई उपलब्ध गर्नुका साथै जनचेतना दिईनेछ । सडकका विभिन्न खण्डमा सडक दुर्घटना न्यूनीकरण गर्न सुरक्षाका उपायहरू जस्तै

डेलाइनेटर, गति सीमा साइनबोर्ड र ट्राफिक सिग्नलहरु अवलम्बन गरिनेछ। सडक सञ्चालनका क्रममा सडकको अतिक्रमण नियन्त्रण गर्न सडकको RoW को राम्रो सीमाङ्कन गरिनेछ। स्थानिय जनताले उपलब्ध गराएको जग्गा अनुसार उपयुक्त स्थानमा ४ वटा मन्दिरलाई स्थानान्तरण गरिनेछ।

### ११) वातावरणीय व्यवस्थापन योजना

यस प्रतिवेदनमा वातावरणीय व्यवस्थापन योजना अन्तर्गत आयोजनाबाट पर्ने सम्भावित प्रभावहरुको न्यूनीकरण विधि, अनुगमन विधि र कार्य तालिका प्रस्तावित गरिएको छ। अनुगमनका लागि आवश्यक भौतिक, जैविक, सामाजिक, आर्थिक तथा साँस्कृतिक वातावरणीय सूचकहरु पनि पहिचान गरिएका छन्। यसका साथै न्यूनीकरणको उपायहरु तथा अनुगमन कार्यको कार्यान्वयन गर्ने जिम्मेवार निकायहरुको पनि पहिचान गरिएको छ।

### १२) वातावरणीय व्यवस्थापन योजनाका लागि चाहिने खर्च

परियोजनाको सामाजिक वृद्धिको लागि लागत रु. ६६,८०,०००.०० रहेको छ। त्यसैगरी परियोजनाको क्षतिपूर्तिको लागि लागत रु. ५,२७,२७,९५०.००, नकारात्मक प्रभाव न्यूनीकरणका उपायहरुको लागि लागत रु. १३,०८,७४,२९५.०० र वातावरणीय अनुगमनको लागि लागत रु. १,८७,४५,०००.०० रहेको छ। वातावरण संरक्षण ऐन बमोजिम प्रस्तावित को उपदफा १ को दफा १२, २०७६, आयोजना मुग्लिङ - आँबुखैरेनी (९.३८४ कि.मि. लम्बाई) सडक खण्डको स्तरोन्नति तथा नयाँ निर्माण कार्यको लागि नेपाल सरकार वन तथा वातावरण मन्त्रालयले प्रस्ताव कार्यान्वयन सुरु भएको २ वर्ष भुक्तान भएको मितिले ६ महिना भित्र प्रस्तावित आयोजनाको परिक्षण गर्नेछ। त्यसैगरी वातावरणीय लेखा परीक्षणको लागत रु. २५,११,५७५.०० रहेको छ। तसर्थ, प्रस्तावको कुल वातावरणीय व्यवस्थापन लागत रु. २१,१५,३८,८२०.०० रहेको छ।

### १२) निष्कर्ष

प्रस्तावित वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदनले जनाए अनुसार यो परियोजनाले ३६०,००० अदक्ष जनशक्ति व्यक्ति दिनहरु र १०८,००० दक्ष जनशक्ति व्यक्ति दिनहरु लाई तिस महिनासम्म रोजगार दिने हुनाले यो परियोजना लाभदायक छ। यस बाहेक यस परियोजनाबाट अरु लाभदायक कुराहरु मध्ये परियोजनाबाट प्रभावित व्यक्तिलाई उच्च प्राथमिकता दिएर आर्थिक र सामाजिक विकासमा योगदान दिने कुरा पुष्टाईएको छ जस्तै शिक्षा, स्वास्थ्य, संचार, बजार, बैकिङ् सेवाहरु समेट्ने छन्। यति मात्र नभएर यसले अप्रत्यक्ष रूपमा उद्यम विकास जस्तै खाना चिया पसल किराना लज र रेस्टुरेन्टलाई पनि मध्यन्त पुप्याने छ। यस परियोजना निर्माणको मुख्य लाभ भनेको त्यहाँको स्थानियलाई सबै मौषमी यातयात सुविधा दिनु हो।

सडक परियोजना निर्माणका लागि १३.३६५ हेक्टर जग्गा RoW मा अधिग्रहण गर्नु पर्ने छ। त्यसमध्ये सरकारी जग्गा ९.५२५ हेक्टर र निजी जग्गा ३.८४० हेक्टर स्थायी रूपले सडक क्षेत्रमा परिवर्तन गरिने छ। सरकारी जग्गाको ५ हेक्टर क्वेरी तथा बरो स्थलमा अस्थायी रूपमा प्रयोग गरिने छ भने १३ हेक्टर निजी जग्गा अस्थायी रूपमा प्रयोग गरिने छ। सडक निर्माण कार्यले १५३ वटा विद्युतीय पोल र ५ वटा ट्रान्सफर्मरलाई बाधा पुप्याउने छ। सडक निर्माणले चे. १+३६० (दायाँ पति), चे. १+१७५ (दायाँ पति), चे. १+३२५ (दायाँ पति), चे. ६+०२५ (बायाँ पति), चे. ६+१०० (बायाँ पति), चे. ६+८०० (बायाँ पति) र चे. ६+९२५ (बायाँ पति) वस्तुको ढलानको अस्थिरता र अन्य भौतिक प्रभावहरु निम्त्याउँछ जुन नियन्त्रणका आयहरुद्वारा न्यूनीकरण गर्न सकिन्छ।

त्यसैगरी सडक निर्माण कारण जैविक प्रभावमा ९.५२५ हेक्टर वनक्षेत्रको प्रत्यक्ष नोक्सानी र दुई हजार रूखको प्रत्यक्ष नोक्सानी (RoW) भित्र हुनेछ। साल, आँप काब्रो, करन, पड्के, सिमल, खिररो, शिरीष, सिसौ, बकाइनो र खयर जस्ता रूखहरु अधिकांश रूपमा काट्नु पर्ने देखिन्छन्। संचालनको चरणमा अन्य जैविक प्रभावहरुमा वन स्रोतको कमी, वन्यजन्तुको बासस्थानमा अशान्ति खराब निर्माण पर्नवास र फोहोरको निपटानबाट हुने क्षरणका कारणजलीय जैविक विविधतामा असर पर्न सक्छ। सामाजिक आर्थिक प्रभावमा ७५ वटा आवासीय संरचना, ५८

वटा आवासीय र व्यवसायिक संरचना, ७८ व्यवसायिक संरचना, ११ वटा गोठ र ५ वटा निजी शौचालय पर्नेछ । २२७ वटा निजी संरचना मध्य, ११९ वटा संरचनाहरू पूर्ण क्षति हुने र १०८ वटा संरचनाहरूको आंशिक क्षति हुने देखिएको छ । साथै २ वटा विश्राम स्थल, प्रहरी भवन र चौकी, ४ वटा मन्दिर, १ आमा समुह संरचना, १ क्यान्टिन र १ सार्वजनिक शौचालय रहेका छन् । आयोजनाको प्रस्तावित स्तरोन्नति र नयाँ निर्माणका लागि माथिल्लो माटोको क्षति हुने डर २.२५ हेक्टर कृषि जग्गा अधिग्रहण गर्नु पर्नेछ । अन्य प्रमुख स्वास्थ्यमा पर्ने असरहरू जस्तै आँखा सम्बन्धी रोग, छाला सम्बन्धी रोग, हुँडा कटान र ढलान काट्ने क्रममा खतरनाक वस्तुको हयान्डलिङ मेसिनरी चलाउने, विटुमेनको काम, रूख काट्ने माटो क्षय जस्ता क्रममा श्वास प्रश्वास सम्बन्धी रोगहरू लाग्न सक्ने देखिन्छ । यस बाहेक, सडक परियोजना संचालन चरणको क्रममा सडक संरक्षणमा अवस्थित माथि उल्लेखित चेनेजअनुशार साना आकारका मन्दिरहरू त्यहाँका स्थानियले गुमाउने छन् ।

माथिको परियोजनाबाट, लाभकारी प्रभावहरू अधिक महत्वपूर्ण र दीर्घकालीन प्रकृतिका प्रतिकूल प्रभावहरूको विरुद्धमा छन् । जसलाई न्यूनीकरण गर्न वा हटाउन सकिन्छ । परियोजनाबाट पहिचान गरिएको प्रतिकूल वातावरणीय प्रभाव परियोजना क्षेत्र भित्र र निर्माण चरण भित्रका स्थानीय प्रभावहरू हुन् । उपरोक्त प्रतिकूल प्रभावहरूलाई न्यूनीकरण गर्ने उपायहरू मध्ये भूमि अधिग्रहण ऐन, २०३४ बमोजिमको निजी जग्गा प्राप्तिको मुआब्जा र क्षतिपूर्ति समिति र प्रचलित कानून बमोजिम निजी संरचनाको मुआब्जा, प्रभावित सार्वजनिक सुविधा र संरचनाको स्थानान्तरण समावेश छन् । माथि उल्लेखित अस्थिर ढलानमा चेक ड्र्याम, रिटेनिङ पर्खाल र गेवियन पर्खालहरू जस्ता बायोइन्जिनियरिङ विधिहरू प्रयोग गरेर सडकको माटोको क्षयलाई कम गरिने छ । त्यसैगरी सडक निर्माणका लागि आवश्यक पर्ने सरकारी जग्गालाई वन नियमवली २०७९ बमोजिम मुआब्जा र १६०० रुख विरुवा प्रति हेक्टर रोपिनेछन् । कटान गरिने २००० नम्बरको रुखको, वन ऐन, दफा (४२) बमोजिम १.१० को अनुपातमा वृक्षरोपण गरिनेछ र ५ वर्ष सम्म रेखदेख गरिनेछ । २२७ वटा निजी संरचनाको क्षतिपूर्ति, ११ सामुदायिक संरचना र ३.८४० हेक्टर निजी जग्गाको पुनर्वास योजना, मुआब्जा समितिको निर्णय र चलिरहेको नियम अनुसार र स्थानिय जनताले उपलब्ध गराएको जग्गा अनुसार उपयुक्त ठाउँमा ४ मन्दिरहरू स्थानान्तरण गर्ने निर्णय उल्लेखित छ ।

प्रतिकूल प्रभावहरूको अनुगमन र यसको न्यूनीकरण उपायहरूको प्रभावकारीताको मूल्याङ्कन गरिने छ । आयोजनाको कूल वातावरण व्यवस्थापन लगायत रू.२१,१५,३८,८२०.०० रहेको छ ।

माथिको परियोजनाबाट प्रतिकूल प्रभावहरूको तुलनामा लाभकारी प्रभावहरू अधिक महत्त्वपूर्ण र दीर्घकालीन रहेको साथै प्रतिकूल प्रभावहरूलाई कम वा हटाउन सकिने देखिन्छ । परियोजनाबाट निम्त्याउने प्राय प्रतिकूल प्रभावहरू परियोजनाको संचालन अवस्थामा र त्यसै परियोजना क्षेत्रमा सिमित रहने देखिन्छ । भौतिक, जैविक र सामाजिक वातावरणमा पर्न सक्ने प्रतिकूल असरलाई न्यूनीकरण गर्न सम्पूर्ण वातावरणीय व्यवस्थापन योजनालाई सुनिश्चित गरी सडक निर्माण गर्न सकिनेछ । साथै, प्रस्तावित वातावरणीय व्यवस्थापन योजना अनुसार सडकको नयाँ निर्माण र स्तरोन्नति गरिनेछ । त्यसैले यो प्रस्तावित परियोजना कार्यान्वयनको लागि उपयुक्त छ ।

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	1
ABBREVIATIONS .....	ix
CHAPTER 1: NAME AND ADDRESS OF THE INSTITUTION PREPARING THE REPORT .....	1-1
1.1 Name and Address of the Proponent .....	1-1
1.2 Name and Address of the Consultant .....	1-1
1.3 Rationality for Conducting EIA .....	1-2
1.4 Objectives of EIA .....	1-2
1.5 Scope of the Study .....	1-3
CHAPTER 2: PROJECT DESCRIPTION .....	2-1
2.1 Background.....	2-1
2.1.1 Project Alignment .....	2-1
2.2 Project Description .....	2-2
2.2.1 Location Accessibility .....	2-2
2.2.2 Project Type .....	2-6
2.2.3 Project Salient Features.....	2-6
2.2.4 Project Activities.....	2-9
2.2.5 Project Requirements .....	2-10
2.2.6 Human Resource Requirement .....	2-11
2.2.7 Energy to be used.....	2-11
2.2.8 Project Schedule.....	2-12
2.2.9 Construction Materials.....	2-15
2.2.10 Location of Labor Camp, Stockpiling Sites and Spoil Disposal Sites.....	2-17
2.2.11 Earthwork Quantity of the Project .....	2-18
2.3 Relevancy of the Proposal .....	2-18
CHAPTER 3: METHODOLOGY FOLLOWED FOR EIA.....	3-1
3.1 Desk Study/ Literature Review .....	3-1
3.2 Project Area Delineation .....	3-1
3.2.1 Direct Impact Zone (DIZ).....	3-2
3.2.2 Indirect Impact Zone (IIZ) .....	3-2
3.2.3 Zone of Influence (ZOI).....	3-2

3.3	Field Work and Analysis .....	3-2
3.3.1	Physical Environment Parameters .....	3-3
3.3.2	Biological Environment Parameters .....	3-5
3.3.3	Socio-Economic and Cultural Parameters .....	3-6
3.4	Impact Evaluation Method .....	3-7
3.5	Impact Categorization and Mitigation Measures .....	3-8
3.6	Significance of the Impact.....	3-8
3.7	Environmental Monitoring .....	3-8
3.8	Public Hearing .....	3-8
3.9	Preparation of EIA Report.....	3-9
CHAPTER 4: REVIEW OF RELEVANT POLICIES, ACTS, RULES, GUIDELINES AND CONVENTIONS .....		4-1
4.1	CONSTITUTION OF NEPAL.....	4-1
4.2	POLICIES AND PLANS .....	4-1
4.3	ACTS.....	4-3
4.4	RULES AND REGULATIONS.....	4-5
4.5	GUIDELINES AND MANUALS .....	4-6
4.6	ENVIRONMENTAL STANDARDS .....	4-7
4.7	CONVENTIONS.....	4-13
CHAPTER 5: DESCRIPTION OF EXISTING ENVIRONMENTAL CONDITION.....		5-1
5.1	Physical Environment.....	5-1
5.1.1	Topography.....	5-1
5.1.2	Land Use .....	5-1
5.1.3	Geomorphology and Geology.....	5-2
5.1.4	Slope Stability.....	5-5
5.1.5	Natural Hazards .....	5-6
5.1.6	Hydrology and Watershed .....	5-7
5.1.7	Climate and Meteorology .....	5-8
5.1.8	Air, Noise and Water Quality .....	5-11
5.2	Biological Environment.....	5-15
5.2.1	List of Community Forest in the Project Area.....	5-15
5.2.2	Vegetation along Road Corridor.....	5-15
5.2.3	Wildlife .....	5-18
5.2.4	Aquatic lives .....	5-19

5.3	Socio-Economic Environment.....	5-20
5.3.1	Demographic Characteristics .....	5-20
5.3.2	Economy .....	5-23
5.3.3	Source of Income .....	5-24
5.3.4	Resources and Raw Materials.....	5-25
5.3.5	Source of Energy.....	5-26
5.3.6	Health and Sanitation.....	5-26
5.3.7	Traffic and Safety .....	5-28
5.4	Cultural Environment .....	5-29
5.5	Project Affected Structures.....	5-30
CHAPTER 6: ALTERNATIVE ANALYSIS.....		6-1
6.1	DESIGN .....	6-1
6.2	PROJECT SITE.....	6-1
6.3	Best Project Road Alternatives.....	6-8
6.4	PROCESS, TIME SCHEDULE .....	6-9
6.5	RAW MATERIAL TO BE USED .....	6-9
6.6	OTHERS.....	6-9
6.6.1	No Action Option.....	6-9
6.6.2	Location Alternatives.....	6-9
CHAPTER 7: SPECIFIC IMPACTS ON THE ENVIRONMENT DUE TO IMPLEMENTATION OF THE PROPOSAL .....		7-1
7.1	ADVERSE IMPACTS DUE TO IMPLEMENTATION OF PROJECT AND THEIR MITIGATION MEASURES.....	7-1
7.2	BENEFICIAL IMPACT.....	7-1
7.2.1	Construction Phase.....	7-1
7.2.2	Operation and Maintenance Phase.....	7-2
7.3	Adverse Impacts .....	7-3
7.3.1	Pre-Construction Phase .....	7-3
7.3.2	Construction Phase.....	7-5
7.3.3	Operation and Maintenance Phase.....	7-12
7.4	Issues from Public Hearing .....	7-13
CHAPTER 8: MEASURES TO REDUCE OR CONTROL THE IMPACT OF THE IMPLEMENTATION OF THE PROPOSAL ON ENVIRONMENT .....		8-1

8.1 BENEFICIAL AUGMENTATION AND IMPACTS MITIGATION MEASURES 8-1

CHAPTER 9: MATTER TO BE MONITORED WHILE IMPLEMENTING THE PROPOSAL .....9-1

9.1 Types of Monitoring.....9-1

9.2 Indicators, Methods, Schedule, Responsible Monitoring Agency .....9-2

9.3 Environment Management Plan .....9-9

9.4 Organization Structure for EMP.....9-9

9.5 Environmental Monitoring Plan (EMoP) .....9-11

9.6 Environmental Monitoring Cost.....9-11

9.7 Costs of Executing the Environmental Management Plan .....9-11

9.8 Environmental Management Budget .....9-11

9.9 Summary Cost for Environment Management Plan.....9-15

9.10 Grievance Re-dressal Mechanism .....9-15

9.10.1 Proposed Grievance Redress Mechanism for the Project Road.....9-16

CHAPTER 10: ENVIRONMENTAL AUDIT .....10-1

10.1 Environmental Audit .....10-1

10.2 Agencies Responsible for Auditing.....10-1

10.3 Elements to Environmental Audit Report .....10-1

10.4 Estimated Environment Audit Budget.....10-7

CHAPTER 11: CONCLUSION .....11-1

REFERENCES ..... a

## LIST OF TABLES

Table 1.1: Experts and their Qualification .....	1-1
Table 1.2: Affected Wards and Municipalities .....	1-3
Table 2.1: Affected Rural Municipalities .....	2-2
Table 2.2: Salient Features of the Project Road.....	2-6
Table 2.3: Salient Features of Proposed Major Bridges .....	2-8
Table 2.4: Salient Feature of the Proposed Minor Bridges along the proposed road .....	2-9
Table 2.5: Permanent Land Requirement for Project Facilities (Including 2 Major Bridges and Access Road).....	2-10
Table 2.6: Temporary Land Requirement for Project Facilities .....	2-10
Table 2.7: Details of Energy Used for Different Purpose.....	2-11
Table 2.8: Summary of Fuel Consume .....	2-12
Table 2.9: CO <sub>2</sub> Emission Factors for Various Petroleum Products as per IPCC Guideline.....	2-12
Table 2.10: Potential sources and Tentative Estimate of Quantities of Construction Materials for base, sub-base and surface dressing .....	2-15
Table 2.11: Sources of Locally Available Materials for Embankment Formation and Filling .....	2-17
Table 2.12: Potential Locations for the Labor Camp.....	2-17
Table 2.13: Potential Locations for the Stockpiling Sites.....	2-18
Table 2.14: Potential Locations for Spoil Disposal Site .....	2-18
Table 3.1: Affected Wards and Municipalities .....	3-2
Table 3.2: Impact Ranking Methodology .....	3-8
Table 3.3: Significance of Impact.....	3-8
Table 4.1: National Ambient Air Quality Standards for Nepal, 2012 .....	4-8
Table 4.2: Recommended Noise Exposure Limits for the Work Environment.....	4-8
Table 4.3: Emissions Limits (g/kWh) for Imports of the New Generators .....	4-8
Table 4.4: Emissions Limits (g/kWh) for In-use DG Sets.....	4-9
Table 4.5: National Drinking Water Quality Standards, 2079.....	4-10
Table 4.6: Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems.....	4-11
Table 4.7: Nepal Water Quality Guidelines for Irrigation Water .....	4-12
Table 5.1: Land Use Pattern Along the Road Alignment (Including Trishuli and Marshyangdi Bridges).....	5-2
Table 5.2: Geological Hazard Mapping along the Road alignment.....	5-5
Table 5.3: Observed Maximum Daily Rainfalls (mm) in the Relevant DHM Stations.....	5-9
Table 5.4: Noise Level of the Project Sites.....	5-11
Table 5.5: Air Quality Status of the Project Area.....	5-11
Table 5.6: Water Quality Status of the river at Project Sites .....	5-13
Table 5.7: List of Community Forest along Project Road .....	5-15
Table 5.8: Major Tree Species found along the Road Alignment .....	5-15
Table 5.9: Lists of NTFPs and their uses in the Project Area.....	5-17
Table 5.10: Major mammals found along the alignment.....	5-18
Table 5.11: Major amphibians and reptiles in the project area.....	5-19
Table 5.12: Aquatic Lives Found in the Project Area .....	5-20



Table 5.13: Population Distribution by Project Affected Rural Municipalities .....	5-20
Table 5.14: Population Distribution of Project Affected Wards.....	5-21
Table 5.15: Population Distribution within ZoI along the Project Road .....	5-21
Table 5.16: Ethnic Composition .....	5-22
Table 5.17: Vulnerable Household of the Project Area .....	5-22
Table 5.18: Literacy Status of the project section.....	5-22
Table 5.19: Nearest School along the Proposed Road Alignment.....	5-23
Table 5.20: Purpose of Migration in the Project Area .....	5-23
Table 5.21: Economically active population in the project area by Age Group.....	5-23
Table 5.22: Average Yearly Income by Source Household .....	5-24
Table 5.23: Land holding size.....	5-24
Table 5.24: Occupation Status of the household in the Project Area .....	5-25
Table 5.25: Sources of Water in Project Affected Area .....	5-25
Table 5.26: Types of Drinking Water Purification Methods in Project Affected Area.....	5-26
Table 5.27: Sources of Cooking in the Project Affected Area .....	5-26
Table 5.28: Source of Lightning in the Project Affected Area .....	5-26
Table 5.29: Health Institution in the Project Area .....	5-27
Table 5.30: Diseases and number of affected person in the Project Affected Area .....	5-27
Table 5.31: Types of Sanitary Facility.....	5-28
Table 5.32: Solid Waste Management in Household Level .....	5-28
Table 5.33: List of Temples along Road Alignment.....	5-29
Table 5.34: List of Project Affected Structures .....	5-30
Table 6.1: Alternative Analysis of Mugling-Abukhairyeni Road .....	6-8
Table 7.1: Details of Affected Public Utilities.....	7-3
Table 7.2: List of Affected Private Structures .....	7-5
Table 7.3: Distribution of Project affected structures by Severity.....	7-5
Table 7.4: List of Affected Community Structures .....	7-5
Table 8.1: Summary of Socio-economic, physical, biological and cultural environment impacts within DIZ .....	8-2
Table 8.2: Impact Ranking Methodology .....	8-27
Table 8.3: Beneficial Measures Augmentation Tables and Adverse Impacts Mitigation Measures and Compensatory Estimated Cost and Responsible Agency .....	8-29
Table 9.1: Types of Monitoring, Parameters, Methods, Location, Schedule, Cost and Monitoring Agency.....	9-2
Table 9.2: Environmental Monitoring Cost .....	9-11
Table 9.3: Environment Management Plan Budget .....	9-12
Table 9.4: Cost for EMP .....	9-15
Table 9.5: Composition Grievance Redress Committes .....	9-16
Table 10.1: Environmental Audit for the proposed work of road construction.....	10-3

### LIST OF FIGURES

Figure 2.1: Location Map of Project Area .....	2-3
Figure 2.2: Location Map of Mugling-Abukhairyeni Road Project .....	2-4

Figure 2.3: Location Map of the Project Area .....	2-5
Figure 2.4: Construction Schedule of the proposed MA Road .....	2-14
Figure 5.1: Physiographic Map of Project Area .....	5-1
Figure 5.2: Geological Map of Nepal .....	5-4
Figure 5.3: Geological Map of Project Area.....	5-4
Figure 5.4: Seismic Hazard Map of Nepal.....	5-7
Figure 5.5: Watershed of Project Area .....	5-8
Figure 5.6: Average Annual Monthly Temperature .....	5-9
Figure 5.7: Average Annual Monthly Precipitation .....	5-9
Figure 6.1: Probable Alternative Route Alignments of Mugling-Abukhaireni Section .....	6-2
Figure 6.2: Alignment of Route Alternative 1 of Mugling – Abukhaireni Section.....	6-4
Figure 6.3: Alignment of Route Alternative 2 of Mugling – Abukhaireni Section.....	6-5
Figure 6.4: Alignment of Route Alternative 3 of Mugling – Abukhaireni Section.....	6-7
Figure 9.1: Organization Structure responsible for EMP Implementation .....	9-10

## APPENDICES

APPENDIX 1: Approval Letter of ToR and Approved ToR
APPENDIX 2: Project Layout Map, Project Components Map and Topographic Map
APPENDIX 3: Public Hearing Notice
APPENDIX 4: Minutes from Public Hearing, Opinions and Suggestions
APPENDIX 5: Issues from Public Hearing
APPENDIX 6: Seven Days Public Notice and Deeds of Enquiry
APPENDIX 7: Approval and Suggestion Letters for EIA
APPENDIX 8: Air, Noise and Water Quality Reports
APPENDIX 9: Checklist for Environmental Studies and Household Questionnaires
APPENDIX 10: Study Team and Declaration Sheet
APPENDIX 11: List of Trees to be cut down
APPENDIX 12: Photographs

*Format prescribed in Schedule 12 of EPR 2077 (First Amendment, 2078) will be followed while preparing the EIA Report of Mugling - Abukhaireni Road.*

**ABBREVIATIONS**

AADT	Average Annual Daily Traffic
AASHTO	The American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
AD	Anno Domini
ADB	Asian Development Bank
ADT	Average Daily Traffic
AP	Affected People
BOD	Biological Oxygen Demand
BZMC	Buffer Zone Management Committee
CBOs	Community Based Organization
CBS	Central Bureau of Statistics
CFUG	Community Forest User's Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	Carbon Monoxide
COI	Corridor of Impact
CSC	Construction Supervision Consultant
DBH	Diameter at Breast Height
DBST	Double Bituminous Surface Treatment
DCC	District Coordination Committee
DG	Diesel Generator
DHM	Department of Hydrology and Meteorology
DIU	District Implementation Unit
DIZ	Direct Impact Zone
DLP	Defect Liability Period
DNPWC	Department of National Parks and Wildlife Conservation
DFO	Division Forest Office
DoR	Department of Roads
EA	Executing Agency
EIA	Environmental Impact Assessment
EMG	Environmental Management Guidelines
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EPA	Environment Protection Act
EPR	Environment Protection Rules
ES	Environmental Specialist
FGD	Focus Group Discussion
EWB	East West Highway
FS	Feasibility Study
GESU	Geo-Environment and Social Unit

GoN	Government of Nepal
GHG	Green House Gas
IA	Implementing Agency
IEE	Initial Environmental Examination
IIZ	Indirect Impact Zone
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
LPG	Liquefied Petroleum Gas
MA	Mugling-Abukhaireni
m	meter
MoFE	Ministry of Forests and Environment
MoPIT	Ministry of Physical Infrastructure and Transport
NAAQS	Nepal Ambient Air Quality Standard
NGO	Non-Governmental Organization
NO <sub>x</sub>	Nitrogen Oxide
NRDB	Nepal Red Data Book
NTFPs	Non-Timber Forest Products
ODS	Ozone Depleting Substances
PCU	Passenger Car Unit
PD	Project Directorate
PPE	Personal Protective Equipment
PIU	Project Implementation Unit
RoW	Right of Way
RM	Rural Municipality
RP	Resettlement Plan
RSSDU	Road Sector Skills Development Unit
SASEC	South Asia Sub-regional Economic Co-operation
SDC	Social Development Consultant
SEA	Strategic Environmental Assessment
SO <sub>x</sub>	Sulphur Oxide
SSEMP	Site Specific Environmental Management Plan
SRN	Strategic Road Network
TA	Technical Assistance
TMO	Transport Management Office
TMF	Terai Mixed wood Forest
TPPF	Transport Project Preparation Facility
VAT	Value Added Tax
VPD	Vehicle Per Day
WWF	World Wide Fund for Nature
ZOI	Zone of Influence

## CHAPTER 1: NAME AND ADDRESS OF THE INSTITUTION PREPARING THE REPORT

### 1.1 Name and Address of the Proponent

Name of the proponent for this proposal is Project Directorate (ADB), Department of Roads (DoR). DoR is the leading government agency for road development under Ministry of Physical Infrastructure and Transport (MoPIT) and is responsible for executing government policies for the road sub-sector into the provision of services.

#### **Project Proponent Contact Address:**

Project Directorate (ADB)  
Department of Roads  
Bishalnagar, Kathmandu, Nepal  
Telephone Number: 01-4437492, 01-4437493  
Fax Number: 01-4437488  
Email: [pdadb@dor.gov.np](mailto:pdadb@dor.gov.np)

### 1.2 Name and Address of the Consultant

Name of the consultant for preparing Environment Impact Assessment (EIA) report is Korea Engineering Consultants Corp. (KECC) in association with Soil Test Pvt. Ltd.

#### **Address of the Consultant**

Korea Engineering Consultants Corp. (KECC) in association with Soil Test (P) Ltd.  
Sukedhara-04, Kathmandu, Nepal  
Phone : 01-4374743, 01-4373625  
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The Consultant in close co-ordination with different experts led by Environmental Engineers has prepared the EIA report.

**Table 1.1: Experts and their Qualification**

S.N.	Name of Experts	Position in Study Team	No. of Involvements in EIA/IEE	No. of Years of Experiences	Qualification
1	Mr. Deepak Kumar Amatya	Environmental Engineer (Team Leader)	11	18	Master Degree in Environmental Engineering
2	Mr. Devi Prasad Dotel	Social Expert/Resettlement Expert	7	17	M. A. in Sociology and Geography
3	Jhamak Bahadur Karki	Biological/Wildlife Expert	4	20	MSc. in Wildlife Science; PhD "Occupancy and abundance of tiger and its prey in TAL, Nepal"
4	Mr. Shashi Shrestha	Highway Engineer	4	20	Master in Transport Engineering
5	Prof. Dr. Shyam	Hydrologist	7	32	M. Eng. (Water Resources Engineering),

S.N.	Name of Experts	Position in Study Team	No. of Involvements in EIA/IEE	No. of Years of Experiences	Qualification
	Kaji Manandhar				
6	Ms. Mandakini Karki	Geotechnical Engineer	4	10	Masters in Geotechnical Engineering
7	Ms. Rejina Prajapati	Environmentalist (Env. Assistant)	6	4	Masters in Environmental Management
8	Ms. Alisha Dahal	Environmentalist (Env. Assistant)	7	4	BSc. (Hons.) in Environmental Science

### 1.3 Rationality for Conducting EIA

The project has proposed the construction of new road section of 4.456 km from Ch.00+470 to 04+926 of National Highway Category and upgrading of 4.928 km of road from Ch. 00+000 to 00+180 (One-way single lane), Ch. 0+180 to 0+350 (One way-Two Lane), Ch. 05+080 to 08+100 (Two way 4 lanes) and Ch. 08+100 to Ch. 09+384 (Two way four lane with service lanes) including two major bridges i.e. 120 m long Trishuli Bridge from 00+350 to 00+470 and 125 m long Marsyangdi Bridge from Ch.04+926 to 05+051.

According to the Schedule 3 (pertaining to Rule 3) Clause A, Forest Sector – No. 5) of the Environment Protection Rules, 2077, this project requires an EIA since the construction of road requires about 9.525 ha of forest area upto RoW of the Road. Hence, because of this legal rationality, EIA of the proposal is mandatory.

Also, as per EPR 2077, Rule 7(8), the EIA and its associated documents are prepared in English as the project is funded by international funding organization- ADB (ADB Loan No. 3012-NEP).

### 1.4 Objectives of EIA

The general objective of the study is to conduct an Environmental Impact Assessment for Upgrading/New Construction of Mugling-Abukhaireni Road as per the Schedule 3, pertaining to rule 3 of Environment Protection Rule 2077 of GoN. The specific objectives of the EIA study of the project are as follows:

- To identify and document the baseline conditions on existing physical, biological, socio-economic and cultural environment in the project affected areas;
- To identify, predict and evaluate the acquired data and information and determine the potential adverse and beneficial impacts with respect to magnitude, extent and duration;
- To enhance beneficial impacts and minimize adverse environmental impacts by employing principles of avoidance, mitigation and compensation;
- To formulate, develop and suggest practical mitigation measures for adverse impacts and to incorporate necessary safeguards in project design, construction and operation plans;
- To develop and implement Environmental Management Action Plan (EMAP) and Environmental Monitoring Plan (EMoP);
- To advise decision makers for further action regarding development of the project.

## 1.5 Scope of the Study

The study area for proposed Upgrading/New Construction of Mugling-Abukhaireni Road Section (9.384 km) has been classified into three parts, i.e. Direct Impact Zone (DIZ), Indirect Impact Zone (IIZ) and Zone of Influence (ZOI) on the basis of the proximity and magnitude of impacts.

### ➤ Direct Impact Zone (DIZ)

DIZ for the proposed project is the area where all the construction activities related to the project works will take place. DIZ of the project includes RoW of the proposed road which also includes Corridor of Impact (COI) and the location of project utilities where project activities take place and from which direct impact on the surrounding environment is expected. The RoW of the project road is 30m (15m on either side from centerline of the road).

### ➤ Indirect Impact Zone (IIZ)

Indirect Impact Zone for the proposed project will be 250 m aerial distance beyond DIZ which includes the area of affected wards of Rural Municipalities.

### ➤ Zone of Influence (ZOI)

The Zone of Influence of the project includes the adjoining wards of the concerned municipality. The ZOI of the proposed road project includes:

**Table 1.2: Affected Wards and Municipalities**

S.N.	Affected Wards	Affected Municipalities and Rural Municipalities	District
1	5	Ichhakamana Rural Municipality	Chitwan
2	2, 3 & 4	Abukhaireni Rural Municipality	Tanahu
3	3	Shahid Lakhana Rural Municipality	Gorkha

Source: Field Survey, 2022



## CHAPTER 2: PROJECT DESCRIPTION

### 2.1 Background

#### 2.1.1 Project Alignment

Mugling-Abukhaireni (9.384 km) is a section of Mugling-Pokhara Road along Prithvi Highway (H04). The Mugling-Abukhaireni road project is the upgrading of existing road from Ch. 00+000 to 00+180 (One-way single lane), Ch. 0+180 to 0+350 (One way-Two Lane), Ch. 05+080 to 08+100 (Two way 4 lanes) and Ch. 08+100 to Ch. 09+384 (Two way four lane with service lanes), construction of new road from Ch. 00+470 – 04+926 (One way two lane) and also construction of two new bridges from Ch.00+350 to 00+470 and from Ch. 04+926 to 05+051, extension or replacement of cross drainage structures and pedestrian friendly road safety measures. The road design standard followed for the upgrading project road is Nepal Road Standard (NRS) 2070 and Nepal Bridge Standard 2067. The project road is categorized as Class II and III as per Clause 3B of NRS 2070. The pavement type for the project road is Asphalt Concrete (AC).

The road passes through rocky terrain consisting vertical rocky cliff from Mugling to Marsyangdi Power House (MPH). Due to these geotechnical difficulties, it was not possible to design the road of four lanes for Mugling-Abukhaireni section following the existing alignment. Under the present project scope, following constructions have been proposed;

- i. Upgrading of existing road section from Ch. 0+000 to 0+180 (One-way Single Lane) and from Ch. 0+180 to 0+350 (One-way Two Lane) of average width 8.875 m in Chitwan District
- ii. Construction of a new two Lane 120 m Steel Arch Bridge over Trishuli River from Ch. 00+350 ~ 00+470. It will connect two districts; Chitwan and Gorkha district.
- iii. Construction of one-way road of two lane at the right bank of the Trishuli River (Ch. 00+470) up to Triveni (Ch 1+100) and continuing again at the left bank of Marsyangdi River up to the opposite side of Marsyangdi Power House (Ch. 04+926) bypassing the Mugling bazaar. The width of the new road section/alignment will be 9.75 m. The new section/alignment will be in Gorkha District. The existing Prithvi Highway from Mugling to Marsyangdi Power House will be used as the one-way road (Mugling to Abukhaireni direction) while the new road at the opposite side of the rivers i.e.; Trishuli and Marsyangdi rivers shall be used as one-way road from Abukhaireni to Mugling direction.
- iv. Construction of new 2 Lane 125 m lengths Arch Bridge at Ch. 04+926 over Marsyangdi River connecting the new section/alignment and existing alignment at Ch. 05+051 along Prithvi Highway bypassing the Power House. It will connect Gorkha and Tanahu Districts. The bridge will be skewed in design.
- v. Upgrading of the existing two-lane road section along Prithvi Highway into 4 lanes of width 19 m from Ch. 05+080 after the Marsyangdi Power House up to Ch. 08+100 at the end of Abukhaireni bazaar.
- vi. The upgrading from Ch. 08+100 to Ch. 09+384 at Abukhaireni will be of 4 lanes with provision of service lanes having total road width of 38 m.

Along with the widening and construction of the road works, the project also covers the construction of new cross-drainages structures (bridges, pipe culverts, and box culverts). New bridges of two lanes will be constructed as per the DoR Bridge standard. Altogether, the project covers total 32 number of cross drainages along this road section. There will be construction

of major bridges (2 nos.) and minor bridges (4 nos.), replacement or extension of existing culverts with pipe culverts (21 nos.) and box culverts (5 nos.).

The estimated budget for the completion of the project is NRs. 3,974,721,024.97 (including VAT and Contingencies) with construction period of thirty months with Defect Liability Period (DLP) of 1 year and Performance Based Maintenance (PBM) periods of 4 years.

## 2.2 Project Description

### 2.2.1 Location Accessibility

The project area is accessible from Kathmandu via Prithvi highway to Mugling of Chitwan District. The total distance from Kathmandu to the project site is 112 km. The route to reach the proposed project site is: Kathmandu – Chandragiri - Naagdhunga – Naubise – Dharke – Galchhi – Malekhu – Darechowk - Mugling.

The road alignment starts at about 936 m east from Junction of Mugling-Narayanghat (Ch. 00+000) road with latitude (27°51'30.94"N), longitude (84°34'8.10"E) and elevation 271.80m amsl in Ichhakamana RM of Chitwan district, Bagmati Province of Nepal.

The alignment then crosses the Trishuli River where Trishuli Bridge has been proposed at (Ch. 00+350 ~ 00+470). The alignment then heads towards north up to Triveni (Ch. 01+100) following the right bank of Trishuli River.

From Triveni, the alignment follows the existing unpaved road following the left bank of Marsyangdi River. The road section passes through the agriculture land and reaches the Bhuwantitar (Ch. 03+790) at an elevation of 272.235 m amsl. Afterwards, the road alignment passes through the Salleri CFUG (Ch. 04+190~ Ch. 04+920). At Ch. 04+920, opposite to Marsyangdi Power House, the road alignment crosses the Marsyangdi River where Marsyangdi Bridge has been proposed of length 125 m. From Triveni to this point (From Ch. 00+350~04+920), the road passes through the Shahid Lakhana RM of Gorkha District, Gandaki Province. After crossing the Marsyangdi Bridge, the road touches the existing Prithvi Highway in Abukhaireni RM of Tanahu District, Gandaki Province. After that, the alignment follows the existing road and reaches the Abukhaireni Bazaar (Ch. 08+200) at an elevation of 310.528 m amsl. From Ch. 06+465 to Ch. 09+384, the alignment passes through Bhange, Kukurgade and Aablu Purano CFUGs in Tanahu district. The project area location along the districts and its respective municipalities with the chainage have been provided in Table 2.1

**Table 2.1: Affected Rural Municipalities**

District	Rural Municipality	Chainage (Km)
Chitwan	Ichhakamana Rural Municipality-5	00+000~00+350
		00+350~04+920
Gorkha	Shahid Lakhana Rural Municipality-3	04+920~06+465
Tanahu	Abukhaireni Rural Municipality-2, 3 and 4	06+465~09+384
<b>Total</b>		<b>9.384 km</b>

Source: Field Survey, 2022

The proposed road starts from Mugling Bazaar of Ichhakamana Rural Municipality of Chitwan district, passing through Gorkha District and ends at Abukhaireni Rural Municipality of PRM in Tanahu District.

The project area is accessible from Kathmandu via Prithvi highway to Mugling of Chitwan District. The total distance from Kathmandu to the project site is 112 km. The route to reach

the proposed project site is: Kathmandu- Chandragiri- Naagdhunga- Naubise- Thakre- Galchhi-Malekhu- Darechowk- Mugling.

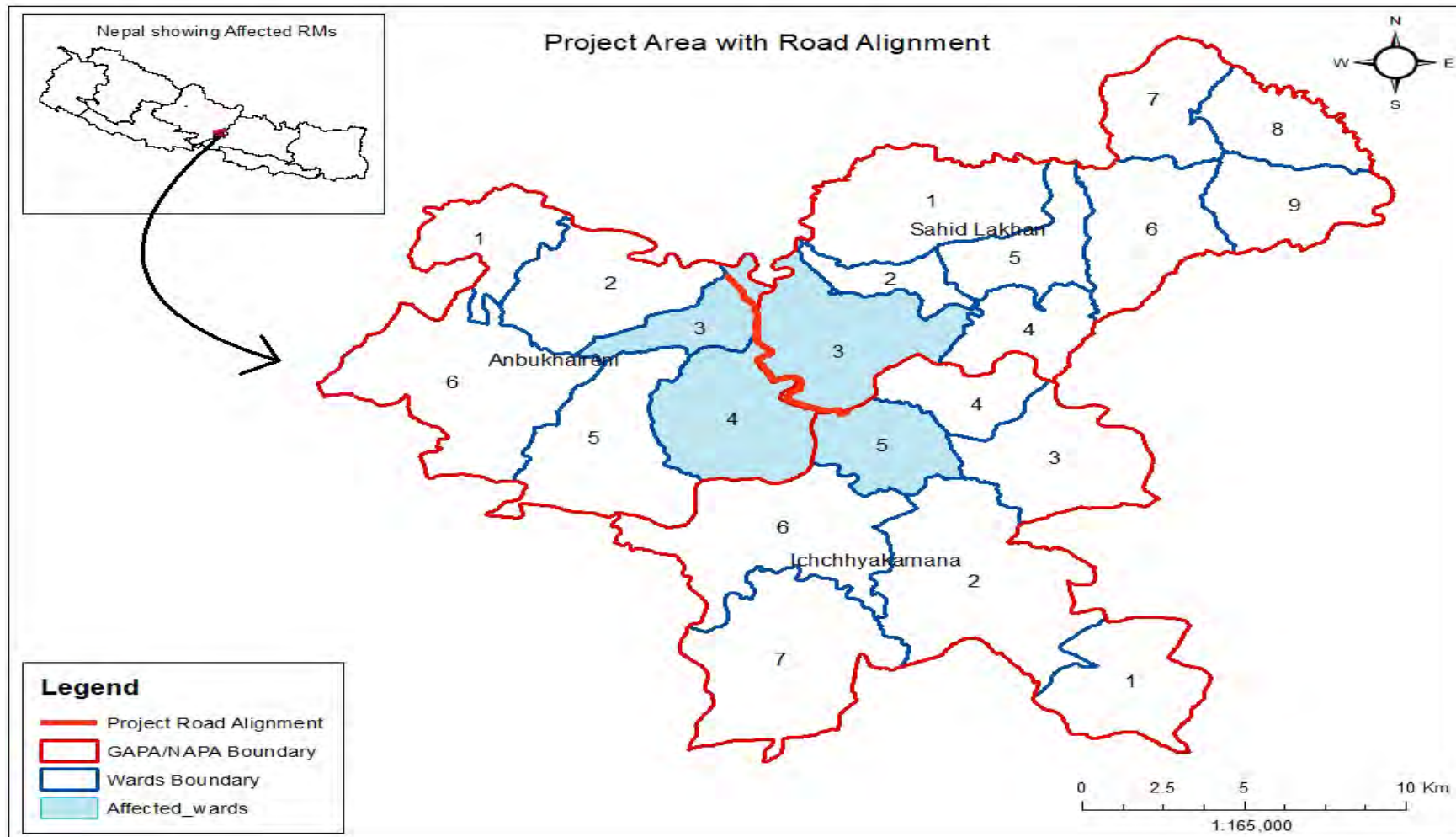
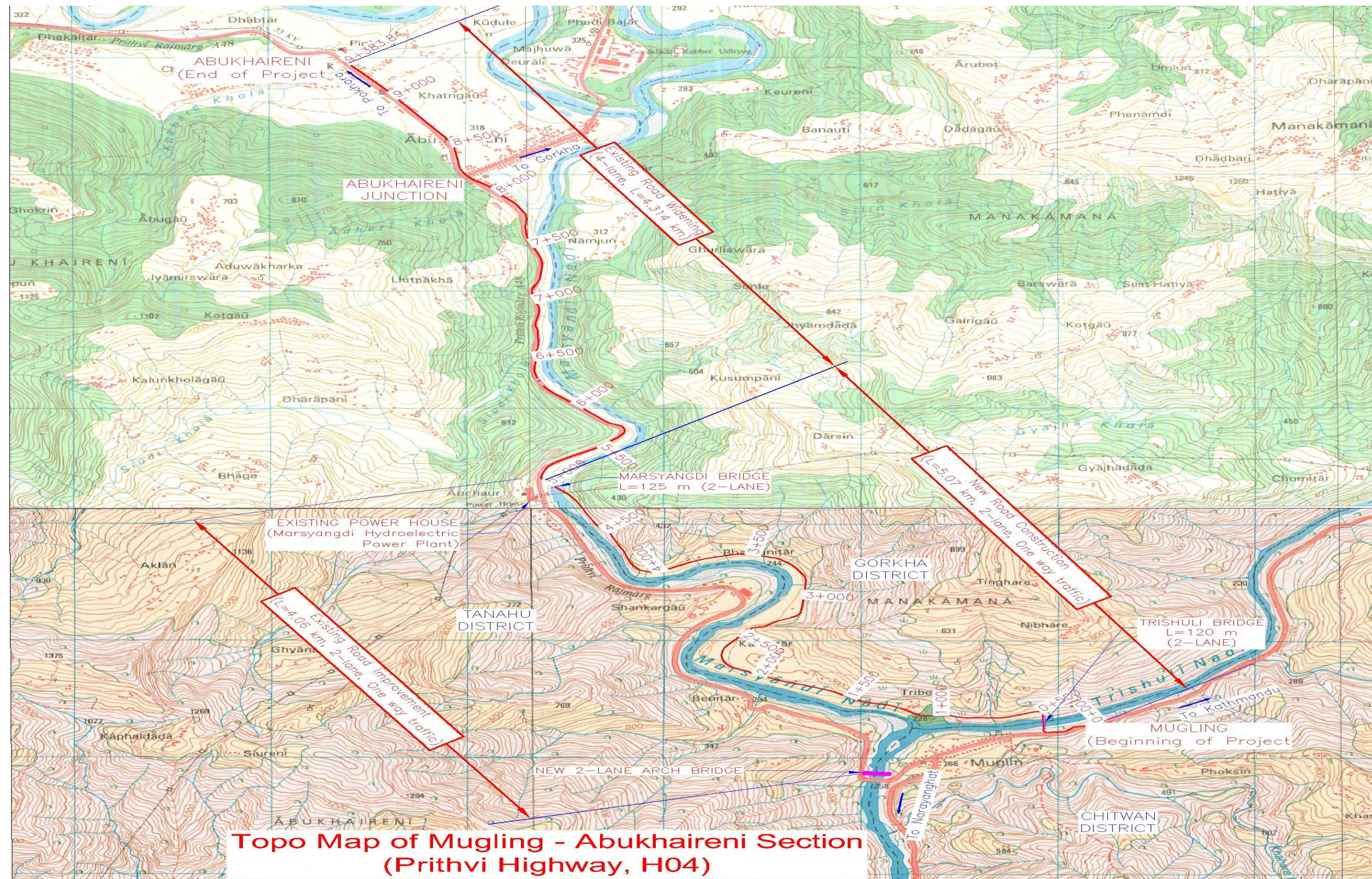


Figure 2.1: Location Map of Project Area



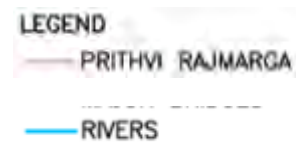
Figure 2.2: Location Map of Mugling-Abukhaireni Road Project



**Topo Map of Mugling - Abukhaireni Section (Prithvi Highway, H04)**

**Map Source:**  
1:25000 Scaled Topo Map Sheet Nos. 2784 03C & 2784 03AB

**Road Alignment Source:**  
Detail Design of Mugling-Abukhaireni Road  
Volume 1 C-1: Design Drawings (December, 2020)



**Figure 2.3: Location Map of the Project Area**

## 2.2.2 Project Type

The proposal is of service delivery type (Transportation service) for construction of new road (5.07 km) and upgrading of existing road (4.314 km) of the Prithvi highway from present two-lane road to four lanes from Mugling Bazaar (PRM: Ch. 81+700) to Abukhaireni (PRM: Ch. 91+764) for a total 9.384 km length. Salient features relating to this road upgrading works are presented in Table 2.2

## 2.2.3 Project Salient Features

The salient features of the proposed road and bridges are shown in the Table 2.2 and Table 2.3.

**Table 2.2: Salient Features of the Project Road**

<b>Name of the Project</b>	
<b>Upgrading/New Construction of Mugling- Abukhaireni Road Section (9.384 km)</b>	
<b>LOCATION</b>	
Province (District)	Bagmati Province (Chitwan District) and Gandaki Province (Gorkha and Tanahu Districts)
Start Point	Starts at about 936m east from the junction of Mugling-Narayanghat (Ch. 00+000).
End Point	End point of Abukhaireni Bazar, Tanahu
Rural Municipality (RM)	Ichhakamana RM-5, Chitwan District Shahid Lakhana RM-3, Gorkha District Abukhaireni RM-2, 3 and 4 of Tanahu District
Existing Road	Double Lane, Asphalt
<b>GEOGRAPHICAL FEATURES</b>	
Terrain	Rolling/Hilly
Elevation Range	Start Point: 271.800 m (amsl) at Mugling, Chitwan End Point: 322.403 m (amsl) at Abukhaireni, Tanahu
Climate	Tropical region
<b>PROPOSED ROAD TYPE</b>	
Classification of road	National Highway
Length of Road	9.384 km
Design Lanes	Ch. 00+000~00+180: One-way Single Lane Ch. 00+180~05+080: One-way two lanes Ch. 05+080~08+200: Two-way 4 lanes without service lane Ch. 08+200~09+384: Two-way 4 lanes with service lane
Type of Pavement	Asphalt Concrete (AC)
Standard of Pavement	Overseas Road Note 31 and/or AASHTO design method/ Pavement Design Guideline (Flexible Pavement, 2014 DoR)
<b>DESIGN PARAMETERS OF PROPOSED ROAD</b>	
Design Standard	Nepal Road Standard, 2070 References: AASHTO, BS, TRL and IRC standards as required
Design Speed	40 km/hr for hill section, 60 km/hr for plain & rolling sections
Right of Way	<b>30 m</b> along the new alignment at Gorkha District <b>50 m</b> along the existing alignment (Prithvi Highway)
Carriage Width	3.7m for single lane 19m for the 4 lanes with service lane
Total Formation (Road Way) Width	<b>Ch. 0+000~0+135: width = 7.75m</b>

Name of the Project	Upgrading/New Construction of Mugling- Abukhaireni Road Section (9.384 km)
	<p>7 m (carriage width) + 0.75 m (Shoulder)  <b>Ch. 0+135~0+185: width = 8.25 m</b>  8.25 m (carriage width)  <b>Ch. 0+185~0+335: width = 9.375 m</b>  1.125 m drain + 8.25 m carriageway  <b>Ch. 0+335~0+485: width = 8.25 m</b>  8.25 m (carriage width)  <b>Ch. 0+485~0+935: width = 9.375 m</b>  8.25 m carriageway + 1.125 m drain  <b>Ch. 0+935~1+635: width = 9.25 m</b>  8.25 m carriageway + 1 m Footpath with drain  <b>Ch. 1+635~2+885: width = 9.725 m</b>  8.25 m carriageway + 1.475 m drain  <b>Ch. 2+885~3+025: width = 9.25 m</b>  8.25 m carriageway + 1 m Footpath with drain  <b>Ch. 3+025~3+475: width = 10.125 m</b>  0.75 m shoulder + 8.25 m carriageway + 1.125 m drain  <b>Ch. 3+475~3+805: width = 9.25 m</b>  8.25 m carriageway + 1 m Footpath with drain  <b>Ch. 3+805~3+825: width = 8.25 m</b>  8.25 m (carriage width)  <b>Ch. 3+825~3+915: width = 10.125 m</b>  0.75 m shoulder + 8.25 m carriageway + 1.125 m drain  <b>Ch. 3+915~4+925: width = 9.375 m</b>  8.25 m carriageway + 1.125 m drain  <b>Ch. 4+925~5+050: Marsyangdi Bridge (12.16 m total width)</b>  <b>Ch. 5+050~5+085: Transition from 2 lane to 4 lanes</b>  <b>Ch. 5+085~7+990: width = 19 m</b>  1 m Footpath with drain + 1 m *2 shoulder + 7.5*2 m Carriageway + 1 m median  <b>Ch. 7+990~8+045: Transition for Bridge</b>  <b>Ch. 8+045~9+297: width = 38 m 4 lanes with service lane</b>  2*7 m (Carriage width), 2+0.5 m (Curb shy) + 2*1 m (Curb shy for service lane) + 1 m (Centre median) + 2*1 m (Drain Cover) + 2*1 m (Greenbelt) + 2* 6.0 m (Service Lane) + 2*2 m (Footpath)  <b>Ch. 9+297~9+384: transition from 38 m to 20.44 m to adjust existing bridge and proposed 2 lane bridge</b></p>
Pavement Camber	2.5 % on either side from centre
Existing/Predicted traffic load (AADT)	5217 vpd (Vehicle per day) at Mugling-Abukhaireni Road section in 2018 AD 18,095 vpd at Mugling-Abukhaireni Road section in 2042 AD
<b>CROSS-DRAINAGE</b>	
Bridges	<b>Total 6 nos.</b>

<b>Name of the Project</b>	<b>Upgrading/New Construction of Mugling- Abukhaireni Road Section (9.384 km)</b>
	2 major bridges at Trishuli River at Ch.00+410 and Marsyangdi River Ch. 04+980 4 minor bridges at Ch. (02+523, 06+310, 06+523 and 08+035)
Pipe Culvert	900 mm dia single cell: 16 nos. 1200 mm dia single cell: 5 nos.
Box-Culverts	1.5x1.5: 1 no. (2 lane) 2x1.5: 2 nos. (2 lane) 1.2 x 1.5: 1 no. (4 lane) 1.2x1.5: 4 nos. (4 lane with service lane)
<b>APPROXIMATED EARTHWORKS QUANTITY</b>	
Cutting volume	1,107,627 cum
Filling Volume	17,254 cum
<b>Total Project Cost</b>	<b>NRs. 2,931,210,195.41 (without VAT &amp; Contingencies)</b> <b>NRs. 3,974,721,024.97 (including VAT &amp; Contingencies)</b>
Total Construction Period	Construction period (30 months), Defect Liability Period (12 months) and Performance Based Maintenance (48 months)

Source: Detail Design of Mugling-Abukhaireni Road, 2019

**Table 2.3: Salient Features of Proposed Major Bridges**

Details of particulars	Description	
	a) Trishuli Bridge	b) Marsyangdi Bridge
<b>LOCATION</b>		
Left bank	Ichhakamana RM, Chitwan District, Bagmati Province	Shahid Lakhan RM, Gorkha District, Gandaki Province
Right Bank	Shahid Lakhan RM, Gorkha District, Gandaki Province	Abukhaireni RM, Tanahu District, Gandaki Province
GPS	27°51'27.595" N and 84°33'57.208"E	27°52'38.19"N and 84°32'24.81" E
<b>DESIGN PARAMETERS</b>		
Total Length	120 m	125 m
Span Arrangement	-	100 m span steel Arch with 25 m steel composite bridge as a side span
Total Width	12.16 m	12.16 m
Carriage Width	8.0 m	8.0 m
Footpath	1.5 m on both side	1.5 m on both side
<b>DESIGN DATA</b>		
Live Load	IRC 70R	IRC 70R
Design Discharge (100 years)	7553 m <sup>3</sup> /sec	4325 m <sup>3</sup> /sec
Linear Waterway	120 m	96 m
Scour Depth	8.11 m	6.53 m
Highest Flood Level	245.37 m	265 m
<b>BRIDGE DECK CONFIGURATION</b>		
Bridge Class	Class 70R, Class A	Class 70R, Class A
Pre-stress Method	Post-Tensioned Concrete	Post-Tensioned Concrete



Details of particulars	Description	
	a) Trishuli Bridge	b) Marsyangdi Bridge
Construction method	Small Block launching	Small Block launching
Type of bearings	EQS type bearing	EQS type bearing
Type of Abutments	RCC inverted T type cantilever with spread footing	RCC retaining wall type, 16.3mx 3.0m stem and height 10.5m.
Type of piers	No pier	Hammer head Type Monolithic
Sub structure and Foundation	-	Rectangular RCC intermediate piers resting on RCC pile foundation {Open Type (16.3m x 8.5m x 1.6m)}
Bridge approach for Storm water drainage prevention	<ul style="list-style-type: none"> <li>• Footpath cum drain having a width of 1.0 m and depth of 1.0 m</li> <li>• Drainage spouts on every 5 m on bridge deck on LHS and RHS</li> <li>• Bridge approach has 0.3% slope and all storm water will flow through liner side drains on either side of the divided carriageway.</li> </ul>	<ul style="list-style-type: none"> <li>• Footpath cum drain having a width of 1.0 m and depth of 1.0 m</li> <li>• Drainage spouts on every 5 m on bridge deck on LHS and RHS</li> <li>• Bridge approach has 0.3% slope and all storm water will flow through liner side drains on either side of the divided carriageway.</li> </ul>

Source: Detail Design of Mugling-Abukhaireni Road, 2019

**Table 2.4: Salient Feature of the Proposed Minor Bridges along the proposed road**

Chainage	Bridge name	Catchment area	Natural Discharge cum/s	Proposed Span	Proposed Height	Abutment Type and Sizes	Super structure
2+523	RCC Bridge	-	-	25 m	14.05 m	RCC retaining wall type abutment, 11m x 1.85m stem and 12.45m height, Foundation: Open Type (10.0mx11.4mx1.6m)	25m DOR Standard Double webbed RCC T Beam
6+305	Box Bridge	-	-	8 m	2.50 m	2 Cell of Box Bridge of size 4.0m x 2.5m	Double Cell Box
6+518	Slab Bridge	7.85 m <sup>2</sup>	71.62	10 m	17.00 m	Pile Foundation; 4 no. of Pile of 1m diameter is provided each side of bridge at equal spacing	10m DOR Standard Slab deck type bridge
8+030	Box Bridge	1.25 m <sup>2</sup>	18.10	8 m	2.50 m	2 Cell of Box Bridge of size 4.0m x 2.5m	Double Cell Box

Source: Detail Design Report of Mugling-Abukhaireni Road, 2019

#### 2.2.4 Project Activities

Implementation of the proposal will carry out the various activities in all pre-construction, construction and operation phase as mentioned below:

##### (i) Pre-Construction Phase

- Land acquisition and clearance of trees from RoW

- Relocation of Public Utilities
- Acquisition of private land and handover of government forest.
- (ii) **Construction Phase**
  - Construction of retaining structures and drainage structures
  - Gravelling and black-topping
  - Bio-engineering works
- (ii) **Operation & Maintenance Phase**
  - Routine Maintenance
  - Emergency Maintenance

## 2.2.5 Project Requirements

### 2.2.5.1 Land Area Requirement

The road alignment will require about 13.365 ha of permanent land upto RoW of the road. Out of the total 13.365 ha of land, 9.525 ha of land will be from forest area under MoFE, 3.840 ha will be Private land (2.25 ha agricultural land and 1.59 ha private forest). Similarly, project will acquire 5 ha of government land for temporary purposes for functioning of quarry and borrow area and 13 ha of private land for labour camps, stockpiling, spoil disposal area, etc. Here, the categorization of 'Agricultural Land' means the land where the occupation of rearing crops and livestock is done. Whereas 'Cultivated Land' means where the cultivation works such as cropping has already been done. The permanent and temporary land requirement is shown in Table 2.5 and Table 2.6 respectively.

**Table 2.5: Permanent Land Requirement for Project Facilities (Including 2 Major Bridges and Access Road)**

Project Components	Permanent Land Required (ha)											Total		
	Forest land		Agricultural land		Settlement Land		Barren Land		Grass land on Foothill		Cultivated and Grass Land	Gov. Total (ha)	Pri. Total (ha)	Grand Total (ha)
	G	P	G	P	G	P	G	P	G	P	G			
Road formation width	1.673	0.742	-	1.042	-	-	-	-	2.636	-	0.144	4.453	1.784	6.237
ROW - 30 m (Gorkha district) (Includes Road formation width)	3.585	1.59	-	2.25	-	-	-	-	5.580	-	0.36	9.525	3.840	13.365

Source: Field Survey, 2022; Note: G= Government, P= Private

#### Ownership status-

All Government land are under the ownership of Ministry of Forests and Environment, GoN

**Table 2.6: Temporary Land Requirement for Project Facilities**

Project Components	Temporary Land Required (ha)											Total
	Forest land		Agricultural land		Mixed Settlement Land		Barren Land		Grass Land		River	(ha)
	G	P	G	P	G	P	G	P	G	P	G	
*Quarry and Borrow area	-	-	-	-	-	-	5	-	-	-	-	5*
Stockpiling	-	-	-	-	-	-	-	2	-	-	-	2

Project Components	Temporary Land Required (ha)											Total (ha)
	Forest land		Agricultural land		Mixed Settlement Land		Barren Land		Grass Land		River	
	G	P	G	P	G	P	G	P	G	P	G	
Labour camp	-	-	-	-	-	1	-	-	-	-	-	1
Spoil disposal	-	-	-	-	-	2	-	-	-	-	-	2
Crusher plant	-	-	-	-	-	-	-	3	-	-	-	3
Concrete batching plant	-	-	-	-	-	-	-	5	-	-	-	5
<b>Total (ha)</b>	-	-	-	-	-	3	5	10	-	-	-	18

Source: Field Survey, 2022; Note: G= Government, P= Private

\*Quarry Sites will be selected in Municipal Approved Area and there will be no need of acquiring government land.

## 2.2.6 Human Resource Requirement

The maximum numbers of workers required for the proposed project during the peak period of construction is estimated to be approximately 108,000 persons days for skilled manpower (150 persons per day) and 360,000 persons days for unskilled manpower (500 persons per day) for 30 months. Local people will be employed as per their skill, experiences and qualification in the project during the construction phase.

## 2.2.7 Energy to be used

Gasoline and electrical energy will be used during the construction phase of the project. The energy required for the construction works is mainly kerosene, diesel and petrol. Diesel will be used for transportation of materials, earthwork filling and excavation. The electrical energy required will be produced from diesel engine electric generator. Kerosene will be used for bitumen heating. Use of firewood will be minimal as labors at the camp will be provided with kerosene or LPG for cooking and heating purpose. Vehicles will use diesel or petrol supplied by the contractor from outside the project area. From this road project about 2.272 (MT) carbons will be emitted. Summary of fuel consume and CO<sub>2</sub> emission from various Petroleum Products as per IPCC Guideline is listed in Table 2.9 below:

**Table 2.7: Details of Energy Used for Different Purpose**

S.N.	Purpose	Quantity, Cum	Energy Used	(lt/cum)	Fuel Consume, It
1	Earthwork in Excavation	920,457.46	Diesel	0.156	143,591.36
2	Earthwork in Filling	28,647.57	Diesel	0.12	3,437.71
3. Sub-grade Preparation					
a.	Scarifying	28,903.80	Diesel	0.10	2,890.38
b.	Sub-grade	26,833.25	Diesel	1.00	26,833.25
4.	Sub-base	35,306.64	Diesel	0.79	27,962.86
5.	Base	20,124.94	Diesel	0.99	19,923.69

S.N.	Purpose	Quantity, Cum	Energy Used	(lt/cum)	Fuel Consume, lt
6.	Prime Coat	134,166	Diesel and Kerosene	0.40	53,666.51
7.	Surface Works	2,120,083.93	Kerosene	-	-
8.	Labor Work	825,063.55	LPG	29,644 No. of LPG Cylinder	-

**Table 2.8: Summary of Fuel Consume**

Fuel	Unit	Quantity
Petrol (Motor Gasoline)	Lt	2,898.00
Diesel Fuel	Lt	262,205.81
LPG	Lt	825,063.55
Kerosene	Lt	16,099.95

**Table 2.9: CO<sub>2</sub> Emission Factors for Various Petroleum Products as per IPCC Guideline**

S.N.	Petroleum Products	IPCC Unit	Unit, Liters	IPCC (CO <sub>2</sub> ) Emission Factor	CO <sub>2</sub> Emission per Liter (kg)	Quantity, Liters	CO <sub>2</sub> Emission, Kg
1	Petrol (Motor Gasoline)	Gallon	3.79	8.78	2.32	2,898.00	6,721.71
2	Diesel Fuel	Gallon	3.79	10.21	2.70	262,205.81	707,220.97
3	LPG	Gallon	3.79	5.68	1.50	25,063.55	238,006.18
4	Kerosene	Gallon	3.79	75.20	19.87	16,099.95	319,837.59
		Conversion			<b>Total CO<sub>2</sub> (Kg)</b>		<b>2,271,786.45</b>
		1Gallon=3.78541 lt.			<b>Total CO<sub>2</sub> (MT)</b>		<b>2.272</b>

### 2.2.8 Project Schedule

A preliminary time schedule for the implementation of the Project has been prepared considering pragmatic productivity rates and logical sequencing of activities.

The soil work or excavation activities of the project should be avoided during the monsoon period. The construction activities will be carried out during the day time only. During the rainy season, the upgrading work has to be stopped to avoid differential settlement of base, sub-base, low strength of road pavement and for safety of work and personals from natural calamities like landslides. The natural compaction of the road should be allowed during the rainy season. Rehabilitation and upgrading work will be carried out during the remaining months.

After completion of pre-implementation works such as land acquisition, vegetation clearance, etc., mobilization of contractors will be done. Construction of project is expected to start on August 2022 and completion is estimated on August 2024. However, these dates might be different as per the time consumed during pre-implementation phase. The proposed project schedule is for 2 years as construction period and one year as defect liability period. Figure 2.4 show the project construction/implementation schedule in two phases: Upgrading works and Operation and Maintenance works.

PROPOSED CONSTRUCTION SCHEDULE OF MUGLING-AANBUKHAIRENI ROAD

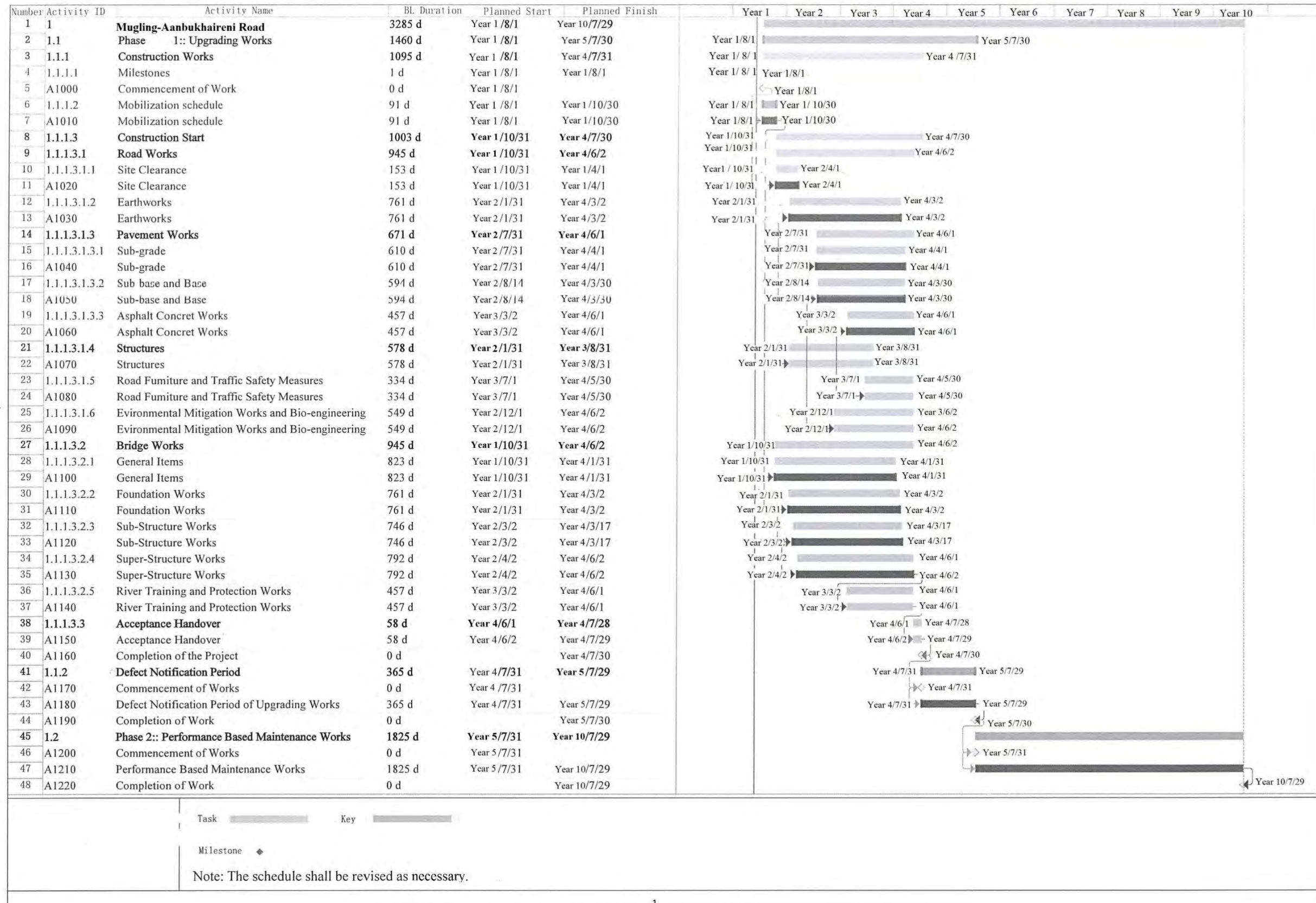


Figure 2.4: Construction Schedule of the proposed MA Road

## 2.2.9 Construction Materials

Local construction materials required for construction of the project road are sand, aggregates, boulders and asphalt concrete aggregates for base course, sub-base course and surface dressing. The quarry sites and borrow pits for construction materials are Kotre Khola, Belkhu Khola, Marsyandi Nadi and Quarry site along the road alignment at 1+000, 1+600, 1+800, 2+900 (RHS), 4+240 (RHS), 6+800 (LHS) and 7+000 (LHS). However, if the contractor needs to use other quarries rather than the above mentioned locations, quarry sites should be government approved sites. In such cases contractor shall comply the mentioned mitigations in the approved report. The identified potential sources with estimated quantity of available materials and its distance from the project road is shown in Table 2.10.

The total estimated available material from above resources is 2,075,500.00 cum. The quantities have been estimated based upon the area and the depth of deposits for each quarry/borrow site. Aggregates of high strength and quality will be selected and use in the project work based on the basis of lab analysis.

**Table 2.10: Potential sources and Tentative Estimate of Quantities of Construction Materials for base, sub-base and surface dressing**

S.N.	Name of the Source	Location	GPS Location	Available Materials	Estimated Quantity (m <sup>3</sup> )	Remarks	Equipment used for materials extraction
1	Quarry at Ch 1+000	1 km away from Ch 0+000 Km towards Pokhara (new alignment)	27° 51' 2.64" N 84° 33' 38.62" E	Boulders, and Gravels	420,000	1 km Black top from start point on LHS	Excavator, Bulldozer, Loader, Tipper, Trucks, Tractors, Shovel and Crusher Plant and Screen plant etc.
2	Quarry at Ch 1+600 (RHS)	1.6 Km away from start point towards Aanbukharen i	27° 51' 39.02" N 84° 33' 18.75" E	Boulders, and Gravels	52,500	1.6 km Earthen Road from start point	
3	Quarry at Ch 1+800 (RHS)	1.8 Km away from start point towards Aanbukharen i	27° 51' 41.51" N 84° 33' 11.81" E	Boulders, and Gravels	52,500	300 m Earthen Road from start point on RHS	
4	Quarry at Ch 2+920 (RHS)	20 m away from chainage start point	27° 52' 02.82" N 84° 33' 12.29" E	Boulders, and Gravels	437,500	300 m Earthen Road from start point on RHS	
5	Quarry at Ch 4+240 (RHS)	4.24 Km away from start point towards Aanbukharen i	27° 52' 16.35" N 84° 32' 40.13" E	Boulders, Cobble Gravels and Sand	52500	4.2 m Earthen Road from start point on RHS	

S.N.	Name of the Source	Location	GPS Location	Available Materials	Estimated Quantity (m <sup>3</sup> )	Remarks	Equipment used for materials extraction
6	Quarry at Ch 6+800 (LHS)	20 m away from the Ch 7+000 on left hand side	27° 53' 21.66" N 84° 32' 23.26" E	Boulders, and Gravels	26,250	20 m earthen road from 7+000 km on LHS	
7	Quarry at Ch 7+000 (LHS)	20 m away from the 6+800 km on left hand side'	27° 53' 28.00" N 84° 32' 23.28"E	Boulders, Cobble Gravels and Sand	26,250	20 m earthen road from 6+800 km on LHS	
8	Marshyandi Nadi	4 km away from 9+393 km at Narighat	27° 56' 05.16"N 84° 28' 44.19"E	Boulders, Cobble Gravels and Sand	252,000	4 km black top road from 9+392 km on RHS	
9	*Belkhu-Trishuli River	35 Km from start from Muglin	27° 48' 54.72" N 84° 56' 47.94"E	Boulders, Cobble Gravels and Sand	504,000	3.5 Km Black top and 200m Earthen Road from start point	
10	*Kotre Khola	66 Km away from End point (9+392 Km)		Boulders, Cobble Gravels and Sand,	252,000	66 km Black top and 500m Earthen Road from end point	
<b>Total available material</b>					<b>2,075,500</b>		

Source: Detail design report of Mugling-Abukhaireni Road, 2019

\* Some of the quarry sites selected is far from the project area in other to keep them as an alternative source for the quarry materials if necessary.

Likewise, borrow pits are selected at 8 locations along the proposed road alignment considering the transport, distance, quality and quantity available. All the considered materials are to be used at the embankment and fill sites; the materials were observed to be of good quality. Details have been given in Table 2.11.

**Table 2.11: Sources of Locally Available Materials for Embankment Formation and Filling**

S.N.	Chainage	Approximately Available Amount				Description of Materials	Remarks
		Length (m)	Breadth (m)	Height (m)	Volume (m <sup>3</sup> )		
1	1 km away from 0+000	300	50	40	600,000	Material is good	Left side of the road in Prithvi Highway after crossing Mugling Bridge
2	1+160-1+300	160	25	5	20,000	Material is good	Along the road alignment
3	1+600	100	50	15	75,000	Material is good	Along the road alignment
4	1+800	150	50	25	187,500	Material is good	300 m away at right side
5	2+920	100	10	10	10,000	Material is good	Right side of the road
6	4+000	100	10	10	10,000	Material is good	Right side of the road
7	6+800	100	35	10	35,000	Material is good	Left side of the road
8	7+000	100	15	20	30,000	Material is good	Left side of the road

Source: Detail design report of Mugling-Abukhaireni Road, 2019

The contractor is responsible for the reinstatement of the quarry/ borrows sites to the satisfaction and with payment of royalty and taxes for the operation of the quarry/ borrows pits operation. The reinstatement plan of the quarry sites and borrow pits will include the protection of river bank with gabion protection mattress and gabion wall and other normal practice such as tree plantation and bio-engineering (as provision in reinstatement plan).

### 2.2.10 Location of Labor Camp, Stockpiling Sites and Spoil Disposal Sites

The barren land away from the settlement area, sensitive receptive and water sources has proposed for labor camp, stockpiling and spoil disposal sites. The identified locations for the labor camp, stockpiling sites and spoil disposal sites are given in Table 2.12, Table 2.13 and Table 2.14 respectively.

**Table 2.12: Potential Locations for the Labor Camp**

S.N.	Chainage	Remarks
1	1+550	Right side of the road alignment
2	2+450	Right side of the road alignment
3	8+425	Right side of the road alignment
4	8+950	Right side of the road alignment
5	2+600	Left side of the road alignment

Field Survey, 2022



**Table 2.13: Potential Locations for the Stockpiling Sites**

S.N.	Chainage	Remarks
1	1+000	Left side of the road alignment
2	1+460	Left side of the road alignment
3	5+440	Right side of the road alignment
4	6+870	Left side of the road alignment
5	7+800	Left side of the road alignment
6	8+620	Right side of the road alignment
7	2+200	Right side of the road alignment
8	3+310	Left side of the road alignment

*Field Survey, 2022*

**Table 2.14: Potential Locations for Spoil Disposal Site**

S.N.	Chainage	Remarks
1	2+500	Left side of the road alignment
2	6+800	Left side of the road alignment
3	5+400	Right side of the road alignment
4	5+650	Right side of the road alignment
5	7+470	Left side of the road alignment
6	7+100	Right side of the road alignment
7	7+350	Right side of the road alignment
8	7+550	Right side of the road alignment

*Field Survey, 2022*

However, if the location changes for labor camps, stockpiling sites and spoil disposal sites during construction, then contractor will identify the appropriate locations in consultation with consultancy adopting the proper mitigation measures.

### 2.2.11 Earthwork Quantity of the Project

Earthwork quantity of the project mainly covers excavation and filling activities. The details of volume for these activities are as follows:

- 1) Excavation: 919444.24 cu.m.
- 2) Filling: 29229.28 cu.m.

### 2.3 Relevancy of the Proposal

Road passes through Prithvi Highway has already become wider but the narrow Mugling-Abukhaireni section impedes the traffic flow. As Mugling-Abukhaireni road project also proposed for the new construction of 4.456 km of road in virgin land of Gorkha, it helps to transform a rural settlement area into a facilitated develop area. Not only that, it also creates an opportunity to the people of Gorkha District accelerating economic boost from the long lasting market in near future. The two lane bridge of about 12.16m width over the Trishuli River and

Marshyangdi river access the people of Gorkha District to sell and buy the local products from near by market of Mugling and Anbukhaireni.  
Not only that, the propose project will help to control the traffic flow without disturbing any component of Marshyangdi Hydropower Project.

## CHAPTER 3: METHODOLOGY FOLLOWED FOR EIA

The EIA process follows the Environmental Protection Rules 2077. This EIA report is prepared in accordance with the legal requirements of GoN, based on approved ToR, field study, consultation with local people/stakeholders and officials of governmental organizations.

### 3.1 Desk Study/ Literature Review

The activities undertaken during the desk study were followings:

- **Consultation session with the proponent** to enhance understanding on the proposed project and associated potential issues.
- **Review of the approved Scoping and ToR document** of the project, and related policy, rules and regulations, guidelines, etc. related to Environmental Assessment process;
- **Preparation for field work mainly involved developing questionnaire and checklist, and training of enumerators.** The questionnaire checklist was designed in consultation with project staffs, which was designed to collect information mainly on socioeconomic issues, and some part of biological and physical aspects. Questionnaires were prepared to facilitate the collection of primary information using two techniques namely- Household survey and Community Consultation. The questionnaire and checklist intended to reveal 3 types of issues related to project (a) related to project component, (b) issues related to project construction, and (c) issues related to operation of the project.
- **Collection of secondary information** to define the existing bio-physical and socioeconomic condition of the study area from published and unpublished reports, maps, articles etc.
- Existing **spatial data** on the project area were also collected - digital data of topographic map 1:25,000 from Survey department. These informations were used to prepare digital elevation map (DEM), land use map, slope and aspect maps.

The following documents which were considered to be relevant for the study were reviewed:

- 1:25,000 scale topographical maps prepared by the Department of Survey, GoN.
- Geotechnical Report of Mugling-Abukhaireni Road and previous geological reports of the Nepal.
- Population Census, Central Bureau of Statistics, GoN/ Nepal, 2068
- District Profile of Affected Districts (Tanahu, Gorkha and Chitwan).
- Profiles of Concerned Rural Municipalities (Abukhaireni RM, Shahid Lakhan RM and Ichhakamana RM).
- Poverty and Social Analysis Report of Mugling-Abukhaireni, 2019
- Resettlement Plan of Mugling-Abukhaireni, 2019
- National Parks and Wildlife Conservation Act, 1973
- Forest Act, 2076, and Forest Regulation, 2079
- Guidelines for Community Forestry Development Program, 2066

Based on the reviewed information with respect to the project, data gaps were identified and the methodology described in following sections of this chapter was developed to collect other relevant information required for EIA study.

### 3.2 Project Area Delineation

For the purpose of the EIA, the study area is defined as the project area consisting of the project site as well as the area that will be impacted due to the construction and operation of the

proposed project. The term “*Project*” indicates the proposed Mugling- Abukhaireni Road and the “*Area*” includes the “*Direct Impact Zone*”, “*Indirect Impact Zone*” and “*Zone of Influence*”. The term “*project area*” is also referred to as study area for the EIA.

The project area or the study area has been divided into three parts, viz. *Direct Impact Zone*, *Indirect Impact Zone* and *Zone of Influence*, on the basis of the proximity and magnitude of impacts.

### 3.2.1 Direct Impact Zone (DIZ)

DIZ for the proposed project is the area where all the construction activities related to project works will take place. DIZ of the project includes RoW of the proposed road which also includes Corridor of Impact (COI) and the location of project utilities where project activities take place and from which direct impact on the surrounding environment is expected. The RoW of the project road is 30 m (15 m on either side from centerline of the road).

### 3.2.2 Indirect Impact Zone (IIZ)

Indirect Impact Zone for the proposed project will be 250 m aerial distance beyond DIZ which includes the area of affected wards of Rural Municipalities.

### 3.2.3 Zone of Influence (ZOI)

The Zone of Influence of the project includes the adjoining wards of the concerned municipality. The ZoI of the proposed road project includes:

**Table 3.1: Affected Wards and Municipalities**

S.N.	Affected Wards	Affected Municipalities/Rural Municipalities	District
1	5	Ichhakamana Rural Municipality	Chitwan
2	2, 3 and 4 (Revised)	Abukhaireni Rural Municipality	Tanahu
3	3	Shahid Lakhana Rural Municipality	Gorkha
4	13	Gorkha Municipality	Gorkha

Source: Field Survey, 2022

## 3.3 Field Work and Analysis

The field study was conducted by a multi-disciplinary team of experts. Field survey was carried out to collect the baseline information on physical, biological, socio-economic and cultural environment of the project area, after the approval of ToR and Scoping Documents by Ministry of Forests and Environment (MoFE).

64 Sample Household Survey and Community consultations were held in the Rural Municipalities along which the road passes so as to generate the baseline data of the area. The sample of questionnaire and checklists is attached in Appendix 9.

In order to cross-check the local information, local officials, ward levels, district co-ordination committee, divisional forest office, soil conservation, land revenue, water supply, irrigation, agriculture, CBS office, local NGOs/CBOs etc. were contacted to solicit site specific information.

While carrying out the survey, inventory of major religious, cultural and community areas, chautaries, gumba, cemeteries, festival areas etc. which might be affected by the implementation of the proposal were also documented.

Data on physical environment have been derived from available topographical map, aerial photographs, GIS maps, site observation and geological map, photography, consultation with

local communities and inquiring the history of natural disasters like flooding and mass movements in the area.

### **3.3.1 Physical Environment Parameters**

#### **3.3.1.1 Topography**

Information and data on topography/terrain types (i.e., elevation, aspects and slopes) were generated with the help of GPS, Topographic Maps, GIS, Google Earth Image, Regional and District Maps.

#### **3.3.1.2 Geology, Soil and Seismicity**

Review of geological map, field investigation and laboratory analysis of soil and rock of Project area was carried out to study the existing geology, sub-grade, sub-base and base strength of the proposed project area and along the road alignment. The detailed description about the geological condition of the project area is presented in Section 5.1.3.

Engineering Geological log along the road alignment was prepared to keep the information on landslide, major gully erosion, debris flow, soil and rock. Information in the log includes depth, rock type, geological structures and weathering grade.

#### **3.3.1.3 Slope Stability**

Slope stability and natural hazards information were investigated through topography/terrain observation and with consultation of local people. Likewise, Flood, landslide and soil erosion prone sections were observed and noted properly to prepare for their appropriate mitigation measures. The slope stability analysis was carried out using the computer program SLOPE/W with the Bishop's Method of analysis. The slope stability in rock was analyzed by using DIP 5.1 version computer software.

#### **3.3.1.4 Hydrology and Drainage**

Field investigation was based mainly on-site observation. Information and data such as rivers and their systems, morphology, catchment condition including maximum and minimum flow of the river and streams were collected from DHM and direct site observation. Description about the results obtained is provided in Section 5.1.6.

#### **3.3.1.5 Meteorology and Climate**

Data for precipitation and temperature were collected from DHM for 10 years. The respective stations are: {Bharatpur (Index No. 0927), Gorkha (Index No. 0809) and Bandipur (Index No. 0808) station}.

#### **3.3.1.6 Air, Water and Noise Quality**

##### **➤ Air Quality Monitoring**

24-hour air quality monitoring of the Muglin Bazar ( $27^{\circ} 51' 28.19''$  N and  $84^{\circ} 33' 57.78''$  E), Abukhaireni Bazar ( $27^{\circ} 54' 2.24''$  N and  $84^{\circ} 31' 12.45''$  E) and Karantar ( $27^{\circ} 51' 47.49''$  N and  $84^{\circ} 33' 57.78''$  E) was performed during the study. Air quality parameters  $PM_{10}$ ,  $PM_{2.5}$ ,  $NO_x$ ,  $SO_x$ , and CO were monitored for investigating baseline air quality of the project area. High Volume Air Sampler (manufactured by Green Tech Instrument India) was used to measure the  $PM_{10}$  concentration present in the ambient atmosphere of the monitoring sites whereas combined air sampler (Low Volume Air Sampler) manufactured by the same manufacturer was employed to measure the  $PM_{2.5}$  concentration. Chemical absorption methods particularly West

Gaeke and Griess-Saltzman were employed to measure the concentration of SO<sub>x</sub> and NO<sub>x</sub> from the ambient atmosphere. Monitoring of the concentration of carbon monoxide was carried out by using gas indicator tube method.

Depending on the size of the particles the suspended particles are collected in different parts of the equipment based on aerodynamic principle. The fresh glass filters and the sampling cups were conditioned properly keeping them inside the silica gel desiccator. The weight of the unexposed cups/filter papers was taken after complete conditioning. Tared filter paper and cups were fitted into the equipment and ambient air was drawn with constant flow for the desired times. The exposed filter paper and cups were conditioned again following the same procedure used for the unexposed filters/cups. Concentration of the different sizes dust particles were calculated from the weight of the dust collected at different points of the equipment.

The air sample was bubbled in a fixed flow through the TCM (solution) and sulfanilic acid absorbing solutions to absorb the SO<sub>x</sub> and NO<sub>x</sub> respectively present in the ambient atmosphere. The TCM was reacted with PRA (Pararosalina Reagent) dye to produced pink color where the intensity of color developed was measured at 548nm to quantify the concentration of SO<sub>x</sub> in the air. Oxides of nitrogen reacts with the absorbing solution (sulfanilic acid solution) to produce pink color complex, the absorbance of which is measured by spectrophotometer at 550nm to quantify the concentration of SO<sub>x</sub> in ambient atmosphere. Ambient gas was suctioned from the indicator tube using standard suction pump and the changed color of the indicator tube was used quantify the concentration of carbon monoxide (CO) in the atmosphere. Then, the results were compared with the Nepal standard for their analysis.

#### ➤ **Water Quality Monitoring**

To assess the baseline water quality of the project area three water samples were collected and analyzed. Water samples specifically from three different locations at downstream of proposed Trishuli River Bridge, (27° 51' 29.49" N and 84° 33' 56.83" E), Near Settlement Area (27° 52' 9.55" N and 84° 33' 8.31" E) and lastly downstream of proposed Marshyangdi River Bridge (27° 52' 35.59" N and 84° 32' 25.27" E) were collected and analyzed to verify the existing water quality of the project area. Water quality parameters specifically pH, turbidity, conductivity, total dissolved solids, TSS, total hardness, alkalinity, DO, BOD, iron, sulphate and *E.coli*. were investigated to assess baseline water quality. Standard methods of testing as specified by the Standard Methods for Examination of Water and Wastewaters, APHA-AWWA-WFE were employed while processing the water samples. And the results obtained were compared with national drinking water quality standard, aquatic ecological standard and irrigation standard.

#### ➤ **Noise Quality Monitoring**

The noise quality monitoring involved the measurement of intermittent noise pressure levels at certain interval of time. The intermittent noise level was monitored at three different places; Mugling (27° 51' 28.19" N and 84° 33' 57.78" E), Karantar (27° 51' 47.49" N and 84° 33' 57.78" E) and Abukhaireni Bazar (27° 54' 2.24" N and 84° 31' 12.45" E) of the project area using real time noise monitoring devices. The intermittent noise levels at the interval of every single hour were recorded for the period of 10-15 minutes. The noise meter was calibrated properly before taking measurements. The intermittent sound pressure levels recorded were treated properly to quantify various noise quality features. Then, the results were compared

with the National Standard. Equivalent Sound Level ( $L_{eq}$ ) was calculated by integrating the sound pressure level over a time period as:

$$L_{eq} = 10 \log \left[ \frac{1}{T} \int (P_A/P_{ref})^2 dt \right]$$

Where,

$L_{eq}$  = Equivalent Sound Level (dB)

T = Time Period (s)

$P_A$  = Sound Pressure (Pa, N/m<sup>2</sup>)

$P_{ref}$  = Reference Sound Pressure (2 10<sup>-5</sup> Pa, N/m<sup>2</sup>)

The results obtained from field survey and laboratory analysis is presented in Section 5.1.8.

### 3.3.1.7 Land Use

Study of land use types were carried out mainly through field observation with the help of topographical maps prepared by Land Use Mapping Project. During field investigation land use data available from Walkthrough Survey were also verified. Similarly, images from Google earth were also analyzed for the purpose.

The above-mentioned data/information were analyzed and interpreted for the preparation of EIA report.

### 3.3.2 Biological Environment Parameters

For biological parameters, both primary and secondary sources of information were used.

#### 3.3.2.1 Primary Sources

Primary sources were basically used for studying flora and faunal diversity. Information on fauna and flora, protected, rare, endangered species and sensitive habitats in the project areas were collected through site visit. Existing situation and possible impacts on wild fauna were studied in relation to risk of project implementation. Information on availability of fauna was also collected in consultation with local informants and members of community forest user's groups. Forest inventory was done along the road within RoW to estimate number of trees and volume of timber to be cleared. Interaction with local people and consultation with local communities were done for wildlife data.

##### i. Vegetation/Forest Resources

Project affected trees (DBH>30cm) and pole (DBH: 10-30cm) along the RoW of the project road alignment were counted individually and noted in a standard data sheet for trees to be cut down. Diameter at breast height (DBH) of the trees was measured at 1.3m from the ground level and height of the affected trees was also measured on the basis of standard format.

The data from tree measurements were quantitatively analyzed for basal area and to calculate the wood volume. Basal Area is the trunk cross-sectional area. The basal areas of each of the trees were calculated on the basis of diameter at breast height. These parameters were calculated by using following formulae:

**Basal Area =  $\pi d^2/4$  and;**

**Volume = Basal Area x Tree height x Form factor (0.50) [m<sup>3</sup>] (Source: <https://www.environmentalpollution.in/forestry>)**

##### ii. Consultation with CFUGs

The representatives of all five community forest affected by the project were consulted. They were pre-informed about the meeting through formal letters. The meeting was focused on availability of flora, dependency of local people on forest resources, availability of Non-Timber Forest Products (NTFPs), species to be planted, possible plantation sites and assistance required to community forest. The information about NTFPs gathered from field observation and consultation is provided in Table 5.9.

### **iii. Wildlife**

Data on wildlife were collected by direct observation and consultation with local people. Major habitat types were identified by direct field observation and using topographic maps. Different signs (e.g., droppings, scratches, calls, pugmarks, carcasses, scales) were considered as a form of identification of mammals, birds and reptiles. Other indirect indicators such as nests, dens, burrows were also observed in the area. The information about the fish was collected in consultation with local people and direct observation. (Provided in Section 5.2.3).

#### **3.3.2.2 Secondary Sources**

Information on conservation status of flora and fauna based on IUCN (1978), CITES (2017) and GoN's act such as Forest Act 2076 and National Parks and Wildlife Conservation Act, 1973 were collected through its revision. Similarly, review of different reports on wildlives published on authentic sources like news portal of MoFE, DoFSC and DNPWC. Other important secondary sources of information are affected district profile and municipality profile.

### **3.3.3 Socio-Economic and Cultural Parameters**

For socio-economic and cultural baseline study, a structured questionnaire was used to generate the information on settlement and individual households. Similarly, secondary data were also used for baseline information.

#### **i. Literature Review**

Based on previous experiences and the review of relevant literature associated with IEE and EIA studies of various road projects, demographic tables were developed. To fill these tables, a desk study was conducted in the office. All the relevant information associated with socio-economic and cultural environment was reviewed. On the basis of the reviewed information, data gaps were identified and the following techniques were used to collect the remaining data.

#### **ii. Identification of PAFs and SPAFs**

The land owners/structure owners of the project affected area have been identified. These identified families were considered as Project Affected Families (PAFs). In addition, the families losing their residence irrespective of their land holding size and other off farm income and the families losing more than 25% or more of land were identified as Severely Project Affected Families (SPAFs).

#### **Data Collection Tools**

After identification of PAFs, their baseline information was collected by using the following techniques: Households' Survey, Key Informant Interview, Public Consultation, Observation, and Photographs.

- **Households' Survey**

A Socio-Economic survey of project affected households (whose land and house will be permanently acquired) was carried out. The household questionnaire was applied by a trained team of enumerators to solicit information from project affected families. The household



survey was conducted within 30% of the household (i.e. 64 no.) from the total affected 223 household losing lands and structure. The questionnaire has been designed to cover demographic characteristics, basic health conditions, income and expenditure, water and sanitation related issues, attitude towards resettlement and expectations from the project etc.

- **Key Informant Interview (KII)**

A total of 10 Key Informant Interview was employed during the field visit to collect information on Project's socio-economic and cultural activities. The municipality level checklist was designed to collect information on basic demographic and migration patterns, food sufficiency and cropping patterns, existence of user's group/committees, public facilities and infrastructure, labour force availability, existence of archaeological and religious sites etc.

- **Field Observation**

The field observation of the project site was made by the team of sociologist and support staff during December, 2015 AD (2072 B.S.) to collect the baseline information of the project area during Poverty and Social Assessment study and during November/December, 2016 AD (2073 B.S.) to identify the potential environmental impact and the pertinent issues. And again, the team makes a field visit during February, 2022 AD (2078 B.S.) to ground truths all the baseline data of the study area. During the field visit, the team met the local stakeholders. Meetings were mainly focused on issues likely to arise due to implementation of the project, existing environment condition of the project area and views/concerns of stakeholders.

### **3.4 Impact Evaluation Method**

The identified impacts were predicted and evaluated in terms of their level of significance. Impact evaluation was done with duly considerations of national policies, acts, rules, strategies, standards and guidelines. In impact evaluation, public concern, social impacts, scientific and professional evidence resource use and ecological damage was also considered. An interactive group method was applied for evaluating significance and importance of the socio-economic parameter. In this process, group of people (Experts and Stakeholders) were involved to evaluate the significance of impact of the project on the environment. Based on the experts and stakeholders' judgement ranking of the impacts, numerical scale was developed to provide a qualitative assessment of various types of predicted impacts. These predicted impacts will be evaluated to know their environmental significance, taking into consideration the Magnitude, Extent and Duration as mentioned in the National EIA Guidelines, 1993 and EPR 2077.

Magnitude of the Impact: The magnitude of impact is determined on the basis of each potential impact severity. It also indicates whether or not the impact is reversible. The magnitude of impact is considered to be serious if a major adverse impact cannot be mitigated. Moderate to minor unmitigated impacts of a similar nature would make the resources still usable but might cause inconvenience to the public.

Extent of Impact: The extent of impact that is confined to the project site is known as site-specific impact. If the impact of the proposed project is limited to the local level/project affected area alone, it is called a local impact. An impact is considered to be of regional level if it extends beyond the local level.

Duration of Impact: Generally, an impact that lasts for only 3 years after project initiation may be classified as short term; an impact that continues for more than 3 years but less than 20 years may be considered as medium term; and an impact that lasts beyond 20 years is considered to be long term. The types of impact produced during different phases of construction of a project are generally of a temporary nature.

### 3.5 Impact Categorization and Mitigation Measures

A matrix will be developed to determine the probable impacts categorization with respect to magnitude, extent and duration. Mitigation measures will be proposed for likely adverse impacts on physical, biological, socio-economic and cultural environment and a matrix will be developed for the same. The Table 3.2 shows the Impact Ranking Methodology.

**Table 3.2: Impact Ranking Methodology**

Magnitude		Extent		Duration		Types
Description	Rank	Description	Rank	Description	Rank	
High/ Major	60	Regional	60	Long Term	20	Direct
Medium/ Moderate	20	Local	20	Medium Term	10	Indirect
Low/ Minor	10	Site specific	10	Short Term	05	

Source: National Environmental Impact Assessment Guidelines, 1993

### 3.6 Significance of the Impact

Significance of the impact will be determined after the addition of the impact values for magnitude, extent and duration of the impacts.

**Table 3.3: Significance of Impact**

Total Impacts' Rank	Significance of Impacts
<45	Insignificant
45-75	Significant
>75	Very Significant

Source: National Environmental Impact Assessment Guidelines, 1993

### 3.7 Environmental Monitoring

An environmental monitoring plan was proposed for baseline, compliance and impact monitoring for physical, biological, socio-economic and cultural environment. A monitoring schedule, monitoring parameters and responsible agencies for monitoring activities was explained. An Environmental impact summary of the proposal was developed, which explains about the project activities, identified environmental impacts associated with these activities, impact prediction in terms of their magnitude, extent and duration, relevant pragmatic mitigation measures and the responsible agency for implementing these mitigation measures. As per EPR 2020, Rule 45(1), proponent will individually prepare and submit the impact monitoring report of Construction and Operation Phase to the concerned institutions or department in the duration of every 6 months. Also, the ADB will be responsible for monitoring of project's impacts in every 6 months during its construction and operation phase.

### 3.8 Public Hearing

The notice regarding the public hearing was published on Chitwan Post on 2078/11/12 (Local Daily). The invitation letters issued by PD ADB for public hearing were dispatched to offices like District Coordination Committee, District Administration Office of Tanahu and Gorkha. Similarly, dispatched to Illaka Police Office, Abukhaireni as well as affected ward officers of Aabukhaireni RM (2, 3 and 4) and Sahid Lakhan RM (ward no. 3) and other concerned agencies. Apart from this, representatives of local clubs of Aabukhaireni, Sahid Lakhan RM and DFOs of Abukhaireni and Sahid Lakhan along with local people were also invited. Public hearing was conducted in Abukhaireni Rural Municipality Hall on 2078/11/14 and Sahid Lakhan Rural Municipality ward no. 3 premises on 2078/11/14 where 23 and 65 participants

attended the event respectively. Public hearing was conducted in Ichhakamana Rural Municipality Hall on 2078/12/16 where 39 participants attended the event.

Altogether, there were 127 participants including stakeholders as well as locals from the DIZ. Major issues/suggestions in the public hearing were collected and presented in the Impact Section (7.4) as well as in Appendix 5 of the report.

### **3.9 Preparation of EIA Report**

Based on the analysis of impacts and their nature, appropriate beneficial impacts maximization measure and adverse impacts mitigation measures were prepared. Such measures were based on site specific issues, past experience on similar projects, and expert judgments. Monitoring plan for the implementation of mitigation measures was prepared. Based on above, Environmental Management Action Plan (EMAP) has been prepared including defined activities, their impacts, mitigation measures, their methodology, implementation schedule, responsible and supervisory agency to implement such measures and cost for mitigation as well as monitoring activities. EIA report was prepared including all the above said details in the format prescribed in Rule 3 of EPA 2076 and Schedule 12 of the EPR 2077.

## CHAPTER 4: REVIEW OF RELEVANT POLICIES, ACTS, RULES, GUIDELINES AND CONVENTIONS

The prevailing plans, policies, acts, rules/ regulations, guidelines, standards, conventions and strategies related with the development of the road projects in Nepal were reviewed during the preparation of EIA report. The objective of the review of legislative provision is to understand existing policy provision that is applicable for the implementation of the project and to ensure meeting these legal provisions during different phases of project implementation. The applicable legislative provisions reviewed are presented here under.

### 4.1 CONSTITUTION OF NEPAL

The article 30 (1) of constitution has granted 'every person shall have the right to live in clean and healthy environment' as a fundamental right for the people. The victim shall have the right to obtain compensation, in accordance with law, for any injury caused from environmental pollution or degradation.

Article 51 of the constitution mentions about pursuing policies to develop balanced, environment friendly, quality and sustainable physical infrastructures, while according priority to the regions lagging behind from development perspective. The article also mentions about sustainable development.

### 4.2 POLICIES AND PLANS

- **Fifteenth Plan (Fiscal Year 2076/77-2080/81)**

Fifteenth Plan 2076 has focused its objectives to extend road network keeping the net transportation cost at minimal level and continue upgrading as well as maintenance work to ensure regular road connectivity. This policy has established multiple working area plans. It has planned to ensure balanced development in considering provincial level balanced infrastructure development while establishing express highway, tunnels and other modern infrastructure based on master. It has also ensured the contract only after completion of all designed reports as well as declaration of Row of the road. Furthermore, it has also been planned to promote modern infrastructure construction through adoption of modern technology as well as providing surplus input on activities such as bioengineering.

- **Nature Conservation National Strategic Framework for Sustainable Development (NCNSFSD), 2015 – 2030 (2071/2085)**

The National Conservation Strategy of Nepal aims to satisfy the basic needs of the people of Nepal (whether material, spiritual or cultural); to ensure the sustainable use of Nepal's land and renewable resources; to preserve the biological diversity of Nepal in order to maintain and improve the variety and quality of crops and livestock and to maintain the variety of wild species both plant and animal; and to maintain the essential ecological and life-support systems such as soil regeneration, nutrient recycling and the protection and cleansing of water and air.

- **20 Year Road Plan, 2059-2079**

The GoN has formulated a 20 Year Road Plan. Nepal's road network can be broadly divided into two parts: the Strategic Road Network (SRN) and the Rural Roads (RR). The SRN is currently being updated to include approximately 5500 kilometers of completed and proposed national highways and feeder roads. It carries most of the road traffic and provides the national transportation links between main centers and to neighboring countries. Within the SRN is the loosely defined core road network (CRN). It comprises approximately 1,500 km of national highways with the highest traffic volumes (greater than 1,000 vehicles per day). The CRN carries the bulk of longer distance commercial traffic movements, linking all major commercial

centers, economic centers and main border crossings. The RR comprises approximately 4,600 km of district roads, plus trails, tracks and suspension bridges.

- **National Biodiversity Strategy and Action Plan, 2071-2077**

The Action Plan designed for the period 2014-2020 is aimed to provide a strategic framework for the conservation of Nepal's biodiversity. The National Biodiversity Strategy and Action Plan have been prepared with a 35-year vision of "conservation of biodiversity for sound and resilient ecosystems and national prosperity". The overall goal is to significantly enhance the integrity of Nepal's ecological systems by 2020, thereby contributing to human well-being and sustainable development of the country.

The policy mentions about the four approaches for land acquisition: Voluntary donation, direct negotiation, Land development program and Expropriation.

- **National Environment Policy, 2076**

The policy has created new version for the management of pollution, waste along with maintenance of greenery to ensure people's right to live in a healthy and hygienic environment. Similarly, the policy has objectives of mainstreaming the environmental concerns in development activities. It has emphasized to promote reuse and recycle of the waste. To prevent, control and minimize the pollution has proposed following policies and strategies; efficient structures will be formed to prevent, control and minimize the pollution;

- Promotion of environment friendly vehicles;
- Waste segregation as well as promotion of reuse and recycle technique;
- To maintain the hygienic aquatic environment direct release of polluted water, sewage and solid waste to the water bodies will be prevented. While managing the solid and liquid waste, appropriate mitigation measures shall be imposed to the source and minimize the potential adverse impacts on downstream area.

- **National Climate Change Policy, 2076**

The Government has followed a theme-based approach in formulating Climate Change Policy, 2076 (BS). The strength of the policy, 2019 is the inclusion of guiding principles which are related to common but differentiated responsibilities and capabilities, need for internalization of climate change aspects in relevant policies, plans and programs, sustainable development, equity, public participation, coordination and cooperation, science-based decision-making, and balance between national priorities and international relations (with priority on climate change adaptation).

- **National Forest Policy, 2075**

This policy focuses on sustainable management of forest in Nepal. It emphasizes for green economy, employment generation, tourism development, carbon sequestration, biodiversity conservation and watershed management, to contribute for country's prosperity as national goal. This policy is related to overall management of forest for development of user's group, cooperatives, forest entrepreneurs, medicinal plants and NTFPs entrepreneurs. As country is newly structured in three federal systems with three type of government, this policy also defines roles and responsibilities and resource mobilization of forest by three types of governments.

- **Land Use Policy, 2072**

Land use Policy is a policy document relating to limits and protection of Land and Land Resources, optimum use and effective management thereto.

The National need of this policy is to ascertain of environment-friendly construction-works by making optimum use of Lands and Land Resources in keeping with a balance between the environment and development, to develop a hygienic, beautiful, well-facilitated and safe

human settlement; to enhance a planned and sustainable urbanization of the country, and to achieve sustainable and inclusive economic boost up through devising and executing of all regional development plans of the country under a level-wise Land Use Plans. The vision of this Policy is to make optimum use of available Lands and Land Resources in pursuit of sustainable social, economic and ecological developments and prosperity of the country as well.

- **Land Acquisition, Resettlement and Rehabilitation Policy for infrastructure development project, 2071 B.S.**

The main goal of this policy is to improve social and economic status of project affected families by providing fair and adequate compensation, appropriate resettlement and rehabilitation assistances. Its main objective is to create conducive environment for timely completion of the project by simplifying land acquisition, valuation, compensation, and resettlement and rehabilitation process. This policy asks to carry out meaningful consultation with affected persons and vulnerable groups and provide compensation on time based on current market value.

- **National Transport Policy, 2058**

This policy states, among others, that the entire process of land acquisition and transferring of land ownership to the project shall be established prior to the commencement of road project implementation. Equally, a basis for livelihood shall be established to the fully displaced families by way of rehabilitation or by any other means.

- **Environmental Assessment in the Road Sector of Nepal: A Policy Document, GESU/DoR, 2056**

The purpose of the Policy Document is to explain, basically the DoR Engineers on what environmental assessment procedures involve and to propose a straight forward set of procedures which make it workable and useful. The document lists Screening, IEE, Scoping, EIA and Monitoring as the five main types of environmental assessment activities. The different phase when a particular type of EA is required is also listed in the document. The document lists the category of environmental adverse impacts, the problems and their general mitigation measures. The document then guides the various steps to be taken while carrying out an EA. Indicative environmental monitoring checklist is given in the document.

### 4.3 ACTS

- **Environment Protection Act, 2076**

The EPA, 2076 recognizes the interdependence between development activities and the environment; and emphasizes the proper use and management of natural resources. This Act provides the legal basis for EIA study and implementation and stresses the minimization of adverse impacts on the physical, biological and socio-economic environments. Sections 3 and 4 require that the project proponent conduct an IEE or EIA of the proposed Project and obtain approval from the concerned agency or ministry for project implementation.

The EPA empowers to prohibit the use of fuel, equipment or plant which may have adverse effects on the environment, and includes provisions for Environmental Inspectors to monitor construction and ongoing infrastructure and development projects. The EPA, 2076 is mandatory and forms the basis for environmental studies of the development project.

- **Forest Act, 2076**

The forest Act, 2076 is expedient to amend and consolidate the prevailing laws on forests in order to manage the national forests as the Government managed forest, forest protection zone, community forest, partnership forest, lease-hold forest and religious forest and to make contribution to national prosperity by protecting, promoting and utilizing the wildlife, environment, watersheds and bio-diversity, while promoting the private, public and urban forests.

- **Labor Act, 2074**

According to the Labor Act 2017, section 4 on employment of workers and employees, and subsection 3 on workers or employees engaged in any contract work of a permanent nature in any enterprise will also be made permanent under subsection (2). Under section 5, no child will be employed. Except in prescribed circumstances, minors and women may ordinarily be employed for the period from 6 a.m. to 6 p.m. Women may be employed like men after making appropriate arrangements on the basis of mutual agreements between the general manager and the employees or workers in question. All labors should be provided safety equipment such as helmets, gloves etc. during works. The Labor Act will be followed in all the works carried out under the Project.

- **Solid Waste Management Act, 2068**

The objectives of the act include maintaining a clean and healthy environment by minimizing the adverse effects of solid waste on public health and the environment. The act mandates local bodies to take the necessary steps to promote reduce, reuse, and recycle (3R), including segregation of MSW at source. It also authorizes the local bodies to formulate rules, by-laws, and guidelines.

- **Road Board Act, 2058**

The Road Board Act, Section 14 has provisioning mandate to the road-related body to submit to the Board an annual programme regarding repair and maintenance of the roads each year within the prescribed time-limit, setting out the roads which it intends to repair and maintain. It has to give information of such programme to the Ministry.

- **Child Labor (Prohibition and Regularization) Act, 2056**

Child related Act, 2048 (1993) and Child Labor (abolition and regulation) Act, 2056 (2001) are the major acts related to child labor in Nepal. The Child Labor (Abolition and Regulation) Act, 2056 (2001), Article 3, Clause 1 prohibited for labor employment any child below the age of 14 years. Clause 2 prohibit child below 16 years to work in risk-prone sectors such as public transportation and construction related works.

- **Motor Vehicles and Transport Management Act, 2049**

The Act defines and prescribes necessary standards 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 engine under the Nepal Vehicle Mass Emission Standard 1999.

- **Soil and Watershed Conservation Act, 1982 (2039)**

The Act was created to manage the watersheds of Nepal. Section 2 (B) of the Act defines soil and watershed conservation. According to section 3, the GoN may declare any area as a protected watershed area and can acquire such land by giving written notice. Determination of the compensation rate for private land for this purpose shall be in consultation with local authorities. Section 10 of the Act identifies activities that are prohibited in areas where natural disasters have occurred or are expected to occur. This act will guide watershed conservation during the implementation of the project.

- **Land Acquisition Act, 2034**

Land Acquisition Act, 2034 (1977) with amendment in 2049 (1993) guides the compulsory acquisition of land in the country. Government can acquire land at any place in any quantity by giving compensation pursuant to the Act for the land acquired for any public purposes or for operation of any development project initiated by government institutions (Section 3 and 4). The powers given under these sections are very broad as government is empowered to acquire any land in the name of public works.

- **Public Road Act, 2031**

The Public Road Act, 1974 has been enacted to ensure the construction and operation of the road projects smoothly. Section 3 of the Act empowers GoN to prohibit the construction of permanent structures (buildings) in the prescribed distance from the road, i.e. the Department of Roads (DoR) has the authority over everything within the boundaries of the road. The DoR may acquire the land temporarily and other property adopting compensatory measures during the construction, rehabilitation and maintenance of the public road (Sections 14 and 15). The Act obliges the DoR to plant trees on both sides of the road and hand it over to the local bodies (Municipality) for their management (Section 16). The Act also empowers the DoR to operate quarries and borrow pits and other facilities during the road construction (Section 17). In sum, the Act facilitates the construction of this road by even acquiring land and property including for the execution of construction materials and development of other facilities during road construction through compensation as negotiated and as well as to maintain greenery along the roadside.

- **Aquatic Animal Protection Act, 1960 (2017)**

The Aquatic Animal Protection Act, 1960 provides the legislative protection of the aquatic habitats. The section three (3) of the Act renders punishment to any party introducing poisonous, noxious or explosive materials into the water source or destroying any dam, bridge or water system with the intent of catching or killing aquatic life. The section four (4) empowers the government to prohibit catching, killing and harming certain kinds of aquatic animals through notification in the Nepal Gazette.

#### 4.4 RULES AND REGULATIONS

- **Forest Regulation, 2079**

According to Rule (87) of Forest Rule 2079; all the projects need to design in such a manner that it will use minimal/no forest area. In case of no option to use the forest area, Rule (91) provisioned that Nepal Government shall provide forest land for the national priority project. The project shall compensate the forest land to the Forest Authority. Compensation of the forest area as well as plantation can be made in equivalence cost. Compensation of forest land will be part as part the provision in rule 92 and rule 93. According to rule (102), it is responsibility of either project to make available the technical persons for the tree cutting process to find the no. of trees to be cleared. Project need to follow the provisions mentioned under the rule 102 and get approval of tree cutting permit. Examined report has to be submitted to Directorate for verification. DFO will issue the cutting permit after getting approval from forest Directorate.

- **Environment Protection Rules, 2077**

The EPR, 2077 establishes the process to be followed during the preparation and approval of Scoping, Terms of Reference for EIAs, and the preparation of IEE or EIA reports for proposed Projects. It also includes provisions for compliance with findings included in the IEE and/or EIA reports; monitoring and environmental auditing; prevention and control of pollution; description of the functions, duties and powers of Environmental Inspectors; conservation of national endowments; establishment of environmental laboratories; mechanisms for operating



the environmental conservation fund; rights to environmental compensation; and other related matters.

- **Labor Rules, 2075**

Rule 7 is concern with occupational safety and health policy. Employers are required to maintain an occupational health and safety policy including provisions related to arrangements Employee's safety and security, Employee's health, probable accident in workplace, precautions to be taken while operating devices and machines in workplace and precautions to be taken while using chemical substances. The Labor Rules has provided the detail safety measures to be followed by Employer.

- **Solid Waste Management Rules, 2070**

Rule 3 mentions about segregation and management of solid waste, rule 4 about discharge of solid waste and rule 5 about discharge and management of harmful and chemical waste.

- **Child Labor (Prohibition and Regulation) Rules, 2062**

This Rule was framed in exercise of powers conferred by section 27 of the Child Labor (Prohibition and Regulation) Act, 2056. Before, employing a child as a Labor an application shall be filed in the Labor office to examine his /her health in relation to his/her ability and inability to do the work, mentioning about the nature of the work and the age of the child. A child working in an Enterprise shall get the monthly remuneration and allowance not less than prescribed by the Government of Nepal by publishing a notice in Nepal Gazette from time to time. A child working in an Enterprise shall get at least Thirteen days public holiday with full salary each year. A child who goes to school shall get 10 days educational leave during the annual examination in a year.

#### 4.5 GUIDELINES AND MANUALS

- **Procedures for National Priority Project to Acquire National Forest Land with Standards, 2076**

This procedure has been formulated as per Section 72 (Ka) of Forest Act 2049. According to Sub-section 1 of Section 4, if any proposed project lies in National Forest, the concerned party should conduct IEE or EIA according to the prevailing EPA and EPR. According to Section 17 of this procedure, the project proponent itself will be responsible to remove the trees on its own cost and hand over the forest resources to the concerned forest office. They should plant the saplings as per forestry norms if the project is subjected to remove the trees. They will be responsible to take care and protect the planted tree for five years with the co-ordination with concerned forest office.

- **Forest Products Collection and Sale/Distribution Guidelines, 2073**

The clauses 3 to 10 of the guidelines have specified various procedures 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 are responsible for the approval. These provisions have a direct relevance to the development of the project and need compliance to these provisions.

- **Occupational Safety and Health Guidelines, 2074**

This guideline guides all projects under DoLIDAR with basic principles for working safely on construction sites and for ways for Contractors and managers to manage the safety and health on site.

- **Reference Manual for Environmental and Social Aspects of Integrated Road Development, MoPIT/DoR, 2003 (2059)**

The Manual is designed to help integrate social and environmental considerations, including public involvement strategies, with technical road construction practices. It suggests stepwise process of addressing E & S issues alongside the technical, financial and others. The Manual is a suggestive, and not exhaustive, and advise and recommends various environmental and social approaches, actions and strategies to assist developers in following mandatory requirements of the law and improving public involvement.

- **Roadside Bio-Engineering- Site Hand Book, DoR, GoN, 2056**

This handbook provides information needed to design, plan, implement and maintain roadside bio-engineering works. It also covers the establishment and maintenance of bio-engineering nurseries.

- **Environmental Management Guidelines, GESU/DoR, 2055**

This guideline assists to integrate environmental consideration in each phase of project cycle. The guideline consists of environmental mitigation measures to be incorporated into Road projects, procedures for public participation, and socio-economic consideration.

- **Guidelines for Environmental Management in Road Sector, 1999 (2055)**

This guideline assists to integrate environmental consideration in each phase of project cycle. The guideline consists of environmental mitigation measures to be incorporated into Road projects, procedures for public participation, and socio-economic consideration.

- **EIA Guidelines for Forestry Sector, 2052**

Within the framework of the National EIA Guidelines, GoN has prepared and implemented separate EIA Guidelines for Forestry Sector which is also related with the project. These guidelines encourage the proponent to identify the likely impacts of the project on environment. The forestry sector EIA guidelines aim to facilitate the sustainable use of forest resources for the socio-economic development and to meet the basic needs of the communities for forest products.

- **National Environmental Impact Assessment (EIA) Guidelines, 2050**

The guideline assists mechanisms for conducting Environmental Assessment. This guideline guides in project screening, scoping, identifying project impacts, adopting mitigation measures, monitoring, evaluating impacts, community participation and report preparation.

#### **4.6 ENVIRONMENTAL STANDARDS**

- **National Road Standard, 2070**

Nepal Road Standards- 2027 (Second Revision 2070), applies to all Strategic Roads in rural areas being constructed within Nepal. Based on this standard, standard designs for roads and bridges including typical drawings were prepared.

- **National Ambient Air Quality Standard, 2069**

National Ambient Air Quality Standard is established for various parameters such as TSP, PM<sub>10</sub>, Sulphur Dioxide, Nitrogen Dioxide, Carbon Monoxide, Lead, Benzene, PM<sub>2.5</sub> and Ozone. The standard states that the maximum concentration stated for averaging time of 24 hours for TSP, PM<sub>10</sub>, Sulphur Dioxide, Nitrogen Dioxide, and PM<sub>2.5</sub> and the maximum concentration stated for averaging time of 8 hours for Carbon Monoxide and Ozone should be under standard limit for at least 95% duration for one fiscal year and should not exceed maximum concentration for 18 days in 365 days. No any parameters shall exceed its maximum concentration limit for two consecutive days within one year.

**Table 4.1: National Ambient Air Quality Standards for Nepal, 2012**

Parameters	Units	Averaging Time	Concentration in Ambient Air, Maximum ( $\mu\text{g}/\text{m}^3$ )
TSP (Total Suspended Particles)	$\mu\text{g}/\text{m}^3$	Annual	230
		24 hours	
PM <sub>10</sub>	$\mu\text{g}/\text{m}^3$	Annual	120
		24 hours	
PM <sub>2.5</sub>	$\mu\text{g}/\text{m}^3$	24 hours	40
Sulphur Dioxide	$\mu\text{g}/\text{m}^3$	Annual	50
		24 hours	
Nitrogen Dioxide	$\mu\text{g}/\text{m}^3$	Annual	40
		24 hours	
Carbon Monoxide	$\mu\text{g}/\text{m}^3$	8 hours	1000
Lead	$\mu\text{g}/\text{m}^3$	Annual	0.5
Benzene	$\mu\text{g}/\text{m}^3$	Annual	5
Ozone	$\mu\text{g}/\text{m}^3$	8 hours	157

(Source: Ministry of Environment, Science and Technology, Nepal Gazette 2069/07/13)

- **National Ambient Sound Quality Standard, 2012 (2069)**

**Table 4.2: Recommended Noise Exposure Limits for the Work Environment**

Types of Environment	Noise Limit Leq (db)	
	Day	Night
Industrial Area	75	70
Commercial Area	65	55
Rural Settlement Area	45	40
Urban Residential Area	55	50
Mixed Residential Area	63	55
Peaceful Area	50	40

Source: Ministry of Environment, Science and Technology, Nepal Gazette 2069/07/13

- **National Diesel Generator Emission Standard, 2069**

The GoN has introduced the National Diesel Generator Emission Standard (NDGES) for new and in-use diesel generators with a capacity of 8 kW-560 kW. The emissions limits are set for four major pollutants: CO, HC, NO<sub>x</sub>, and PM. Generators used for the project should comply with the emissions limit.

#### 1. Emissions Limits (g/kWh) for Imports of New Diesel Generators

**Table 4.3: Emissions Limits (g/kWh) for Imports of the New Generators**

Category (kW)	CO	HC+NO <sub>x</sub>	PM
Kw < 8	8.00	7.50	0.80
8= kW < 19	6.60	7.50	0.80
19= kW < 37	5.50	7.50	0.60

Category (kW)	CO	HC+NO <sub>x</sub>	PM
37 = kW <75	5.00	4.70	0.40
75 =kW<130	5.00	4.00	0.30
130 = kW <560	3.50	4.00	0.20

*Note: This standard is equivalent to EURO III or INDIA III*

Source: Ministry of Environment, Science and Technology, Nepal Gazette 2069/07/13

## 2. Emissions Limits (g/kWh) for In-use DG Sets

**Table 4.4: Emissions Limits (g/kWh) for In-use DG Sets**

Category (kW)	CO	HC	NO <sub>x</sub>	PM
Kw < 8	8.00	1.30	9.20	1.00
8= kW < 19	6.60	1.30	9.20	0.85
19= kW < 37	6.50	1.30	9.20	0.85
37 = kW <75	6.50	1.30	9.20	0.85
75 =kW<130	5.00	1.30	9.20	0.70
130 = kW <560	5.00	1.30	9.20	0.54

*Note: This standard is equivalent to EURO III or INDIA III*

Source: Ministry of Environment, Science and Technology, Nepal Gazette 2069/07/13

- Sampling collection point should be located at one-third of the DG set stack height.
- kW= Power Factor \* kW
- Testing Methodology: Should be according to ISO 8178 or equivalent to ISO 8178 standard set by the manufacturing country.

### • Nepal Vehicle Mass Emission Standard, 2069

Nepal Vehicle Mass Emission Standard 2069 has been enforced so as to enhance environmental cleanliness at the sites important from the cultural, religious and touristic perspectives, and to offer people an environment where they can inhale fresh air. This standard entailed about the types of documents related to positive ignition engines, type approval and conformity assessment requirements of imported petrol and diesel driven vehicular means equivalent to the Euro 3 will only be operated as per the standard. Thus, this standard allows the movement of environment friendly zero emissions vehicles complying with the Euro III standard and restricts the earlier Euro I vehicles.

### • Nepal Bridge Standard, 2067

Department of Roads (DOR) has formulated these standards with a view to establish a common procedure for design and construction of road bridges in Nepal. All permanent bridges shall be designed for a design life of minimum 50 years. Traffic projections shall be made for a period of 30 years and designed for a design discharge of 100 yrs. return period.

As per Nepal Bridge Standards 2067, Classification of bridges shall be as follows:

- Culvert: Length up to 6m
- Minor Bridge: When length  $\leq$  50m (with span  $\leq$  25m)
- Major Bridge: When span  $>$ 25m or length  $>$ 50m (with smaller spans)
- Special Bridge: Bridge that require special design considerations, whose construction features (e.g. concrete girder bridges with  $>$ 50m span, steel truss  $>$ 100m span, arch bridges, suspension bridges, cable-stayed bridges and other non-standard bridges)

The standard has provided guidelines for geometric standards (carriageway, footpath, curbs and safety curbs (bridge barriers), carriageway drainage, clearances (vertical & horizontal or lateral), Minimum Free board, and Bridge Loadings, etc. Railings, Material Specification, provision of carrying utilities (electricity, water, telephones, cables, etc.).

- **National Drinking Water Quality Standards, 2079**

**Table 4.5: National Drinking Water Quality Standards, 2079**

Type	Compulsory Test Parameters	Unit	Maximum Concentration Limits	Remarks
Physical	Turbidity	NTU	5	NHBGV
	pH	-	6.5-8.5*	NHBGV
	Color	TCU	5	NHBGV
	Taste & Odor	-	Should not be objectionable	NHBGV
	Electrical Conductivity	µs/cm	1500	NHBGV
Chemical	Iron	mg/L	0.3 (3)	NHBGV
	Manganese	mg/L	0.2	NHBGV
	Arsenic	mg/L	0.05	NHBGV
	Fluoride	mg/L	0.50-1.50	HBGV
	Ammonia	mg/L	1.50	NHBGV
	Chloride	mg/L	250	NHBGV
	Sulphate	mg/L	250	NHBGV
	Nitrate	mg/L	50	HBGV
	Copper	mg/L	1	NHBGV
	Zinc	mg/L	3	NHBGV
	Aluminium	mg/L	0.20	NHBGV
	Total Hardness	mg/L	500	NHBGV
	Residual Chlorine	mg/L	0.1-0.50	HBGV
Micro Biological	E. Coli	CFU/100 ml	0	HBGV

\*These values suggest minimum & maximum limit.

( ) The value inside bracket is valid if there is no alternative.

*Added Test Parameters under risk and relevancy*

Type	Parameters	Unit	Maximum Concentration Limits	Remarks
Physical	Total Dissolved Solids	mg/L	1000	NHBGV
Chemical	Calcium	mg/L	200	HBGV
	Lead	mg/L	0.01	HBGV
	Cadmium	mg/L	0.003	HBGV
	Chromium	mg/L	0.05	HBGV
	Cyanide	mg/L	0.07	HBGV
	Mercury	mg/L	0.001	HBGV
	Nitrites	mg/L	3	HBGV
Micro Biological	Total Coliform	CFU/100 ml	0	HBGV

*HBGV: Health Based Guideline Value*

*NHBGV: Non-Health Based Guideline Value*

*Source: Government of Nepal, Ministry of Water Supply*

- Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems

**Table 4.6: Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems**

S. N.	Parameters Name	Target Water Quality Range	Chronic Effect Value	Acute Effect Value
1	Aluminium (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 CaCO <sub>3</sub> )	<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 CaCO <sub>3</sub> )	< 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 or a particular site or case, at a specific time.		
15	Lead (µg/L)			
	Soft Water (60 mg/l CaCO <sub>3</sub> )	< 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, or by >5%, and should be assessed by whichever estimate is more conservative.		
20	Phenols (µg/L)	< 30	60	500

S. N.	Parameters 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, through 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°C, 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: Environment Statistics of Nepal, 2019

- **Nepal Water Quality Guidelines for Irrigation Water**

**Table 4.7: Nepal Water Quality Guidelines for Irrigation Water**

S.N	Parameter	Maximum Concentration Limits	Remarks
<b>Physical Constituents:</b>			
1	pH	6.5-8.5	Adverse effects on plants outside this range
2	Suspended Solids	< 50 mg/l	Above the limit problem with sedimentation and irrigation system
3	Electrical Conductivity	< 40 mS/m	Upto 540mS/m depending upon sensitivity of crops.
<b>Chemical Constituents:</b>			
1	Aluminium	< 5.0 mg/l	Upto 20mg/l max. acceptable conc.
2	Arsenic	< 0.1 mg/l	>2mg/l creates severe problem
3	Beryllium	< 0.1 mg/l	0.1-0.5 mg/l max. acceptable conc.
4	Boron	< 0.5 mg/l	Upto 15mg/l depending upon species.
5	Cadmium	< 0.01 mg/l	0.01-0.05 mg/l max. acceptable conc.
6	Chloride	< 100 mg/l	Upto 700 mg/l depending upon species

S.N	Parameter	Maximum Concentration Limits	Remarks
7	Chromium	< 0.1 mg/l	Upto 1.0 mg/l max. acceptable conc.
8	Cobalt	< 0.05 mg/l	Upto 5.0 mg/l max. acceptable conc.
9	Copper	< 0.2 mg/l	Upto 5 .0 mg/l max. acceptable conc.
10	Fluoride	< 2.0 mg/l	Upto 15 mg/l max. acceptable conc.
11	Iron	< 5.0 mg/l (non-toxic)	>1.5 mg/l creates problem in drip irrigation system
12	Lead	< 0.2 mg/l	Upto 2.0 mg/l max. acceptable conc.
13	Lithium	< 2.5 mg/l	For citrus <0.75 mg/l
14	Manganese	< 0.02 mg/l	Upto 10 mg/l max. acceptable conc.
15	Molybdenum	< 0.01 mg/l	Upto 0.05 mg/l max. acceptable conc.
16	Nickel	< 0.2 mg/l	Upto 2.0 mg/l max. acceptable conc.
17	Nitrogen (Inorganic)	< 5 mg/l	Higher concentration may affect sensitive plants and may contaminate ground water
18	Selenium	< 0.02 mg/l	Upto 0.05 mg/l max. acceptable conc.
19	Sodium Absorption Ratio (SAR)	< 2.0	Upto 10 depending upon sensitivity of crops.
20	Sodium	< 70 mg/l	Upto 460 depending upon sensitivity of crops
21	Total Dissolved Solids (as EC)	< 40 mg/l	Upto 540 mS/m depending upon sensitivity of crops
22	Uranium	< 0.01 mg/l	Upto 0.1 mg/l max. acceptable crops
23	Vanadium	< 0.1 mg/l	Upto 0.1 mg/l max. acceptable crops
24	Zinc	< 1.0 mg/l	Upto 5 mg/l max. acceptable crops
<b>Microbiological Constituents</b>			
1	Coliforms (faecal)	< 1 count/100ml	1-1000 count/100ml could be used for plants for which edible parts are not wetted.

Source: Environment Statistics of Nepal, 2019

#### 4.7 CONVENTIONS

Nepal is signatory to many international conventions, which deal with the protection of environment. A list of the conventions on which Nepal is a signatory are:



- **Convention on Biological Diversity, 2049**

Nepal signed the convention on Biological Diversity on June 12, 1992 in Reo de Janerio. The convention provides a boarder framework on the need for carrying out EIA to minimize adverse impacts of the projects and programs on biodiversity. The Article 14 of the convention provides for the impact assessment and minimizes the adverse impact. In broader sense, it calls upon the Parties to introduce appropriate procedures for EIA and ensure public participation, exchange information and consult on adverse effectson biodiversity of other states, notify immediately to other states in case of danger or damges to the biodiversityand initiate action to prevent or minimize such damages.

- **UN Framework Convention on Climate Change, 1992 A.D. (2048/49)**

The convention was signed in order to stabilize the greenhouse gases (GHG) in the atmosphere. UNFCCC was first initiated in 1992 and was officially enforced since March 14, 1994. In Nepal it was enacted from 31<sup>st</sup> July 1994 and several activities on research and awareness raising programs were conducted in order to popularize this convention. In order to accelerate the implementation of UNFCCC, Kyoto Protocal was brought forth and signed by participating Nations. Nepal has responsibilities to abide by the rules and regulations of the conventions. Although road development is not generating GHG, but in case of Nepal project implementation requires clearance of the forest area. Clearing or degrading of the forest area reduces the carbon sequestration capacity of the forest.

- **ILO Convention on Indigenous and Tribal Peoples, 2046**

ILO Convention No.169 highlights the need to recognize indigenous and tribal people's specific knowledge, skills and technologies as the basis for their traditional economies and self-determined development process. In Article 15, the rights of the peoples concerned to the natural resources pertaining to their lands shall be specifically safeguarded. The peoples concerned shall wherever possible participate in the benefits of such activities and shall receive fair compensation for any damages which they may sustain as a result of such activities. Article 16 (2) clearly mention that where the relocation of these peoples is considered necessary as an exceptional measure such relocation shall take place only with their free and informed consent.

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora, (CITES), 1973 (2029)**

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants doesnot threaten their survival. It was entered into force in Nepal in 16/9/1975. Various plants and animal's species that need various levels of international attention and protection are listed in CITES Annex as presented here under.

**APPENDIX I:** Appendix I I list species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate).

**Appendix II-** Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. International trades in specimens of

Appendix-II species may be authorized by the granting of an export permit or re-export certificate.

**Appendix III-** Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation.

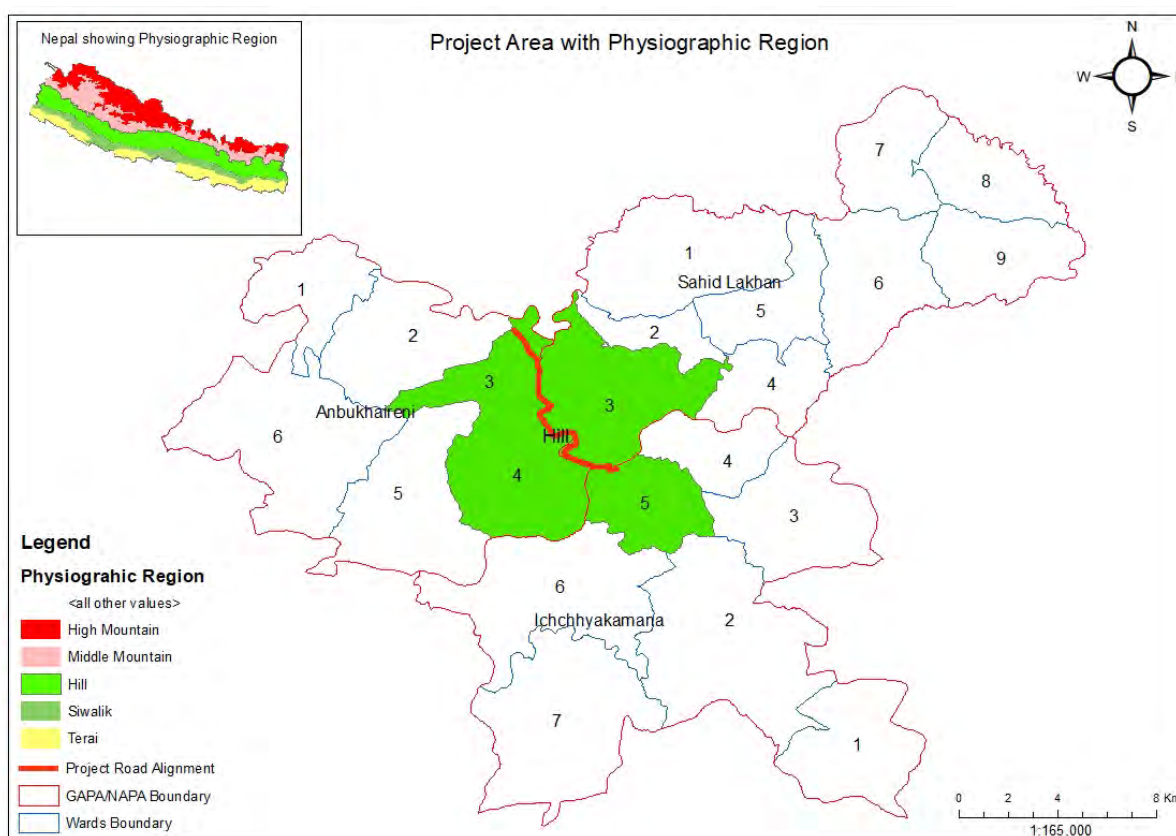
## CHAPTER 5: DESCRIPTION OF EXISTING ENVIRONMENTAL CONDITION

### 5.1 Physical Environment

#### 5.1.1 Topography

The proposed road starts from east of Mugling Bazaar at an elevation of 219m amsl, latitude 27°85'82.05" N, longitude 84°56'3581.54" E, crosses the Trishuli River at Mugling of Chitwan district lies at 27°51'27.595" N and 84°33'57.208" E and ends at Abukhaireni at an elevation 1500m, latitude 28°13'31.85" N and longitude 84°22'42.52" E. The topography of the project area passes through moderate to steep rocky section consisting numerous hill slope terraces.

The proposed road section is partly rolling and hilly along the alignment through the right bank of Trishuli River and both right and left bank of Marshyandi river valley close to the foothill. Climatically, the project road lies in the tropical zone.



**Figure 5.1: Physiographic Map of Project Area**

#### 5.1.2 Land Use

The land use pattern along the road alignment within Direct Impact Area is classified as agricultural land, grassland, forest land, water bodies and settlement area. Forest land is land spanning more than 0.5 ha with trees higher than 5m and a canopy cover of more than 10% to tackle windbreaks, shelterbelts and corridors of trees greater than 0.5 ha and at least 20m wide. Agriculture land is land cultivated for crops that are replanted after each harvest or permanent crops that are not replanted after each harvest. Pasture land is land used for at least five years or more to grow herbaceous forage either cultivated or growing naturally. The land classified as others includes built-up areas, roads and other transportation features, barren land, etc. Details of land use pattern along the road alignment are given in table below:

**Table 5.1: Land Use Pattern Along the Road Alignment (Including Trishuli and Marshyangdi Bridges)**

LHS			RHS		
From	To	Legend	From	To	Legend
0+000	0+350	Forest	0+000	0+350	Grass Land on Uphill And Few Settlement Area
0+350	0+470	Trishuli River			
0+470	0+990	Agriculture Land	0+400	0+900	Agriculture Land
1+000	1+260	Triveni CFUG	1+000	1+260	Triveni CFUG
1+260	1+450	Grass Land on Foothill	1+260	1+450	Grass Land on Uphill
1+450	1+680	Agriculture Land	1+450	1+690	Grass Land on Uphill
1+680	1+710	Private Forest	1+680	1+710	Private Forest
1+170	2+160	Agriculture Land	1+170	2+160	Grass Land on Uphill
2+160	2+170	Private Forest	2+160	2+170	Private Forest
2+170	2+550	Agriculture Land	2+170	2+550	Agriculture Land
2+550	2+570	Barren Land	2+550	2+570	Barren Land
2+640	2+750	Grass Land on Foothill	2+640	2+750	Grass Land on Uphill
2+750	3+910	Agriculture Land and slopy hills	2+750	3+910	Agriculture Land
3+910	4+090	Grass land on Foothill	3+850	4+200	Grass Land on Uphill
4+090	4+920	Salleri CFUG	4+090	4+920	Salleri CFUG
4+920	5+050	Marshyangdi River			
5+050	5+80	Tea Shop (Property of Marshyangdi Power House)			
5+080	6+465	Bhange CFUG	5+080	6+465	Bhange CFUG
6+520	7+910	KukurGade CFUG	6+520	7+910	KukurGade CFUG
7+910	8+180	Settlement area	7+910	8+180	Settlement area
8+180	8+290	Chisapani CFUG (Revised)	8+180	8+290	Settlement area
8+300	9+297	Settlement area	8+300	9+297	Settlement area

Source: Inventory Survey of Mugling- Abukhaireni Road, 2022

Land use Type	Area coverage (Ha)	Area coverage (%)
Forest Area	2.415	38.72%
Agricultural Land	1.042	16.70%
Barren Land	-	
Settlement	-	
Grassland	2.636	42.26%
River Flood Plain	0.144	2.30%

Source: Department of Survey, 2021

### 5.1.3 Geomorphology and Geology

The road alignment crosses the Trishuli river and follows the right bank of the Trishuli river, the road almost runs through river terrace and colluvium for 4+100 km from the start, then follows the steep cliff up to the small village where the area is gentle around the village, again the road follows the steep cliff until it crosses the river at Marshyangdi power house.

Geologically, the proposed road project is situated in the Lesser Himalaya rocks of Nuwakot complex (Kunchha formation) in central Nepal. The project area covers the rock of bluish grey Phyllite and Whitish coarse-grained quartzite, Fagfog quartzite consist of white, coarse grained quartzite.

The Kunchha Formation is well-distributed in and around the Mugling-Abukhaireni area. It forms comparatively smooth ridges with gentle spurs and valley slopes. Mostly uppermost part of the Kunchha Formation is exposed along the Mugling-Abukhaireni motor road and Marshyangdi river section. Further, a complete succession of the Fagfog Quartzite was observed along the road section about 2 km south of Mugling. It consists of thin- to thick-bedded (5cm to 1.5m), medium- to coarse-grained, white quartzite with thin (~1 cm) partings of grey, fine-grained Pelitic Phyllite.

### **Trishuli Bridge**

The proposed bridge over Trishuli River at Mugling of Chitwan district lies at 27° 51' 27.595" N latitude and 84° 33' 57.208"E longitude. The bridge site is also located in the rocks of the Lesser Himalayan of Nuwakot complex (Kunchha formation). The riverbed of the Trishuli River is covered by Alluvial deposits and bedrocks of the Kunchha formation which can be observed on left and right abutment. The bedrock is phyllite with intercalated quartzite. The rock is light grey coarse grained Phyllite. The river cuts the rock of lesser Himalayan making a steep valley at the bridge site location. The Phyllite with Quartzite intercalation from Kunchha formation covers the area around the bridge site.

### **Marshyangdi Bridge**

The proposed bridge over Marshyangdi River at Tanahu district lies at 27° 52' 38.19" N Latitude and 84°32'24.81" E Longitude. The bridge site is also located in the rocks of the Lesser Himalayan of Nuwakot complex (Kunchha formation). The area around the bridge site is covered by the Phyllite with Quartzite intercalation from Kunchha formation.

The geological map of Nepal shows no any fault line (where the fault cuts the Earth's surface) around the project area. (*Source: Geological map of western Nepal, Department of Mines and Geology, 2011*).

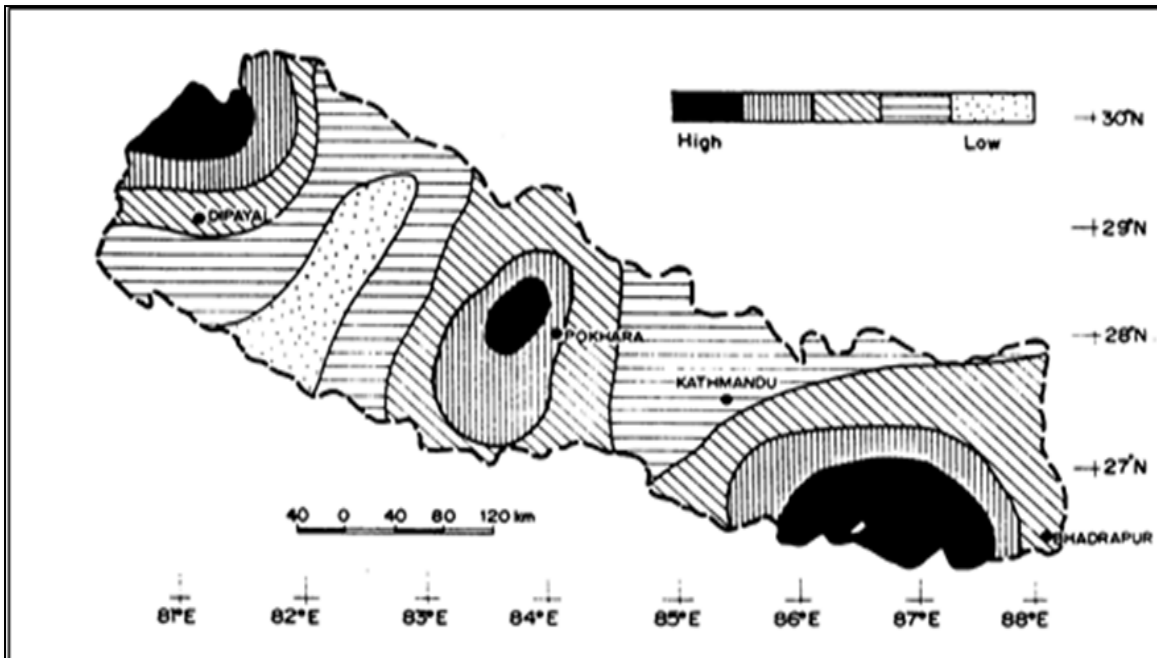


Figure 5.2: Geological Map of Nepal

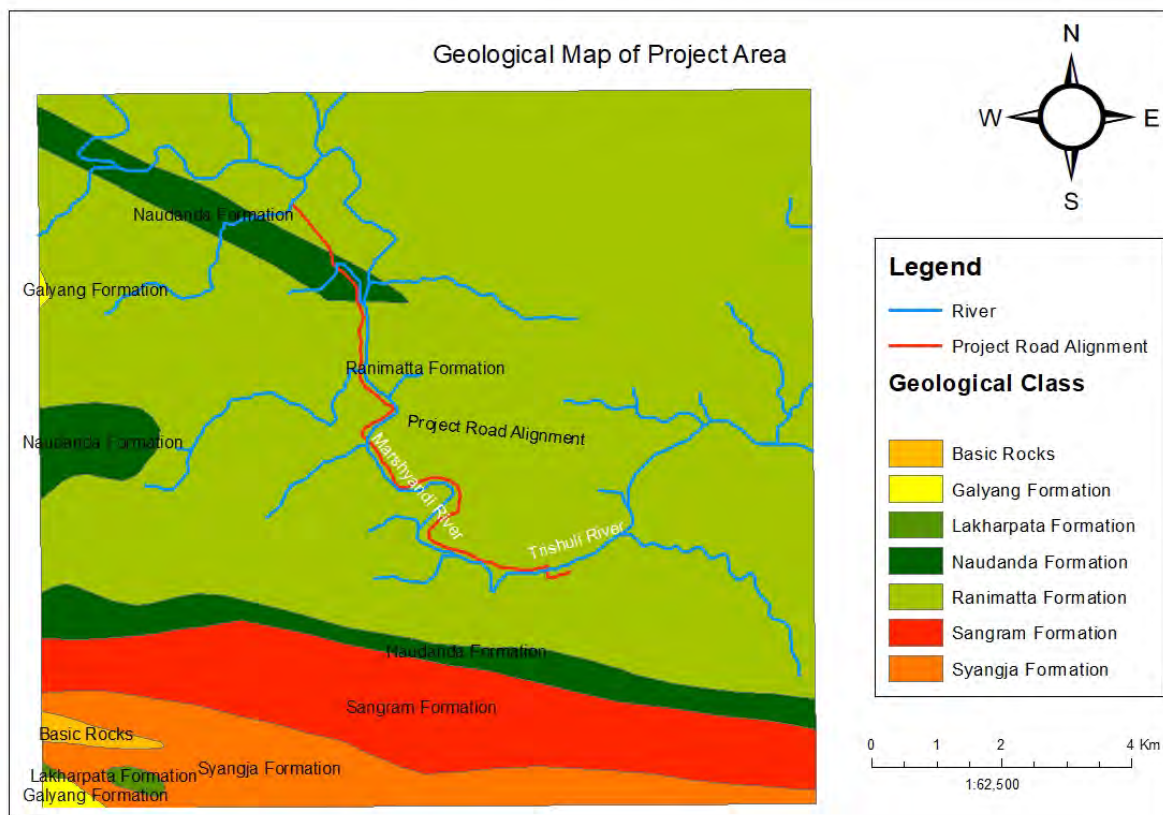


Figure 5.3: Geological Map of Project Area

### 5.1.4 Slope Stability

The road alignment from 0+000 to 0+160 Km is stable with respect to hill slope with counter dip with foliation whereas joint sets may form wedge failure. The bedrock at 2+550 is stable with the lithology siliceous Phyllite with quartz veins counter dip with respect to slope. The road alignment from 0+380-0+450 and 3+200-4+000 observed to be stable on the colluviums covered area. The road encounter steep cliff at 4+000~4+900 after Bhuvanitar which has counter dip with respect to foliation with rock Phyllite and Meta Sandstone.

The slope stability from 6+240 to 7+710 is poor due to the joints and partings of Phyllite between joints. Especially from Chainage 6+000~6+5000 where, the geographical conditions of the existing road were formed by the large cut slopes of existing roads and cliffs adjacent to the Marshyangdi River, there is possibilities of landslide or slope instabilities from the construction works.

The river terrace consists of gravel and boulders of quartzite and phyllite around Trishuli and Marshyangdi proposed areas. The river terrace is gentle and stable at both the proposed bridge areas. Slope instabilities were observed at 1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS).

Majority of the road alignment have Low to High soil and rock hazards. Shallow soil depths, medium gradient, presence of dry cultivated land are the major components for High soil hazard along the road alignment. While the presence of the structural and lithological characters of the rock are the reason behind having the high rock hazards along the road alignment. Details have been given in Table 5.2.

**Table 5.2: Geological Hazard Mapping along the Road alignment**

S.N.	Chainage	Soil/Rock Types	Factors affecting the hazards	Status of Hazards (Visual Inspection)
1	1+200~1+500 (RHS)	Alluvial deposits - 40% and Colluvial deposits - 60%, Major rock types as quartzites, metasandstones and phyllites	Erosion, landslides, weathering and rotational slide	High
2	5+100~5+130	Bedrock: Slightly weathered,	Erosion, landslides, weathering of rock	High
3	6+100~6+520 (LHS)	Bedrock: Slightly weathered, Quartzite. Counter dip with respect to hill slope	The opening in the fractures is high. The joint set on the rocks shows the possibility of failure due to steep cliff.	High
4	6+520~7+100 (LHS)	Bed rock of Quartzite. The depth of bedrock is shallow (about 5m) Bedrock: - Moderately- Completely	The opening in the fractures is high. The joint set on the rocks shows the possibility of failure due to steep cliff	High

S.N.	Chainage	Soil/Rock Types	Factors affecting the hazards	Status of Hazards (Visual Inspection)
		weathered. Counter dip with respect to hill slope		
5	7+610~7+670 (LHS)	Colluvium of Quartzite, metasandstone and Phyllite. The depth of bedrock is shallow (about 5m) Bedrock: - Moderately- Completely weathered. Counter dip with respect to hill slope	The opening in the fractures is high. The joint set on the rocks shows the possibility of failure due to steep cliff	Moderate
6	7+800~7+910 (LHS)	Colluvium of Quartzite, metasandstone and Phyllite. The depth of bedrock is shallow (about 5m) Bedrock: - Moderately weathered. Counter dip with respect to hill slope	The opening in the fractures is high. The joint set on the rocks shows the possibility of failure due to steep cliff.	Moderate
7	8+000 - 9+390 (LHS)	Residual soil	Weathering of rock and Joint Failure	Low

Source: Field Survey. 2022

### 5.1.5 Natural Hazards

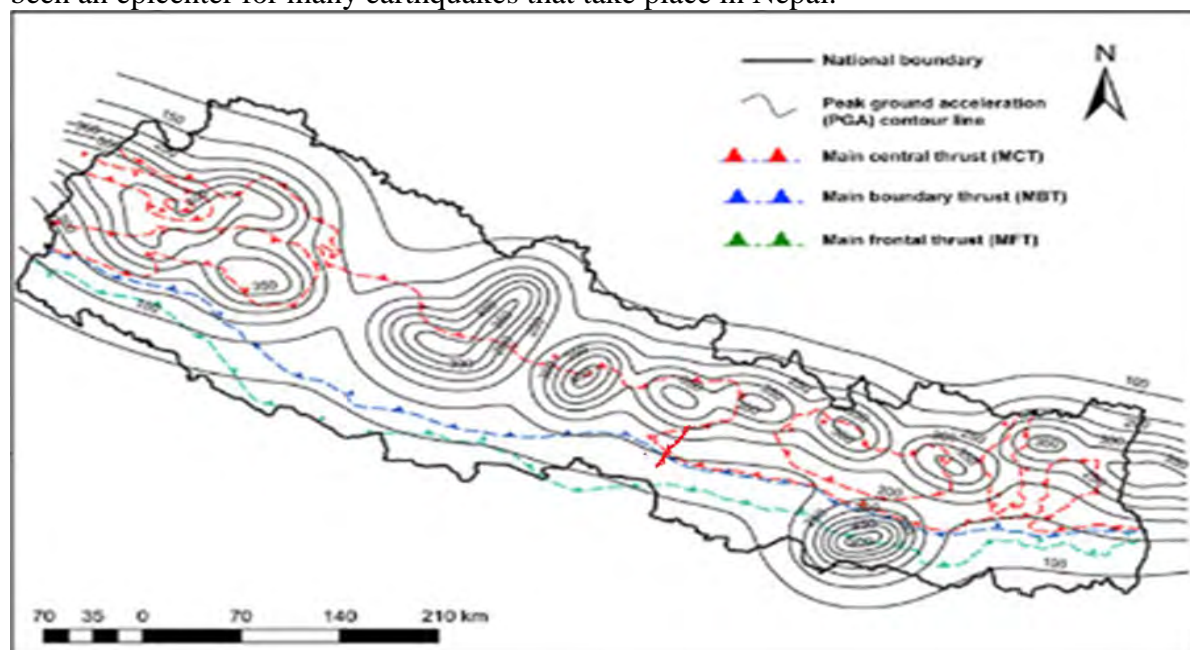
A natural hazard is the threat of naturally occurring event that might cause negative effects to humans. Actually, they are the results of the naturally occurring processes that have operated throughout the Earth's history.

#### ➤ Seismicity

Nepal on a regular interval witnesses, earthquake along the major active faults in east-west alignment can be observed. According to Bajracharya (1994) has divided five seismic zones (Zone1, Zone 2, Zone 3, Zone 4, Zone 5) with relation to the seismic hazard (Low, Moderate and High as shown in Figure 4.2. The road alignment falls in the seismic moderate hazard area (Seismic zone 3) of the Nepal Himalaya. However, the epicenter of most devastating



earthquake on 25 April 2015 was at Gorkha District. From 2010-2018 Gorkha Districts has been an epicenter for many earthquakes that take place in Nepal.



**Figure 5.4: Seismic Hazard Map of Nepal**

#### ➤ Flood, Soil Erosion and Landslide

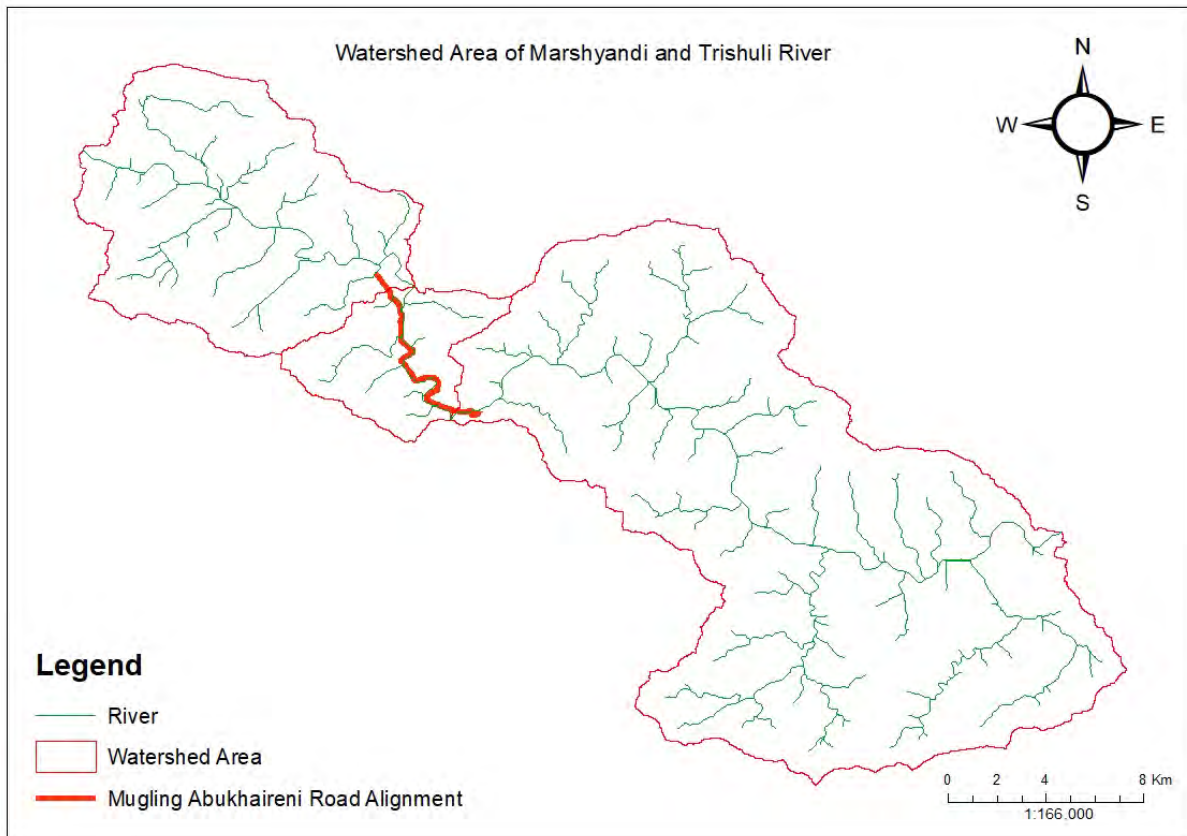
Flood, soil erosion and landslide are the most significant natural hazard in the world which affects the enormous population in the world. Asian countries are most frequently affected from the high density of the riverine floods, Landslide and Soil Erosion. Nepal had witnessed numerous hazards in few decades causing huge economic and the human loss. From the field survey, it was found that there had occurred a heavy flood on Shrawan 5<sup>th</sup>, 2077 at early morning 4 am. According to local people, flood has damaged 2 building and 1 Tahara. Not only that flood has damaged household materials and rafting materials of worth \$ 4,182.00.

#### 5.1.6 Hydrology and Watershed

**Surface Water:** Surface water of the project area includes rivers, streams and lakes. Major rivers of the project area includes Trishuli and Marshyangdi. Both Trishuli and Marshyangdi rivers are originating from the higher Himalayas and is sub-basin of the Gandaki basin of Nepal. The catchment area of the Trishuli River is measured to be 12,240 sq. km. The river length from its headwaters to the proposed bridge site is 80 km. The elevation range in the catchment is between 6,899 m and 244 m.

Similarly, the catchment area of Marshyangdi River is measured to be 4500 sq. Km. The river length from its headwaters to the proposed bridge site is 76 km. The elevation range in the catchment is between 6899 m and 244 m.

The project area lies in the Gandaki basin. In Gandaki basin, as per 2010 inventory, there were 1,337 glaciers with the area of 1800 sq. km. ranging from the elevation of 8,093 masl to 3,273 masl. The overall catchment area of Gandaki basin is 44,658 sq. km. Gandaki basin had 432 number of glacier lakes. (Source: Bajracharya, et. al. 2020).



**Figure 5.5: Watershed of Project Area**

### 5.1.7 Climate and Meteorology

The project area lies in tropical region. Project area climate is heavily influenced by the monsoon (June-September) with maximum rainfall at that time. The project areas average monthly rainfall is about 300 mm. The overall pattern of seasonal temperature changes with change in seasonal rates. Chitwan district has maximum and minimum temperature of 36°C and 5°C respectively with the annual rainfall of 2145 mm per year. Gorkha varies only slightly from neighboring Tanahu. The average maximum temperature is 20°C, and the lowest temperature is 7°C with the average rainfall of 2913 mm per year. Tanahu district climate is heavily influenced by the monsoon (June-September) with an average annual rainfall of 2058 mm. The average annual monthly temperature and the average annual monthly precipitation graph of three different station Gorkha, Bharatpur and Bandipur is shown in Figure 5.6 and Figure 5.7 respectively. The maximum daily rainfall data in the nearest DHM stations are shown in Table 5.3.

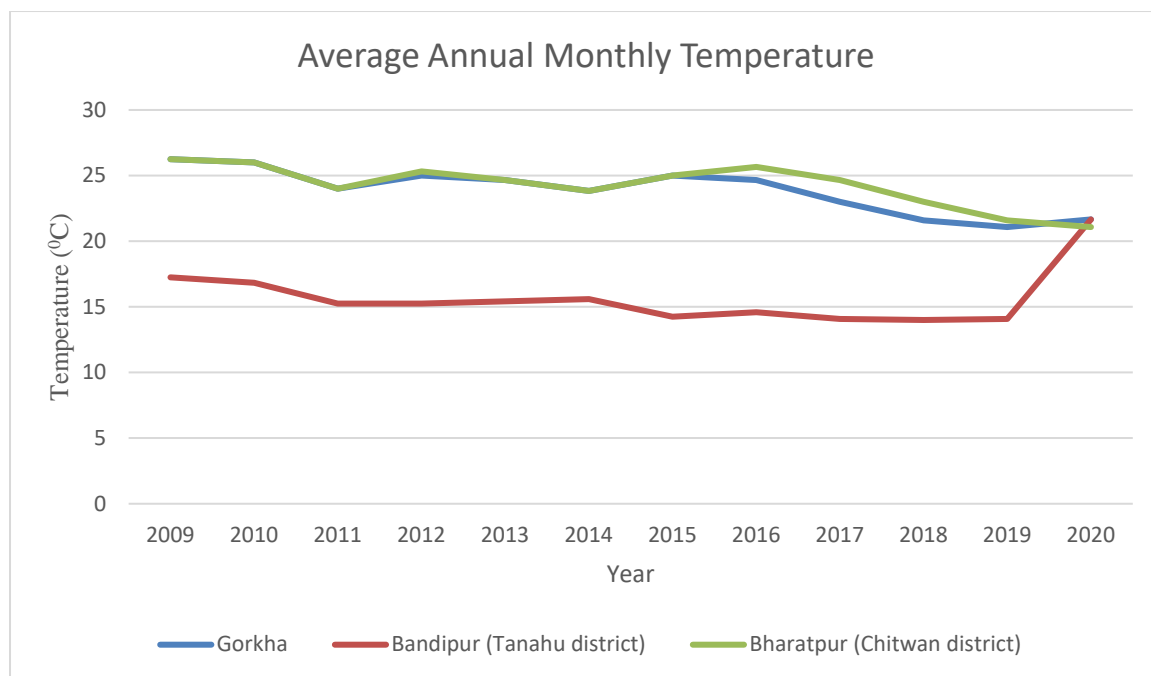


Figure 5.6: Average Annual Monthly Temperature

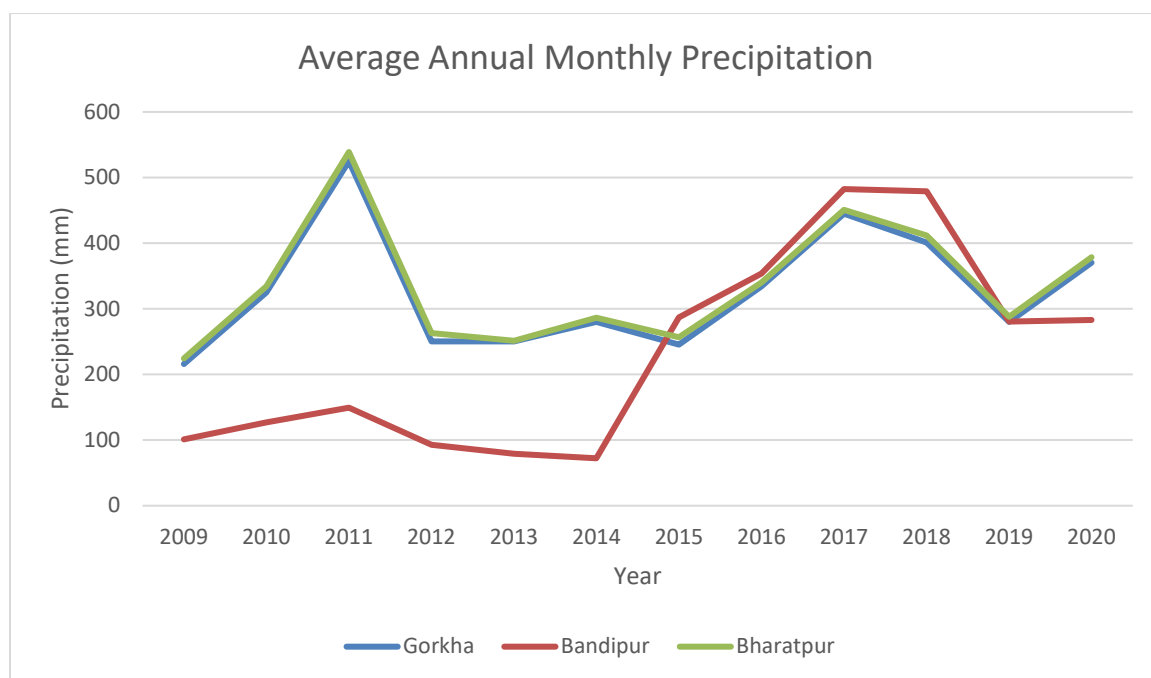


Figure 5.7: Average Annual Monthly Precipitation

Table 5.3: Observed Maximum Daily Rainfalls (mm) in the Relevant DHM Stations

Road Sector	Mugling Abukhaireni	
Stn. No.	0809	0808
Stn. Name	Gorkha	Bandipur
Latitude	28°00'	27° 56'
Longitude	84°37'	84° 25'
Elevation (m)	1097	965
Period of Record	1971-2016	1971-2016
No. of Data	46	46

Road Sector	Mugling Abukhaireni	
1971	78	172
1972	97	132
1973	81	102
1974	95	200
1975	102	102
1976	153	80
1977	86	88
1978	86	80
1979	124	133
1980	118	146
1981	116	127
1982	94	94
1983	140	115
1984	119	101
1985	89	82
1986	95	96
1987	134.3	126
1988	100	160
1989	75.9	96.4
1990	105	126.2
1991	90.2	
1992	86	50.4
1993	78	45
1994	117.2	60.4
1995	132.6	117
1996	96.6	85.5
1997	112	97.2
1998	45.5	40.1
1999	164	160
2000	138	126
2001	83.5	98.2
2002	68.9	89.35
2003	109	200.2
2004	69.5	82.5
2005	81	110
2006	75.5	100
2007	92.5	146
2008	58	75
2009	108.3	113
2010	94.5	155
2011	121	112
2012	110.1	89
2013	94.5	112
2014	103.7	181.5
2015	105.2	102
2016	80.2	83.2

Source: Main Report Annex, Hydrological Studies and Drainage Design of MA Road, 2019

### 5.1.8 Air, Noise and Water Quality

Instrumentally monitored databases of air, noise and water quality were created through field data exploration. The project area lies in the rural setting without industrial establishment and vehicular movement. The equivalent sound pressure level data during day and night time in the project area is shown in Table 5.4. The results shows that equivalent noise level at day (Ld) at Mugling Bazar and Abukhaireni Bazar is slightly above National Quality Standard because these location are at the center zone of Busy vehicles all the time. Results of Noise Monitoring of Project area is presented in Table 5.4

**Table 5.4: Noise Level of the Project Sites**

National Quality Standard		Results Obtained								
Day	Night	Equivalent Noise Level (Leq)	Mugling Bazar		Leq	Karantar		Leq	Abukhaireni Bazar	
			Day (Ld)	Night (Ln)		Day (Ld)	Night (Ln)		Day (Ld)	Night (Ln)
55	50	60.17	61.78	45.05	55.8	54.78	43.82	67.94	71.49	42.81

Source: Field Study, 2022

Likewise, the air qualities in 3 different locations were measured in the project area. The results of the on-site measurement of quality of ambient air in the project area were found to be within the National Ambient Air Quality Standard. The results of air quality measurement are presented in Table 5.5

**Table 5.5: Air Quality Status of the Project Area**

Parameters	Maximum Conc. Limit as per National Ambient Air Quality Standard for Nepal, 2012 ( $\mu\text{g}/\text{m}^3$ )	Averaging Time	Results		
			Site 1 (Muglin Bazar)	Site 2 (Abukhaireni)	Site 3 (Karantar)
PM <sub>10</sub>	120	Annual	66.8	73.2	61.1
		24 hours			
PM <sub>2.5</sub>	40	24 hours	27.9	29.3	13.4
Carbon Monoxide (CO)	10,000	8 hours	ND	ND	ND
TSP	230	Annual	123.5	156.8	85.2
		24 hours			

Parameters	Maximum Conc. Limit as per National Ambient Air Quality Standard for Nepal, 2012 ( $\mu\text{g}/\text{m}^3$ )	Averaging Time	Results		
			Site 1 (Muglin Bazar)	Site 2 (Abukhaireni)	Site 3 (Karantar)
NO <sub>x</sub>	80	Annual	0.32	0.26	0.31
		24 hours			
SO <sub>x</sub>	70	Annual	<1	<1	<1
		24 hours			
Wind Speed (m/s)			0.75	0.33	0.86
Wind Direction			ES	SW	EW

Source: Field Study, 2022

The baseline study of project area for surface water quality was carried out at the downstream of proposed Malekhu and Trishuli bridges. The results of river water was compared with drinking water standard, guideline for irrigation purpose and guideline for protection of aquatic ecosystem as the river water is used for multiple purposes. The result of river water quality tested is presented in Table 5.6. From the results below, it was found that level of Manganese value is four times higher in all three sources for irrigation purposes. Similarly, river water is affected from E.Coli and is unsafe for drinking and irrigation purposes under National Drinking Water Quality Standard, 2062 and Nepal Water Quality Guidelines for Irrigation Purposes.

**Table 5.6: Water Quality Status of the river at Project Sites**

S. N.	Parameters	National Drinking Water Quality Standards, 2062	Nepal Water Quality Guidelines for Irrigation Water	Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems	Results		
					MA_WS_01 (Downstream of Proposed Trishuli River Bridge) (27° 51' 29.49" N 84° 33' 56.83" E)	MA_WS_02 (Near Settlement Area) (27° 52' 9.55" N 84° 33' 8.31" E)	MA_WS_03 (Downstream of Proposed Marshyangdi River Bridge) (27° 52' 35.59" N 84° 32' 25.27" E)
1	pH at 18°C	6.5 - 8.5	6.5 - 8.5	> 0.5	8.3	8.2	8.2
2	Electrical Conductivity (µmhos/cm), max.	1500	< 40 mS/m	-	203	275	282
3	TSS	-	< 50 mg/l	<10% of the background TSS conc. At a specific	2.1	2.8	3.0
4	Dissolved Oxygen	-	< 40 mg/l	80-120	8.1	8.6	8.8
5	Arsenic	0.05	< 0.1 mg/l	<10	<0.01	<0.01	<0.01
6	Chloride	250	< 100 mg/l	-	3.7	6.2	2.9
7	Turbidity	5 (10)	-	-	3.8	4.2	4.5
8	Color (TCU), max.	5(15)	-	-	0.20	0.25	0.20

S. N.	Parameters	National Drinking Water Quality Standards, 2062	Nepal Water Quality Guidelines for Irrigation Water	Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems	Results		
					MA_WS_01 (Downstream of Proposed Trishuli River Bridge) (27° 51' 29.49" N 84° 33' 56.83" E)	MA_WS_02 (Near Settlement Area) (27° 52' 9.55" N 84° 33' 8.31" E )	MA_WS_03 (Downstream of Proposed Marshyangdi River Bridge) (27° 52' 35.59" N 84° 32' 25.27" E )
9	Total Hardness as CaCO <sub>3</sub> (mg/l), max.	500	-	-	93	121	122
10	Calcium (mg/l), max.	200	-	-	25.6	33.6	33.2
11	Magnesium (mg/l), max.	-	-	-	7.05	8.99	9.48
12	Ammonia (mg/l), max.	1.5	-	<7	<0.05	<0.05	<0.05
13	Nitrate (mg/l), max.	50	-	-	1.05	0.62	0.98
14	Fluoride (mg/l)	0.5-1.5	< 2.0 mg/l	<750	0.28	0.33	0.24
15	Iron (mg/l), max.	0.30(3)	< 5.0 mg/l	Should not vary more than 10% of the background dissolved iron in specific time.	0.26	0.22	0.30
16	Manganese, (mg/l), max.	0.20	< 0.02 mg/l	<180	0.08	0.08	0.09
17	Fecal Coliform,	Nil	< 1 count/100ml	-	460	460	460

Source: Field Study, 2022



## 5.2 Biological Environment

Information on flora and fauna were collected through field survey and consultation with local people and are categorized below:

### 5.2.1 List of Community Forest in the Project Area

A total of 9.525 ha of the forest land will be used for the road construction upto RoW of the road. The project road passes through five community forest (CF) namely, Triveni Dharmik C.F., Salleri C.F., Bhange C.F., Kukur Gade C.F. and Chisapani C.F. The list of community forest is given in Table 5.7 below.

**Table 5.7: List of Community Forest along Project Road**

SN	Name of Community Forest	Vegetation Type	Chainage	District	Tree Species
1	Triveni CF	Hilly Mixed Hardwood Forest	0+900-1+500	Gorkha District	Aap, Amba, Bakaino, Chap, Chilaune, Dhusure, Gindhari, Ipil, Kabro, Khirro, Sal, Sidure, Simal, Siris, Sisoo, Khair, Utis
2	Salleri CF	Sal Forest/TMHF	4+200-4+900	Gorkha District	
3	Bhange CF	Hilly Mixed Hardwood Forest	5+00-6+405	Tanahu District	
4	Kukur Gade CF	Hilly Mixed Hardwood Forest	6+405-7+780	Tanahu District	
5	Chisapani CF (Revised)	Hilly Mixed Hardwood Forest	8+050-8+200	Tanahu District	

Source: Field Survey, 2022

### 5.2.2 Vegetation along Road Corridor

#### A. Tree Species

The major tree species found within the project area are Aap (*Magnifera indica*), Bakaino (*Melia azedarach*), Kabro (*Ficus lacor*), Karan (*Adina cordifolia*), Khayer (*Acacia catechu*), Khirro (*Sapium insigne*) (Royle), Red siris (*Albizia julibrissin*), Sal (*Shorea robusta*), Simal (*Bombax cibeia*), Siris (*Albizia lebbeck*) and Sissoo (*Dalbergia sissoo*), Ipil Ipil (*Leucaena leucocephala*), Aasana (*Pterocarpus marsupium*), Buddhaeulo, Jamuna (*Syzygium cumini*), Bauni Kath, Dhudekhirro, Taki (*Bauhinia purpurea*), Gindhari (*Premna integrifolia*), Kavro (*Ficus lacor*), Chilaune (*Schima wallichii*), Khirro (*Falconeria insignis*) etc.

The major flora found along the road alignment is shown in the Table 5.8 below:

**Table 5.8: Major Tree Species found along the Road Alignment**

S.N.	Nepali Name	Scientific Name	IUCN list	CITES	NPWC Act,
1	Sal	<i>Shorea robusta</i>	Banned for felling, transportation and export	-	Legally Protected against commercial use
2	Saj	<i>Terminalia elliptica</i>	-	-	-

S.N.	Nepali Name	Scientific Name	IUCN list	CITES	NPWC Act,
3	Pipal	<i>Ficus religiosa</i>	-	-	-
4	Jamun	<i>Syzygium cumini</i>	-	-	-
5	Amala	<i>Emblica myrobalan</i>	-	-	-
6	Aap	<i>Magnifera indica</i>	-	-	-
7	Simal	<i>Bombax ceiba</i>	Banned for felling, transportation and export	-	Legally Protected against commercial use
8	Salifa	<i>Annona squamosa</i>	-	-	-
9	Khayer	<i>Acacia catechu</i>	Threatened	-	Legally Protected against commercial use
10	Siris	<i>Albizia lebbeck</i>	-	-	-
11	Sissoo	<i>Dalbergia sissoo</i>	-	-	-
12	Bakaino	<i>Melia azedarach</i>	-	-	-
13	Epilipi		-	-	-
14	Aasana	<i>Pterocarpus marsupium</i>	Near Threatened	-	-
15	Jamun	<i>Syzygium cumini</i>	Least Concern	-	-
16	Buddhaeulo		-	-	-
17	Bauni Kath		-	-	-
18	Dhudekhirro		-	-	-
19	Taki	<i>Bauhinia purpurea</i>	-	-	-
20	Gidhari	<i>Premna integrifolia</i>	-	-	-
21	Kavro	<i>Ficus lacor</i>	-	-	-
22	Chilaune	<i>Schima wallichii</i>	Least Concern	-	-
23	Khirro	<i>Falconeria insignis</i>	-	-	-

Source: Field Study, 2022

Legend: IUCN= IUCN Red List Category EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern CITES Appendix I, Appendix II and Appendix III, GoN = Government of Nepal P=Protected by NPWC Act 1973.

## B. Non-Timber Forest Products (NTFPs)

The natural vegetation plays an influential role in the socio-economic conditions and life style of local people. Diverse ethnic group inhabit the project area. Local people use the varieties of biological resources in various ways like food, medicine and fodder. People around the project area location reported different uses of plant resources. Some common NTFPs are Harro (*Terminalia Chebula*), Barro (*Terminalia bellerica*), Tite pati (*Artemisia vulgaris*), Kurilo (*Asparagus racemosus*) which are used as medicine and food purposes. Other trees species in the area are used as firewood depending upon their availability. Herbal merchants usually from outside of the project area harvest medicinal plants in the project area though currently, there is no record of commercial utilization of such resources in the project area. Some of the NTFPs listed in the project area are given in Table 5.9.

**Table 5.9: Lists of NTFPs and their uses in the Project Area**

S.N.	Common Name	Scientific Name	IUCN List	Parts used	Purpose
1	Bel	<i>Aegle Marmelos</i>			Medicine
2	Bamboo	<i>Arundinaria bamboos</i>	-	Shoot	Food/Vegetable
3	Harro	<i>Terminalia Chebula</i>	-	Fruits, Bark	Medicine
4	Barro	<i>Terminalia bellerica</i>	-	Bark	Medicine
5	Bayer	<i>Ziziphus mauritiana</i>			
6	Amala	<i>Phyllanthus emblica</i>	-	Fruit, Seeds	Medicine/Food
7	Tite Pati	<i>Artemisia dubia</i>	-	Plant	Medicine
8	Sikakai	<i>Acacia rugata</i>	*		Pods and leaves are used for hair growth and malarial fever.
9	Kurilo	<i>Asparagus racemosus</i>	-	Plant	Medicine/Spice for Food
10	Gurjo	<i>Tinospora cordifolia</i>		Bark	Medicine
11	Neem	<i>Azadirachta indica</i>		Bark, Leaves, Flower	Medicine
12	Rajbriksha	<i>Cassia fistula</i>	-	Fruit pulp, Leaves, Root	Medicine/Aroma
13	Ghyukumari	<i>Aloe vera</i>	-	Leaves	Medicine
14	Bojho	<i>Acorus calamus</i>	-	Stem/Plant	Medicine/Aroma
15	Bhyakur	<i>Dioscorea species</i>	Appendix II	Fruit/Leaves	Medicine/Spice for Food/ Culinary
16	Tejpat	<i>Cinnamomum tamala</i>	-	Leaves and bark	Medicine/Spice for Food

Source: Field Study, 2022

## C. Protected/Endangered Plant Species

Few listed endangered tree species are reported during the field study. Plant species such as Sal (*Shorea robusta*), Chammp (*Michelia champaca*), Khair (*Acacia catechu*) and Simal (*Bombax ceiba*) are listed in national protection of timber trees banned for felling, transportation and export. Among these species, Chammp (*Michelia champaca*) and Khair (*Acacia catechu*) are listed in ICUN Threat Status as Threatened and Endangered respectively. Also, Harro (*Terminalia chebula*) is listed as medicinal plants threatened through over collection for the export trade. These species are enlisted as nationally protected plant species.

### 5.2.3 Wildlife

#### 5.2.3.1 Mammals

Virtually, no wildlife and wild animals of significance were noted within the project area. No endangered species inhabit were found around the project area. The information on wildlife and avian fauna gathered from the local residents indicated that Leopard cat (*Felis bengalensis*), Jungle cat (*Felis chaus*), Jackal (*Canis aureus*), Monkey (*Macaca assamensis*), Langur monkey (*Presbytis entellus*), Squirrel (*Funambulus pennati*), Fox (*Vulpes bengalensis*), Hare (*Lepus migricollis*) and Porcupine (*Hystrix hodgsoni*) etc. are some notable species reported in the project area forest. Also, the major mammals found along the alignment are listed in the **Table 5.10** below:

**Table 5.10: Major mammals found along the alignment**

S.N.	Nepali Name	Common Name	Scientific Name	Conservation Status			
				IUCN List	CITES Appendix	NRDB	GoN
1	Ratuwa	Barking Deer	<i>Muntiacus vaginalis</i>	LC	-	VU	-
2	Jarayo	Sambar	<i>Cervus unicolor</i>	VU	I	VU	-
3	Badel	Wild boar	<i>Sus scrofa</i>	LV	-	LC	-
4	Sano Nyaurimusa	Small mongoose	<i>Herpestes javanicus</i>	LV	-	LC	-
5	Langur	Grey Langur	<i>Semnopithecus hector</i>	NT	I	-	-
6	Syal	Golden Jackal	<i>Canis aureus</i>	-	III	-	-
7	Sano Chamero	Least Pipistrelle	<i>Pipistrellus tenuis</i>	LC	-	LC	-
8	Hundar	Stripped Hyena	<i>Hyaena hyaena</i>	NT	I	EN	-
9	Ratel	Honey Badger	<i>Mellivora capensis</i>	LC	III	EN	-
10	Dhwase Chituwa	Clouded Leopard	<i>Neofelis nebulosa</i>	V	I	EN	-
11	Malaha Biralo	Cat	<i>Prionailurus viverrinus</i>	LC	II	LC	-
12	Badar	Monkey	<i>Rhesus macaque</i>	LC	-	-	-
13	Kharayo	Rabbit	<i>Hispid hare</i>	EN	I	-	-
14	Dumsi	Porcupine	<i>H. cristata</i>	LC	-	-	-

(Source: Field Study, 2022)

Legend: **GoN = Government of Nepal** P = Protected by NPWC Act 1973, **NRDB (National Red Data Book) Status:** CR = Critically endangered EN = Endangered NT = Near Threatened VU = Vulnerable DD = Susceptible **CITES Appendix I, Appendix II Appendix III IUCN = IUCN Red List Category** EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern

### 5.2.3.2 Birds

Similarly, major birds reported in the project area include Sparrow (*Passer domesticus*), Owl Bam (*Tytoalba*), Crow (*Corous macrorhynches*), Nepali Kaliz pheasant (*Lophura leucomelanos*), Cuckoo (*Eudynamus scolopacea*), Jungle Fowl (*Gallus gallus*), Myna (*Gracula religiosa*), Red Turtle Dove (*Streptopelia tranquebarica*), Hill Partridge (*Arborophila hyperythra*) etc.

### 5.2.3.3 Reptiles and Amphibians

Common species of reptiles and amphibians such as Rat snake (*Ptys mucosus*), Bengal Monitor lizard (*Varanus bengalensis*) are reported. Study on protected or listed reptiles and amphibians are listed in Table 5.11.

**Table 5.11: Major amphibians and reptiles in the project area**

Nepali Name	Common Name	Scientific Name	Conservation Status			
			IUCN List	CITES Appendix	NRDB	GoN
Salamander	Cheparo	<i>Ambystoma spp</i>	LC	-	LC	-
Frog	Bhyaguto	<i>Rana tigrina</i>	LC	-	LC	-
Common krait	Krait Sap	<i>Bungarus caeruleus</i>	LC	-	LC	-
Bengal Monitor lizard	Bengal Monitor lizard	<i>Varanus bengalensis</i>	LC	-	LC	-
Garden Lizard	Cheparo	<i>Chamaeleo calyptratus</i>	LC	-	LC	-
Toad	Bhyaguto	<i>Bufo toad</i>	LC	-	LC	-
Cobra Snake	Goban	<i>Naja naja</i>	LC	-	LC	-
Lizard	Cheparo	<i>Japalura variegata</i>	LC	-	LC	-
Green Tree Viper	Hariyo Sarpa	<i>Trimeresurus gramineus</i>	LC	-	LC	-
Water Snake	Pani Sarpa	<i>Xenochrophis piscator</i>	LC	-	LC	-

(Source: Field visit, 2022)

Legend: **GoN = Government of Nepal** P = Protected by NPWC Act 1973, **NRDB (National Red Data Book) Status:** CR = Critically endangered EN = Endangered NT = Near Threatened VU = Vulnerable DD = Susceptible **CITES Appendix I, Appendix II Appendix III IUCN = IUCN Red List Category** EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern

### 5.2.4 Aquatic lives

The commonly found fish species in the Marshyangdi and Trishuli Rivers are Asala/Chuche Asala (*Schizothorax progastus*), Bam/Raj Bam (*Anguilla bengalensis*), Buduna (*Gerra aunandalei*), Buhari (*Wallagoatta*), Katle, Copper Mahseer (*Neolissochilus hexagonolepis*), Kabre (*Glyptothorax trilineatus*), (*Acrossocheilus hexagonolepis*), River stone carp (*Psilorhynchida esucatio*), Sahar (*Tor tor*) and Stone carp (*Psilorhynchus pseudocheneis*). The list of aquatic lives is given in Table 5.12:

**Table 5.12: Aquatic Lives Found in the Project Area**

Nepali Name	Common Name	Scientific Name	Conservation Status			
			IUCN List	CITES Appendix	NRDB	NPWC Act
Asla	Chuche asla	<i>Schizothorax progastus</i>	LC	-	-	-
Bam	Indian eel	<i>Anguilla bengalensis</i>	NT	-	-	-
Buduna	-	<i>Garra rupecula</i>	NT	-	-	-
Buhari	Whiskered Catfish	<i>Wallago attu</i>	NT	-	-	-
Copper Mahseer	-	<i>Neolissochilus hexagonolepis</i>	NT	-	-	-
Kabre	-	<i>Glyptothorax trilineatus</i>	LC	-	-	-
River Stone Carp	-	<i>Psilorhynchida sucatio</i>	LC	-	-	-
Sahar	-	<i>Tor tor</i>	-	-	-	-
Stone Carp	-	<i>Psilorhynchus pseudecheneis</i>	LC	-	-	-

Source: Field Study, 2022

### 5.3 Socio-Economic Environment

#### 5.3.1 Demographic Characteristics

##### 5.3.1.1 Population Distribution of Project Affected Municipalities

Total population of 3 Rural Municipalities of three districts touched by the proposed project road section, is 80,194 with 15,152 households. Gender-wise population distribution is estimated to be 51.90 % male and 48.12 % female. The Table 5.13 shows the population distribution by Project Affected Rural Municipality.

**Table 5.13: Population Distribution by Project Affected Rural Municipalities**

District	Rural Municipality	HHS	Male	Female	Total	Family Size
Chitwan	Ichhakamana	5517	13599	13366	26,965	4.9
Gorkha	Shahid	5000	15000	12555	27555	5.5
Tanahu	Aabukhaireni	4635	13014	12660	25674	5.5
<b>Total</b>		<b>15152</b>	<b>41613</b>	<b>38581</b>	<b>80194</b>	<b>5.2</b>

Source: Rural Municipality Office Survey, 2022

### 5.3.1.2 Population Distribution of Project Affected Wards

Total population of five different wards of 3 Rural Municipalities (RM) of three different districts touched by the proposed road section is 22936 with 4412 households. Gender-wise population distribution is estimated to be 51.50% male and 48.49% female. Household survey is undertaken for the Affected Rural Municipalities have been surveyed recently and are shown below in Table 5.14:

**Table 5.14: Population Distribution of Project Affected Wards**

District	Rural Municipality	Wards	HHs	Male	Female	Total	Family Size
Chitwa	Ichhakamana	5	856	2147	2033	4180	4.88
Gorkha	Shahid	3	652	2000	1521	3521	5.4
Tanahu	Aabukhaireni	2	858	2067	2048	4115	4.7
		3	161	4375	4389	8764	5.4
		4	434	1225	1131	2356	5.4
<b>Total</b>			<b>441</b>	<b>1181</b>	<b>11122</b>	<b>2293</b>	<b>5.1</b>

Source: Ward Office Survey, 2022

### 5.3.1.3 Population Distribution of Project Affected Areas (ZOI) through household survey

Total number of household within ZOI is 211. The total population of the household within ZOI is 1112. Gender-wise population distribution is estimated to be 48.20% male and 51.79% female. The population distribution of household within ZOI is shown in Table 5.15.

**Table 5.15: Population Distribution within ZoI along the Project Road**

District	Rural Municipality	Wards	HH S	Male	Female	Total	Family Size
Chitwa	Ichhakamana	5	11	40	35	75	5
Gorkha	Shahid	3	8	35	45	80	5
Tanahu	Aabukhaireni	2	10	25	27	52	5.2
		3	177	427	458	885	5
		4	5	9	11	20	4
<b>Total</b>			<b>211</b>	<b>536</b>	<b>576</b>	<b>1112</b>	<b>4.8</b>

Source: Household Survey, 2022

### 5.3.1.4 Population Distribution of Surveyed Household

All together 64 households have been surveyed to find out the baseline data of project affected areas, like ethnicity, literacy rate, migration trend, their economic status, income level, their energy use and solid waste management technic.

### 5.3.1.5 Caste/ Ethnicity and Language

In project district, majority of people are Brahmin, Chhetri, Gurung, Magar, Newar, and Dalits. The majority of total population is Brahmin-hill in Chitwan district which accounts 28.56% of the total population. Similarly, in Gorkha and Tanahu districts, the majority of total populations are Gurung (15.21%) and Magar (11.87%) respectively.

In project area, majority of people are Brahmin/Chhetri and Janjati (indigenous) with the total population of 39.1 % and 54.6 % respectively. The major indigenous people are Gurung,

Newar, Magar and Tamang. Nepali is the common National Language speaks in the project area. Table 5.16 presents the ethnic composition along the project road section.

**Table 5.16: Ethnic Composition**

S.N.	Ethnicity	Household	%
1	Brahamin/Chhetri	25	39.1
2	Janjati (Indigenous)	35	54.6
3	Dalit	4	4.7
4	<b>Total</b>	<b>64</b>	<b>100.0</b>

Source: Household Survey, 2022

### 5.3.1.6 Vulnerable and Indigenous People

The major indigenous people residing in the project area are Magar, Newar and Gurung. The socio-economic survey shows that there are nearly 56% of the Indigenous people residing in the project area. Similarly, the socio-economic survey shows that there are 52 vulnerable household in the project area. The vulnerable people of the project area with their household number are presented in Table 5.17.

**Table 5.17: Vulnerable Household of the Project Area**

S.N.	Vulnerability Category	Number of HH	Number of HH (%)
1	Below Poverty Level	21	40.38 %
2	Female Headed Households	8	15.38 %
3	Having Elderly Members	2	3.84 %
4	Dalit	5	9.61 %
5	Indigenous	14	26.92 %
6	Having Disable Member	2	3.84 %
	Total Vulnerable Households (HHs)	52	100 %

Source: Field Survey, 2022

### 5.3.1.7 Literacy and Education Level

The project affected district have literacy rate of 62.09% in average with the literacy rate of 70.76% in Chitwan district, 53.85% and 61.07% of Gorkha and Tanahu Districts respectively. In all three districts, male populations are more literate than female populations.

More than 78.2% of total population is literate in the project area with more population had pursued degree above SLC. Altogether, 7 schools fall along the road alignment.

Details have been given in Table 5.18 below. Also, the nearest school along the proposed road alignment along with the chainage is given in Table 5.19.

**Table 5.18: Literacy Status of the project section**

Education Status	Sex		Total	Percentage (%)
	Male	Female		
Below 5 Year	14	6	20	5.6
Illiterate	22	36	58	16.2
Literate (Can read and write)	28	23	51	14.2
Primary (1-5)	20	17	37	10.3
6 to 10	57	33	90	25.1
Class 10-12	40	36	76	21.2
Graduate and above	14	12	26	7.3



Education Status	Sex		Total	Percentage (%)
	Male	Female		
<b>Total</b>	<b>195</b>	<b>163</b>	<b>359</b>	<b>100</b>

Source: Household Survey, 2022

**Table 5.19: Nearest School along the Proposed Road Alignment**

School/college	Chainage	Settlement	Distance
Karantar Namuna Prathamik Vidhyala (School)	1+780	Karantar	60 m from Center line of the project road
Active Greenland H.S. School	8+850	Abukhaireni	25 m from Center line of the project road

Source: Household Survey, 2022

### 5.3.1.8 Settlement

The major settlement areas along the proposed area are Mugling and Abukhaireni. Mugling is the junction of three highways to Kathmandu, to Narayanghat, and to Pokhara. The end point at Abukhaireni, a local urban area, is the junction of the main road to Gorkha (F035).

### 5.3.1.9 Migration Trend

The migration trend covered by the household survey in the project area shows only 39 households are migrated in the project area out of 64 households within rural municipality in last 10 years and the remaining houses had not moved. The household survey reveals that the purpose of the migration is mainly for trade & business. Table 5.20 shows purpose of migration in the project area.

**Table 5.20: Purpose of Migration in the Project Area**

S.N.	Purpose of Migration	Households	Percent (%)
1	Employment	21	53.8
2	Trade/ business	14	35.9
3	Education	1	2.6
4	Others	3	7.7
	<b>Total</b>	<b>39</b>	<b>100</b>

Source: Household Survey, 2022

### 5.3.2 Economy

The economy of the project affected area is based on multiple activities. All most all surveyed households reported that they have income from different sources. The main source of income of the people relies on foreign employment, business, services (government & non-government organizations) and wage labors.

The most economically active population by age group between 16 to 45years of age has been reported more 55.03% along the corridor of this road. The percentage of old aged group. 65 years and above is about 8.10% of the total population. The following Table 5.21 presents the total population by age groups.

**Table 5.21: Economically active population in the project area by Age Group**

Age Group	Male	Female	Total	%
0-5	14	6	20	5.59
6-15 Year	24	13	37	10.34
16-45 Year	102	95	197	55.03
46-65 Year	38	37	75	20.95

Age Group	Male	Female	Total	%
65 Above	17	12	29	8.10
Total	195	163	358	100

Source: Household Survey, 2022

### 5.3.3 Source of Income

Households were found to depend on more than one source of income in the surveyed households. Almost all reported that they have income from different sources. However, the main source of income of the people relies on trade and business, services (government and non-government organizations) and remittances. Table 5.22 presents the source of income.

**Table 5.22: Average Yearly Income by Source Household**

Income	Total Amount	%
Agriculture	2,119,000	5.6
Livestock	4,620,000	12.1
Service	5,558,000	14.6
Business	23,528,000	61.8
Industry	660,000	1.7
Agricultural Wages	480,000	1.3
Non Agricultural Wages	1080000	2.8
Foreign Employment	5280000	13.9
Others	300000	0.8
Total	38,045,000	100

Source: Household Survey, 2022

#### 5.3.3.1 Land Holding Size

In Chitwan district, the number of individual holdings with land is 88,242. Paddy, maize, millet, buckwheat, wheat and barley are the cereal crops grown in the district. Cash crops are potato, tobacco, sugarcane and oilseed. Buffalo, goat, sheep, pig, fowl and duck are the major livestock in the district. Likewise, in Gorkha and Tanahu district, the numbers of individual holdings with land are 57,671 and 59,233 respectively. Paddy, maize, wheat, buckwheat, millet and barley are the cereal crops grown in both districts. Potatoes sugarcane, tobacco and oil seeds are the major cash crops in the district. Cattles, buffaloes, goat, pigs, and fowl are the major livestock and poultry types in the district (*Source: District profile of Nepal, 2014/15*). Land holding is one of the wellbeing indicators of households in Nepal. The baseline surveys of the surveyed HHs are shown in Table 5.23.

**Table 5.23: Land holding size**

Land Type	No. of HHs	No. of HHs (%)	Total Land in Ha.	Average Land in Ha.
Ghar Bari (homestead)	20	31.25	2.12	0.06
Khet (irrigated land)	12	18.75	4.05	0.13
Pakho Bari (non-irrigated)	27	42.18	4.6	0.11
Kharbari (sloppy land)	5	7.81	1.2	0.09
Total	64			

Source: Household Survey, 2022

### 5.3.3.2 Occupation

Business is the mainstay of the economy, providing a livelihood for majority of the population in project area, which accounts 24.3% of the total population whereas other income sources are from agriculture and service. 18.4% of the total populations have no jobs, which accounts for unemployment population of the project area. Table 5.24 provides the main sources of income of the interviewed households.

**Table 5.24: Occupation Status of the household in the Project Area**

S.N.	Occupation	Sex			Percentage (%)
		Male	Female	Total	
1	Agriculture	19	27	46	12.8
2	Livestock	5	2	7	2.0
3	Service	19	9	28	7.8
4	Business	49	38	87	24.3
5	Agricultural Wages	5	2	2	0.6
6	Industry	-	2	7	2.0
7	Non-Agricultural Wages	29	18	47	13.1
8	Foreign Employment	7	13	20	4.7
9	Student	14	3	17	5.6
10	Housewife	6	5	11	3.1
11	No Job	28	38	66	18.4
12	Other	10	10	20	5.6
<b>Total</b>		<b>191</b>	<b>167</b>	<b>358</b>	<b>100</b>

Source: Household Survey, 2022

### 5.3.4 Resources and Raw Materials

#### 5.3.4.1 Source of Drinking Water

In the project districts, major source of drinking water is found to be from Tube well and piped water. Tubewell/ Handpump (49.26%) is the major source of drinking water in Chitwan while tap water in Gorkha (62.81%) and Tanahu (74.47%) districts (Source: District Profile, 2020). The various sources of water in the project area is shown in Table 5.25.

In the project area, major source of drinking water is found to be from piped water (96.87%). About 3.0 % of the households use underground water and spring water for the purpose of drinking water. The Table 5.26 shows drinking water purification method prior to drinking in the project affected area.

From the survey, it revealed that 1.6 % of household directly drink water from the source without treatment and 98.4 % household goes through different types of purification method prior to drinking.

**Table 5.25: Sources of Water in Project Affected Area**

Source of drinking water	Households	Percentage (%)
Piped water	62	96.87
Well/ Spring	1	1.50
River/ Stream	-	-
Underground (tube well)	1	1.50
Rainwater	-	-
Not stated	-	-
<b>Total</b>	<b>64</b>	<b>100</b>

Source: Household Survey, 2022

**Table 5.26: Types of Drinking Water Purification Methods in Project Affected Area**

Drinking water purification method	Households	Percentage (%)
Direct from the source	1	1.6
Boiling	8	12.5
Filter	1	1.6
Boiling and Filter	40	62.5
Use of Piyush	5	7.8
Others	9	14.1
<b>Total</b>	<b>64</b>	<b>100.0</b>

Source: Household Survey, 2022

### 5.3.5 Source of Energy

#### 5.3.5.1 Cooking

In Chitwan district, only 39.70% use LP Gas as source of cooking while 49.06% of total HHs uses wood/firewood as source of cooking. Similarly, in Gorkha and Tanahu districts, majority of HHs use wood/firewood for cooking which accounts 84.34% and 67.87% respectively. Others sources for cooking in all districts are biogas, kerosene, cow dung, electricity, etc.

The household survey in the project affected area, revealed that for cooking purpose firewood is used by 12.50% household, LP- gas by 87.50% household. The **Table 5.27** shows sources for cooking in the project affected area respectively.

**Table 5.27: Sources of Cooking in the Project Affected Area**

Fuel for cooking	Households	Percent (%)
Firewood	8	12.50
LP- gas	56	87.50
<b>Total</b>	<b>64</b>	<b>100</b>

Source: Household Survey, 2022

#### 5.3.5.2 Lighting

Source of energy for lighting in three districts, Chitwan, Gorkha and Tanahu, are electricity which accounts for the 85.93%, 76.42%, and 77.09% respectively out of total HHs in project districts (*Source: District Profile, 2020*). Other sources of energy for lighting are kerosene, solar, biogas and others.

From the household survey in the project affected area, it revealed that 98.43% household use electricity as lighting source. The Table 5.28 shows sources for lighting in the project affected area respectively.

**Table 5.28: Source of Lightning in the Project Affected Area**

Fuel for Lighting	Households	Percent (%)
Electricity	63	98.43
Tukimara	1	1.56
<b>Total</b>	<b>64</b>	<b>100</b>

Source: Household Survey, 2022

### 5.3.6 Health and Sanitation

There is one private hospital in Abukhaireni and 2 Health Post at Mugling Bazaar and Abukhaireni. The list of health institution in the project municipalities is presented in the Table 5.29.

**Table 5.29: Health Institution in the Project Area**

Type of Institute	Name of Institution	Location
Hospital	Private hospital	Abukhaireni
Health post	Abukhaireni Health Post	Abukhaireni
Health post	Ichhakamana Health Post	Mugling

Source: Ward Office Survey, 2022

The predominant diseases as reported are mainly Asthma, eye diseases, bath diseases, blood bleeding, blood pressure, dysentery, common cold, maternity related, pain in stomach, gastric, etc. HIV related disease was not reported in the project-affected area. However, only 20 households were aware of HIV AIDS mainly through radio/TV, newspapers, social mobilizer and books while 44 households are still unaware about the HIV AIDS. The Table 5.30 shows the type of diseases and number of affected persons (Source: Household Survey, 2022).

**Table 5.30: Diseases and number of affected person in the Project Affected Area**

Types of diseases	Project Affected Area	
	Male	Female
Diarrhoea/ Dysentery		1
Typhoid	1	
Uterus	2	
Skin	2	
Gastric	1	
Asthma	5	1
Eye	3	
Bath Disease	3	4
blood bleeding	4	4
brain tumor		1
Mirgaula	2	
Mutu rogi	2	
Mutu,presure,sugar		1
Mutusambandhi		1
Presure	3	1
Stone	1	1
Sugar	2	2
<b>Total</b>	<b>31</b>	<b>18</b>

Source: Household Survey, 2022

### **Sanitation**

In the project affected districts, 73.83%, 41.20% and 63.59% households have Modern toilet facilities with safety tank in Chitwan, Gorkha and Tanahu districts respectively (Source: District Profile, 2020). Those who have toilet mostly possess either pan or pit type toilet with flush system. In the project affected area only 42.19% of the households have flush system connection with septic tank and 10.94% households have flush system connection with drains. The Table 5.31 shows types of sanitary facilities available in the surveyed households.

**Table 5.31: Types of Sanitary Facility**

Types of Sanitary Facilities	Households	Percentage (%)
Khaldo	10	15.6
Dui Khalde sulabha charpi	20	31.2
Flush system connection with septic tank	27	42.19
Flush system connection with drains	7	10.94
<b>Total</b>	<b>64</b>	<b>100</b>

Source: Household Survey, 2022

The household survey (64 HHs surveyed in 2018), revealed that 27 HHs (42.18%) disposed the waste via dumping in nearby Marshyangdi River and road side. While 8 HHs (12.50%) dumped the generated wastes in agriculture land, pits and used for composting. The Table 5.32 shows solid waste management in the households' level in the Project Area.

**Table 5.32: Solid Waste Management in Household Level**

Methods of Solid Waste Management	Households	Percentage
Waste collection by Rural Municipalities	-	-
Composting	8	12.50
Dumped in agriculture land	8	12.50
Burning	6	9.37
Dumped near- by road/ river/ stream side	27	42.18
Dumped in pits	10	15.62
Reuse	5	7.81
<b>Total</b>	<b>64</b>	<b>100</b>

Source: Household Survey, 2022

### 5.3.7 Traffic and Safety

Based on traffic, this road is classified as Type II & III and is being designed for a speed of 40~60kmph. Safety requirements along the road are studied in detail and accordingly necessary safety provisions like safe designed junctions, vehicles U-turning locations, pedestrian level crossings have been made at required locations in the design. Further safety measures have been provided including road signs, delineators, chevron signs, w-beam crash barriers, gabion crash barriers, road marking, speed restrictions in busy areas, etc. Traffic Safety has been considered in the design of Mugling - Abukhaireni road based on:

- Nepal Road Safety Measures
- Traffic Signs Manual for Nepal Roads
- Road Safety Notes published by Traffic Engineering and Safety Unit of DoR, Nepal
- Nepal Road Standards and DoR guidelines

The most crucial safety issues of the proposed road are related with topography, geotechnical, steep cutting, climate, environment and anthropogenic features such as subgrade failure, side slope failure, cutting of land, forest reduction.

School children who use roads to access schools are exposed to high crash risks as their behavior on the road is highly unpredictable. The design of MA has incorporated the following measures to safeguard school children along the school zones.

- Reflectorized platform raised zebra-crossing or reflectorized zebra crossing with rumble strips before it in front of it;
- Kerbed footpath with handrails for 100 m in both directions from the school frontage or crossing in both directions in both sides and
- Road studs installation before the crossing for night visibility.

Motorcyclists are also at significant risks on Nepalese hill roads owing to several dangerous behaviors of motorcyclists such as general tendency of reckless driving at sharp bends; inherently more loss of control than four-wheel vehicles and more aggressive overtaking of slow-moving four-wheel vehicles. Motorcyclists represent relatively younger drivers which is another contributing factor that influences risky driving behavior. The final design of MA road has following measures to enhance motorcyclists' safety along MA Road.

- Gradual tapering of the carriageway/ shoulder interface to mitigate instability to motorcyclists to sudden edge drop;
- "No-overtaking" sign and marking at road segments with limited visibility and
- Retro-reflective single chevrons along the sharp curves to effectively delineate the turning path

The design of Mugling - Abukhaireni has following measures to improve pedestrian safety;

- Introducing footpath kerb 10 – 15 cm to be friendly to people with disabilities;
- Kerb-ramps at all the intersection and mid-block crossings.
- Consideration to increase the footpath width to 1.8 m at all the bazars to be wheelchair friendly;
- Provision of footpaths with kerb-ramps are friendly to people with disabilities and wheelchair users along the Abukhaireni Bazaar (Km 8 +050 - 9+300)
- Traffic calming measures such as reflectorized rumble strips before zebra crossings or platform raised reflectorized zebra crossing;
- Demarcation of crossing with road studs for visibility during the night time;
- Provision of one kerb-ramped, mid-block crossing (reflectorized) with road stud illumination at every 250 m interval of a bazaar, where appropriate.

#### 5.4 Cultural Environment

The identified 5 small temples are located along the proposed road where certain communities conduct ritual worship in special occasion. Their details have been given in Table 5.33. Among these, Triveni Bhagwati Temple at Ch 1+060 Km carries a religious value in the locality of Karantar and Bhuwanitar. It is located at Triveni Religious Forest on the right side of the proposed road. It overlooks the river valleys of Trishuli the south and Marshyangdi in the west. The surrounding area of Triveni Bhagwati temple including the existing road use for the celebration of Haribodani Ekadasi Triveni Mela by local annually in an immense scale.

**Table 5.33: List of Temples along Road Alignment**

S. N.	Chainage	Temple	Rural Municipality	Settlement Name	Distant from the center line (m)	Remarks
1	0+050	Shree Siddha Baba	Ichhakamana	Mugling Bazaar	2	Within the formation width
2	0+505	Ichchakamana Mai	Ichhakamana	Gorkha	2	Left Side from the centerline of the road
3	1+060	Triveni Bhagawati Temple and its territory	Shahid Lakhani	Karantar	27.5 m	Right side from the centerline of the road
4	5+080	Laxmi Narayan	Abukhaireni	Power house	2	Within the formation width
6	7+850	Ganesh Mandir	Abukhaireni	Abukhaireni	2	Within the formation width

Source: Inventory Survey, 2022.

## 5.5 Project Affected Structures

The details of project affected structures are given in Table 5.34:

**Table 5.34: List of Project Affected Structures**

S.N.	Types of Structures	Numbers	Remarks
1	Residential Structures	223	Within the formation width
2	Electrical Poles/Telephone Poles	153	Within the formation width
3	Transformer	5	Within the formation width
4	Resting Place (Pratikshalay)	2	Within the formation width
5	Police Building and Post	2	Within the formation width
6	Temples (small)	4	Within the formation width
7	Ama Samuha Structure	1	Within the formation width
8	Canteen (Chamena Griha)	1	Within the formation width
9	Public Toilet	1	Within the formation width
11	Shed	11	Within the formation width
12	Private Toilet	5	Within the formation width
	Total	408	

Source: Inventory Survey, 2022



## **CHAPTER 6: ALTERNATIVE ANALYSIS**

Alternative analysis has been considered as an integral part of EIA study, which involves an examination of alternative ways of achieving objectives of the proposed project. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the adverse impacts. The various alternatives to achieve the project objectives with minimum environmental degradation are discussed below:

### **6.1 DESIGN**

There are two types of road design and construction methods. They are conventional and green road approach. In conventional method, heavy machineries and equipment, explosives, heavy concrete structures with the application of bituminous surfacing, side drains, bridges and culverts etc. are extensively involved. Green road approach which is normally referred as a labor based, environmentally friendly and participatory focuses to conserve the delicate mountain ecology through the protection of vegetation cover as means of soil conservation.

The proposed road has been designed considering conventional approach with labor based to some extent and complying with the environmental laws and regulations, safeguarding air and water quality, conserving materials and resources, etc.

### **6.2 PROJECT SITE**

Mugling- Abukhaireni Road is a section of Mugling – Pokhara road, which falls under Prithvi Highway (H04). There is a small market area along the road at Mugling, which is the junction of three highways to Kathmandu, to Narayanghat, and to Pokhara. The end point at Abukhaireni, a local urban area, is the junction of the main road to Gorkha (F035). Originally construction of Mugling – Pokhara road was started in 1967 with the Assistance from the Chinese Government. The construction was completed in 1974. The length of existing two lane paved road in this section (Mugling – Abukhaireni) is 8.0 km. The pavement, cross drainage, and off-road structures are in good condition. The important function of National highway is to minimize travel time of people and logistics; also, it should be easily accessible to major hub towns. For efficient road network and balanced development of adjacent areas, it should consider short-haul connections in major cities. From this perspective, new road routes have been studied for additional two-lane road, based on the connection between Mugling and Abukhaireni.

The three probable alternatives of the route alignment of this road section for upgrading are described with the figure below and Table 6.1.



Figure 6.1: Probable Alternative Route Alignments of Mugling-Abukhaireni Section

**Alternative Route 1:**

Mugling bazar - Right bank of Trishuli River - Karan tar - left bank of Marshyangdi river-crossing the Marshyangdi river just after the powerhouse of Marshyangdi Hydroelectric Project (MHEP) – Abukhaireni Junction.

Figure 6.2 shows the alignment of route alternative 1. Under this alternative, existing two-lane road along the right bank of Marshyangdi River up to Marshyangdi Hydroelectric Power (MHEP) plant at Ch 4+750 is used by the traffic heading towards Abukhaireni. A new 2-lane road (~4.75 km) crossing the Trishuli river near the start of Mugling Bazaar without affecting any existing house is constructed along the opposite bank (left bank) of Marshyangdi river up to the MHEP plant and used by the traffic heading towards Mugling. The existing 2-lane road from the MHEP plant up to Abukhaireni is improved to 4-lane standard for two-way traffic.

The new road route section along the left bank of Marshyangdi River passes through nearly virgin land with very few settlements and farm lands. In this alternative, there will be 2-laned one way carriageway along each bank of Marshyangdi River from Mugling to the powerhouse at Ch 4+750 and 4-laned carriageway from the powerhouse to Anbukhaireni along the existing Mugling – Pokhara alignment. The construction cost is reduced and the highway function provided is also improved. The route length from Mugling to Abukhaireni along the new route at the left bank of Marshyangdi river is 7.9km and two new bridges of two lanes are required across Trishuli River and Marshyangdi River. A new two-lane bridge under construction at Mugling across Trishuli River just beside the existing old suspension bridge is used in this alternative. There exists an earthen track (600 m approx.) in the initial part of this route. The initial section of 4.75 km length of the alignment lies in Gorkha district and remaining 3.15 km up to Abukhaireni lies in Tanahu district. An existing earthen local road to Manakamana temple and bazaar, a popular Hindu pilgrimage destination, connects with the alignment of this alternative at km 1+150.

The salient features of route alternative 1 are:

- The total road length = 7.90 km
- Number of 2-lane new bridges = 2 nos.
- The total length of 2-lane bridges = 150 m (Trishuli Bridge) + 170 m (Marshyangdi Bridge) = 320 m
- Length of New Road = 6.4 km (including bridges)
- Length of existing road improvement = 1.5 km
- Total estimated project cost = NRs. 3,132,498,819 (including bridge, land, resettlement, & environmental costs)

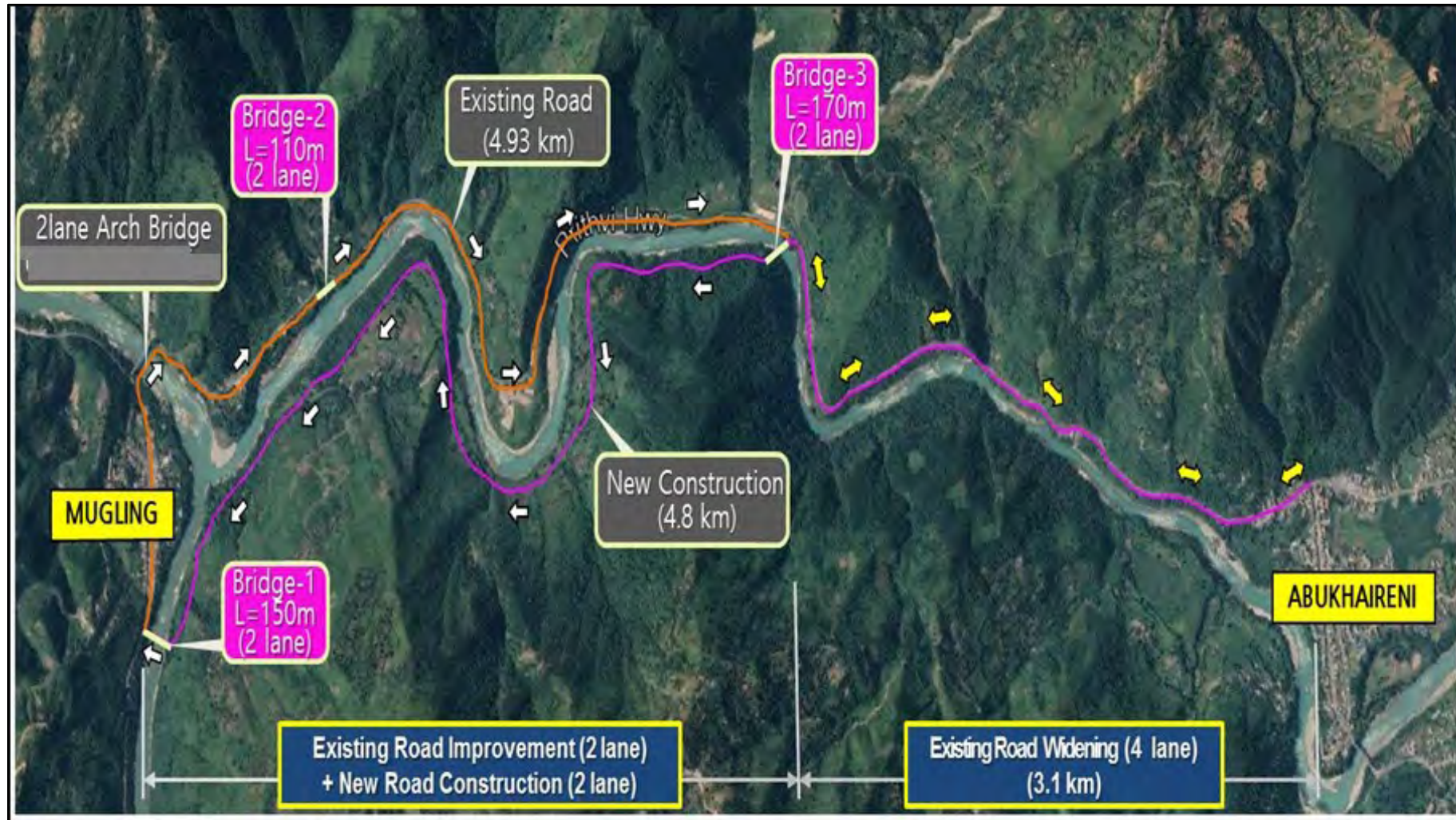
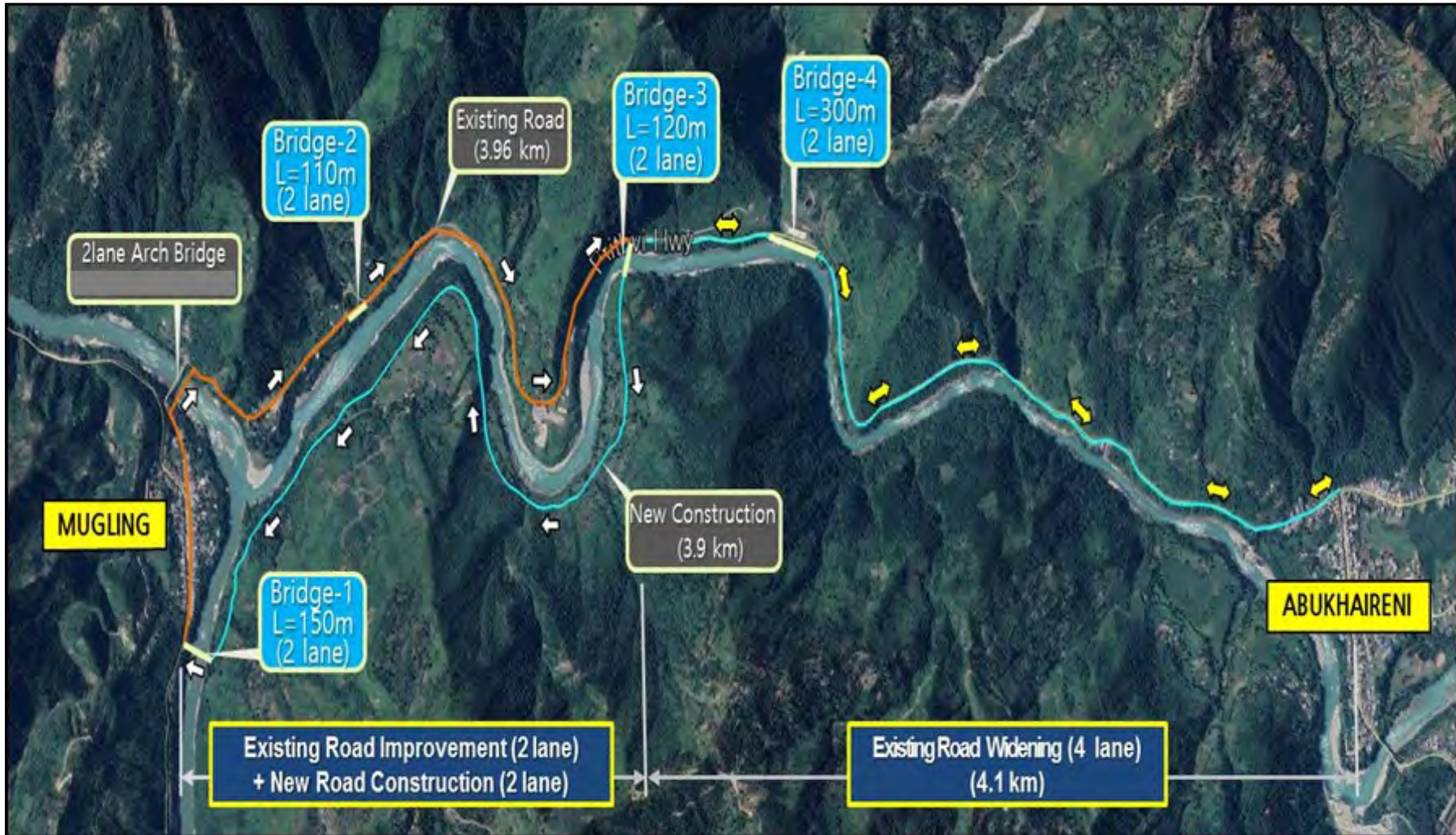


Figure 6.2: Alignment of Route Alternative 1 of Mugling – Abukhaireni Section

**Alternative Route 2:**

Mugling bazar – Karantar- Marshyangdi Bridge-1- Marshyangdi Bridge-2 (at powerhouse of MHEP) – Abukhaireni following the existing road



**Figure 6.3: Alignment of Route Alternative 2 of Mugling – Anbukhaireni Section**

Figure 6.3 shows the alignment of route alternative 2. Under this alternative, existing two-lane road along the right bank of Marshyangdi River up to Ch 3+960 is used by the traffic heading towards Abukhaireni. A new 2-lane road (3.9 km) for traffic heading towards Mugling crosses Trishuli River near the start of Mugling Bazaar without affecting any house, follows the right bank of Trishuli river at the start, then the left bank of Marshyangdi river until it crosses the Marshyangdi river at km 3+960 just next to the end of the steep section at the right bank of the river and follows the existing Mugling – Pokhara road alignment up to Abukhaireni. There will be 2-laned carriageway along each bank of Marshyangdi river from Mugling to Ch 3+960 and 4-lane carriageway from Ch 3+960 to Abukhaireni along the existing Mugling – Pokhara road. The total road length is 8.0 km and includes three bridges of lengths 150m over Trishuli river, 120 m over Marshyangdi river, and 300 m parallel to the existing Mugling – Abukhaireni road and Marshyangdi river at the location of the power house of MHEP. The initial 3.96 km length of the new alignment lies in Gorkha district and remaining 4.1 km up to Abukhaireni lies in Tanahu district. An existing earthen local road to Manakamana temple, a popular Hindu pilgrimage destination, connects with the alignment of this alternative.

The salient features of route alternative 2 are:

- Total Road length = 8.0 km
- Number of 2-lane bridges required = 4 nos
- The total length of 2-lane bridges = 150 m (Trishuli Bridge) + 120 m (Marshyangdi bridge-1) + 300 m (Marshyangdi bridge-2 parallel to the existing road beside the powerhouse) = 570 m
- Length of New Road = 6.5 km (including bridges)
- Existing road improvement = 1.5 km
- Total estimated project cost = NRs. 3,895,498,956 (including bridge, land, resettlement, & environmental costs)

### **Alternative Route 3:**

Mugling Bazaar-Trishuli Bridges (one existing & other under construction)- New bridge (along the Right bank of Trishuli (150m), Marshyangdi river R/B (110m)- 2 Bridges (350m & 300m) at MHEP site-Abukhaireni.

Figure shows the alignment of route alternative 3. This road route follows the existing road alignment. There are total four bridges proposed in this alternative for upgrading the existing road to four lane standards. Measured from the end of the existing suspension bridge over Trishuli river, first bridge is located at 190m just beside and parallel to the existing road to avoid cutting of the steep hard rock stretch, second bridge is located at 1.0 km to bypass the existing short loop (geometric improvement), third bridge is located at 2.85 km to avoid cutting of steep hard rocky stretch, and fourth bridge is located at 3.86 km just beside and parallel to the existing road to avoid damaging to the power house structures. All bridges are parallel to the river bank. It has an adverse function as the main road network due to the longer driving distance compared to other alternatives and also the existing old suspension bridge over Trishuli River needs to be repaired to the required standard. The total road length is 8.02 km. The initial 0.9 km of the alignment lies in Chitwan district and remaining length of 7.3 km up to Abukhaireni lies in Tanahu district.



Figure 6.4: Alignment of Route Alternative 3 of Mugling – Abukhaireni Section

The salient features of this alternative are:

- Total Road length = 8.02 km
- Number of 2-lane bridges required = 3 nos.
- Number of 4-lane bridges required = 1 no.
- The total length of 2-lane bridges = 150 m (at 0.19 km) +350 m (at 2.85 km) 300m (at 3.86 km) = 800 m
- The total length of 4-lane bridge = 110 m (at 1.0 km)
- New Road length = 7.1 km (including bridges)
- Existing road use = 1.1 km
- Total estimated project cost = NRs. 4,954,499,368 (including bridge, land, social, & environmental costs)

**Table 6.1: Alternative Analysis of Mugling-Abukhaireni Road**

Description	Alternative-1	Alternative-2	Alternative-3
<b>Design</b>	Conventional	Conventional	Conventional
<b>Project Area (Alignment)</b>	Mugling bazar-Rt. Bank of the Trishuli river-Karantar-Lf. Bank of Marshyangdi river, crossing the Marshyangdi river just after the powerhouse of the Marshyangdi-Hydroelectric Project (MHEP)- following the existing road.	Mugling Bazar-Karantar-Marshyangdi Bridge 1-Marshyangdi Bridge 2 (at powerhouse MHEP)- ABukhaireni following the existing road.	Mugling Bazaar-Trishuli Bridges (one existing and other under construction)- New Bridge (along the rt. Bank of Trishuli (150m), rt. Bank of Marshyangdi river- 2 bridges at MHEP site.
<b>Total Road Length</b>	7.90 km	8.0 km	8.02 km
<b>Existing Road Improvement</b>	1.5 km	1.5 km	1.1 km
<b>Total No. of Major Bridges</b>	2	3	4
<b>Time Schedule</b>	October-June (at day time)	October-June (at day time)	October-June (at day time)
<b>Raw Materials</b>	Boulders, cobbles, gravel and sand for road base and sub-base matters	Boulders, cobbles, gravel and sand for road base and sub-base matters	Boulders, cobbles, gravel and sand for road base and sub-base matters
<b>Total Estimated Cost (Including bridge, land, resettlement and environmental costs)</b>	NRs. 3,132,498,819.00	NRs. 3,895,498,956.00	NRs. 4,954,499,368.00

### 6.3 Best Project Road Alternatives

Among these three alternatives, Option 1 road route has been preferred the best option. The major reason avoiding alternative 2 is that the construction of bridge over Marsyangdi River is quite impossible because of complex terrain and the construction of 300 m bridge which is parallel to Mugling–Pokhara road to avoid the disturbance to Marshyangdi hydropower Project



is impossible because of its lengthiness. In the same manner, the major reason avoiding Alternative 3 is that all the proposed bridges are impossible for the construction because of its geographical structures with complex terrain. On the other hand, alternative 1 road project is the shortest route among three alternatives with construction of 2 major bridges and the project cost for Alternative 1 is comparatively lower than Alternative 2 and Alternative 3. The Alternative 1 road project is far sustainable with minimum environmental impacts in comparison with Alternative 2 and Alternative 3 road project. Also, the new construction of 7.90 roads in Alternative 1 in virgin land provides lots of benefits and opportunities like transportation facilities, local market and economic development of Gorkha people. The design option in alternative 1 will have a minimum range of environmental impacts than other two alternatives which can be minimized by expert's mitigation measures and compensating to those where impacts cannot be mitigate.

#### **6.4 PROCESS, TIME SCHEDULE**

The soil work or excavation activities of the project should be avoided during the monsoon period. The construction activities will be carried out during the day time only. During the rainy season, the upgrading work has to be stopped to avoid differential settlement of base, sub base and low strength of road pavement. The natural compaction of the road should be allowed during the rainy season. Rehabilitation and upgrading work will be carried out during the remaining months. The upgrading work is more appropriate from October to June as the local people are more or less free from farming activities.

##### **Activities to be avoided during monsoon:**

The activities to be avoided during monsoon includes clearing & grubbing works, felling down trees, dismantle works, major earthworks (cutting and filling), pavement works, major structure works, road furniture works and bridge works.

#### **6.5 RAW MATERIAL TO BE USED**

Different physical resources required for the upgrading of the existing road include conventional approach. Boulders, cobbles, gravel and sand for road base and sub base matters and concrete will be used. Based upon the types and quantities of construction materials, construction material sources and quarries have been envisaged to ensure sufficient construction materials during the construction stage of the road.

#### **6.6 OTHERS**

##### **6.6.1 No Action Option**

The no action option alternative prevents the implementation of the proposal and it deprives the beneficial impacts to the local peoples. In absence of this proposal, the travel time for locals to market centers and headquarter takes longer time and transportation of materials is much difficult. So, do- nothing situation limit the access of local people, make community remote and isolated from a main stream of the country. This will deprive the project areas from the benefits of modern transportation facilities. Hence, no action option is irrelevant in this context.

##### **6.6.2 Location Alternatives**

The people living in the project area require an efficient and safe mode of transportation to have the access to the market and other service centers. Along with the accessibility, the need of the proposed route is for minimizing the traffic congestion at the Mugling-Abukhaireni section. At the same time, there is need to conserve the physical, biological and socio-economic and cultural environment. As the road does not have much adverse impacts on the

environment due to measures taken to stabilize it, this could be best option for better access. No alternative route has been proposed besides the existing route from Mugling-Abukhaireni.

## CHAPTER 7: SPECIFIC IMPACTS ON THE ENVIRONMENT DUE TO IMPLEMENTATION OF THE PROPOSAL

### 7.1 ADVERSE IMPACTS DUE TO IMPLEMENTATION OF PROJECT AND THEIR MITIGATION MEASURES

The specific impacts of the implementation of the proposal on the environment during the pre-construction, construction, operation and maintenance phases has been identified and presented in the following section. The impacts have been quantified to the extent possible.

The identified impacts have been predicted in terms of their magnitude (minor, medium and high), extent (site specific, local and regional) and duration (short, medium and long term). Such predicted impacts are ranked as insignificant, significant and very significant. Both beneficial impact and adverse impact issues on physical, biology and social environment have been summarized with impact ranking in Table 8.1.

### 7.2 BENEFICIAL IMPACT

#### 7.2.1 Construction Phase

##### 7.2.1.1 Socio-Economic and Cultural Environment

- **Employment opportunity for local people in accordance to their education, experience and efficiency.**

The road upgrading works require labors every day. It is likely that locals will prefer to work in the project to stay close to their families. The household survey reports, the population of economically active group is 55.03% in the project area and 4.1% are involved in the agriculture wages and non- agriculture wages. So, those involved in the agriculture can be engaged in the project during agriculture off- season. Further, during the public consultation and public hearing, many have asked for the employment opportunity to the affected families and locals. Also, from household survey, 69.28% local people have said there will be increase in employment from the project. However, the local people may not be sufficient to complete the project on time so; labors outside the project area will be required too.

The project offers a wide range of works for unskilled and skilled laborers. People within the project area and outside the project area would generate substantial income from unskilled and skilled job generated in the project. The construction works offer a wide range of works for about 360,000 person days for unskilled manpower (500 persons per day) and 108,000 person days for skilled labors (150 persons per day) for 30 months during construction period. Out of the total manpower needed, the project provide about 30% of employment to the locals including women. *The impact is direct, high magnitude, local and short term in nature. So, the impact is ranked as very significant.*

- **Increase in economic opportunities and income generating activities such as business, and its impact on local economy;**

During the construction activities of road, labor groups, construction crew, project team and travelers seek for different types of facilities and services, such as food, accommodation and other necessary services. In other to meet their demand, enterprises like food and tea shops, groceries, lodges and restaurants will be developed. This will increase employment opportunities and help in income generation of the local people. Similarly, those enterprises will encourage local people to increase the local products, which will ultimately, increase the self employment opportunities of the local people generating income. Increase in demand on the local production like pulses, milk, meat, vegetables, fruits etc. may provide added impetus

for local production and marketing in project area as well as near by project area. *The impact is indirect, moderate magnitude, local and long term in nature. So, the impact is ranked as significant.*

- **Relevant trainings to unskilled labor in project activities for improving their efficiency.**

The project required number of skilled and unskilled labor in the project activities. However, the project requires huge number of unskilled labor for different activities. But, the project also needs to train the unskilled labor to carry out the work effectively. The project will conduct TNA (Training Need Assessment) and provide training like bio-engineering, mason, carpentry, tailoring and other constructed related training accordingly to the able and qualified unskilled project affected people; so that they can get advantages by increasing their efficiency and wages. One of the strategies of the road project is to give emphasis for the employment of local people who are living along the road corridor and are supposed to be affected by the road project. These strategies not only provide employment opportunities to the local poor people but also supports in transfer of skills and technical know-how while working in construction works and inject money in rural economy. From the project, one can build skills in masonry works, carpentering, etc. These skills will benefit the locals in getting long-term employment opportunity in road construction projects in future. *This impact will be direct, moderate magnitude, site specific and long-term in nature. The impact is ranked as significant.*

## **7.2.2 Operation and Maintenance Phase**

### **7.2.2.1 Socio-Economic and Cultural Environment**

- **Increase in Economy**

During the road construction phase and operation phase, various enterprises were developed to meet the demand of the project crew members, project team and the travellers. These enterprises often continue for long time after completion of the project, which will increase the economy of the local people. After the completion of the road project, many internal tourists may come to visit for their cultural, scientific, historic and scenic values. This will indirectly increase the economy of the local people. Also, the road is the route to reach one of the tourist destinies "Pokhara" which can create great impact on local market of the road project. *This impact will be direct, moderate magnitude, local and long-term in nature. The impact is ranked as significant.*

- **Increase in Land Values**

The upgrading of the road project leads to rising land values along the road alignment due to enhancement in trade and business, reliable transportation facilities. Increase in land values also enhances farmers' capability for borrowing loans on collaterals. High value lands are easily acceptable to banks and micro-finance institutes to provide loans. As per Minimal valuation Book of Chitwan, Gorkha and Tanahu Districts, 2076/77 minimal valuation of land along the Project Road between NRs. 25,00,000.00 - 80,00,000.00 per ropani. This could increase with increase in time period. *The impact is indirect, high magnitude, local and long term in nature. The impact is ranked as very significant.*

- **Local Area Development**

With the upgrading of road works, there will be subsequent increase in income levels from micro enterprises and by the gradual development of additional facilities and services in the area due to better access, it is expected that there will be an overall improvement in the quality

of life of rural people with reduction in travel time to social services, market areas and travelling to other parts of the country. In addition, the project will improve access to markets, health institutes, employment, social and education opportunities. This will bring about increase in productivity in rural areas and eventually improve the overall socio-economic condition of people living in or nearby road corridor. New market areas and settlements will develop, urbanization and industrialization will be possible, and all this will lead to the regional development of the area. *This impact is indirect, moderate magnitude, local and long-term. So, the impact is ranked as significant.*

- **Increase in Tourism**

Upgrading of the road will connect road between different places. Specially, this road is the main road for the Pokhara and Gorkha. Hence, the upgrading of the road will increase number of internal and external tourists. With increase in the tourist number, the services and facilities such as, restaurants, lodges and other accommodation services and facilities will also increase. Along with that, this increases the economy of the local people and regional people. *The impact is indirect, high magnitude, regional and long-term. So, the impact is ranked as very significant.*

- **Increased mobility through project access road**

The improved road access will bring quantified and non-quantified benefits. The quantified benefits of the project include the travel time saving and vehicle operating cost saving for motorized vehicles, which result higher vehicle speed and improved riding quality with the project. In addition to quantified benefits, few non-quantified benefits from the project are improved access to markets, health institutes, employment, social and education opportunities. This will bring about increase in productivity in rural areas and eventually improve the overall socio-economic condition of people living in or nearby road corridor. New market areas and settlements will develop, urbanization and industrialization will be possible, and all this will lead to the regional development of the area. *This impact is direct, high magnitude, regional and long-term impact. So, the impact is ranked as very significant.*

### 7.3 Adverse Impacts

#### 7.3.1 Pre-Construction Phase

##### 7.3.1.1 Physical Environment

- **Disturbances to public utilities**

Proposed road upgrading works requires the removal and relocation of public utilities from the proposed road RoW. This will cause disturbance to the locals and service providers in their daily activities and business. It is revealed that from the proposed Upgrading and new construction of the road project cause disturbance to 153 electrical poles/telephone poles and 5 transformers are listed in Table 7.1.

*The impact is direct, high magnitude, site specific and short term in nature. The impact is ranked as very significant.*

**Table 7.1: Details of Affected Public Utilities**

S.N.	Description of Particulars	Total Number
1	Electrical Poles	153
2	Transformer	5
	<b>Total</b>	<b>158</b>

Source: Field Visit, 2022

- **Disturbances to Land Use (Necessary Permits from Concerned Authorities/Parties/Persons for Placement and Operation of Project Utilities such as Quarry sites and Borrow Pits, Stockpiling, etc.)**

Upgrading of the road required acquisition of the land permanently up to formation width. Along with that, the project needs temporary land for storage of the stockpiling and quarry materials. The land may belong either to government or to the individuals and should require permits from concerned authorities/parties for its use. For the upgrading of the road project, 13.365 ha are required for ROW of the road and 18 ha is required for the temporary land use. From 18 ha of the land, 5ha is used for Quarry and Borrow area, 2ha is used for the stockpiling, 1 ha is used for the labour camp, 2 ha is used for the spoil disposal, 3 ha for crusher plant and 5 ha for concrete batching plant. The details of Land use are provided in Table 2.5 and Table 2.6. *The impact is indirect, moderate magnitude, local and short term in nature. The impact is ranked as significant.*

### 7.3.1.2 Biological Environment

- **Clearance of vegetation/road side trees within RoW.**

Upgrading/New Construction of the road will require clearance of 9.525 ha of forest area within RoW. But the road project will clear only 2,000 numbers of trees that lie within corridor of impact (COI). The remaining parts of the forest area will remain as a green belt protecting forest and environment. For the new construction of the road in Gorkha section, the project needs clearance of 670 no. of trees whereas, for the upgrading of the road in Tanahun section, the project needs clearance of 1330 no. of trees. The major trees that need to be cut down are Sal (*Shorea robusta*), Aasana (*Pterocarpus marsupium*), Karma, Chilaune (*Schima wallichii*), Katus (*Castanopsis indica*), Simal (*Bombax ceiba*), Padke (*Albizia julibrissin*), Khirro (*Wrightia arborea*), Sisao (*Dalbergia sisoo*), Khair (*Acacia catechu*), Karan (*Millettia pinnata*) and Aap (*Magnifera indica*). All the trees which need to be cleared belong to the five community forests and are presented in APPENDIX 11.

*The impact is direct, high magnitude, local and long term in nature. The impact is ranked as very significant.*

- **Handover of Forest Lands to the project.**

The opening of new road section, widening of existing road and construction of bridges requires acquisition of forest areas and public lands. The proposed project requires 9.525 ha of forest land for the road which basically requires clearance before implementation of the project. The details of the affected trees are shown in Annex 11.

*The impact is direct, high magnitude, local and long term in nature. So, the impact is ranked as very significant.*

### 7.3.1.3 Socio-Economic and Cultural Environment

- **Acquisition of Private and Community Structures**

Land, structure and property acquisition is required for the improvement and construction of the road geometry. During upgrading and new construction of the road geometry, a total of 75 residential structures, 58 residential and commercial structures, 78 commercial structures, 11 shed and 5 private toilets will be affected which falls on private structures and needed to be

acquainted by the proposed road project during its construction phase. Out of 227 private structures, 119 are fully affected and 108 are partially affected. Similarly, a total of 2 resting places, 2 police building and post, 4 temples, 1 Aama Samuha Structure, 1 Canteen and 1 Public toilet that falls on community structures need to acquire for the proposed project. The details have been given in Table 7.2. *The impact is direct, high magnitude, local and long term in nature. The impact is ranked as very significant.*

**Table 7.2: List of Affected Private Structures**

S N	Descriptions	Chitwan District	Gorkha District	Tanahu District	Total
		Ichhakamana	Sahid Lakhan RM	Abukhaireni	
1	Residential Structures	7	7	61	75
2	Residential & Commercial	3	0	55	58
3	Commercial	1	1	76	78
4	Shed	0	10	1	11
5	Private Toilet	0	3	2	5
	<b>Total</b>	<b>11</b>	<b>21</b>	<b>195</b>	<b>227</b>

Source: Household Survey, 2022

**Table 7.3: Distribution of Project affected structures by Severity**

Structure Types	No of Structure			Plenth Area (sqm <sup>2</sup> )		
	Fully	Partially	Total	Fully	Partially	Total
Residential	33	42	75	2375	2763	5138
Residential & Commercial	19	39	58	2745	6696.5	9441.5
Commercial	53	25	78	3303	2544	5847
Shed	9	2	11	137	29	166
Toilet	5	0	5	93.25	0	93.25
<b>Total</b>	<b>119</b>	<b>108</b>	<b>227</b>	<b>8653.25</b>	<b>12032.5</b>	<b>20685.75</b>

Source: Household Survey, 2022

**Table 7.4: List of Affected Community Structures**

S.N.	Structure Types	No.
1	Resting Place (Pratikshalay)	2
2	Police Building and Post	2
3	Temples (small)	4
4	Aama Samuha Structure	1
5	Canteen (Chamena Griha)	1
6	Public Toilet	1
	<b>Total</b>	<b>11</b>

Source: Household Survey, 2022

### 7.3.2 Construction Phase

#### 7.3.2.1 Physical Environment

- Changes in topography, land use pattern and land cover

The design of 9.384 km road length will hamper the landscape of the project area. The construction of cross drainage structures, extension or replacement of existing culverts, box culverts and pipe culvert may change the morphology, longitudinal profile and hydrological character of river/ stream etc. So, during the construction phase, poor design and construction works will disturb the existing landscape and scenic values of the site. *The impact is direct, high magnitude, site specific and short term in nature. So, the impact is ranked as very significant.*

- **Possibility of landslides, soil erosion and slope instability**

The proposed road alignment is prone to landslides and soil erosion. The slope instabilities are found in the hill slope as well as valley slope. The geotechnical study report reveals that slope is instable at Ch. {1+360 (RHS), 1+175 (RHS), 1+325 (RHS), 6+025 (LHS), 6+100 (LHS), 6+800 (LHS) and 6+925 (LHS)}. Factors for landslides, slope destabilization and soil erosion during construction phases are vibration, spoil disposal, borrow and quarry areas operation, slope cutting and exposed surface, construction carried out in rainy season without proper water control, drainage facilities, etc.

Consequences of landslides and soil erosion affect the safety and serviceability condition of roads and bridges. It also has chain effect on the farmers (loss of crops or farmland), land (degradation due to silt/ debris deposition), water (degradation of quality), river and streams (change in regime), vegetation (loss and impact) and on other infrastructures.

*The impact is direct and indirect, high magnitude, site specific and short-term in nature. So, the impact is ranked as very significant.*

- **Pollution due to excavated spoil disposal, construction wastes and haphazard storage of construction materials, solid waste and wastewater disposal**

The upgrading and the new construction of the road will generate approximately 327,496 cum quantity of construction spoil. The haphazard disposal of the spoil may cause slides due to overload of instable slope area, soil erosion, destroy vegetation, hazards to settlement at downhill side, disrupt natural drainages and pollute water sources etc. As well as, various construction activities such as demolition of structures, cutting of earth and rock mass for widening in some sections of project road, scarification of existing pavement will result to generation of huge quantity of construction waste.

On the other hand, the waste (degradable and non-degradable) generated from construction works and labor camp during the construction period, if not disposed or managed properly will cause land pollution ultimately damaging the farm lands, crops productivity, human health and properties through direct deposition or indirectly as a result of mass flow. Moreover, the top soil might be damaged due to the filling activities by construction materials, improper dumping of waste and liquefaction of these wastes.

*The impact is direct, high magnitude, local and short term in nature. So, the impact is ranked as significant.*

- **Loss of top soil;**

The widening of the road formation works requires permanent productive land (excluding settlements) from where the vegetation and top soil will be removed. The quantity of the top soil generation from the permanent land is approximately 2,605 cum assuming thickness of topsoil to be 25cm. Likewise, the establishment of project utilities (stockpiling, labor camps and others) will require temporary land from where the vegetation and top soil will be removed. So, this all result in a reduction of plant growth and yield as the top soil has highest concentration of organic matter, microorganisms, mineral particles, water and air.



*The impact is direct, high magnitude, site specific and short term in nature. The impact is ranked as very significant.*

- **Issues due to quarry and borrow activities**

The construction works will require construction materials like sand, gravel, boulders, etc. Ten different sites have been identified as quarry sites. The major quarry materials are boulders, cobble, gravels and sand. The estimated quarry materials are 2,075,500 m<sup>3</sup>. Over extraction will lead to deepening of river bed, river course to change and river edge to fall into the river. *The impact due to quarrying is considered to be indirect, moderate magnitude, local in extent and short term in duration. The impact is ranked as significant.*

- **Disruption of natural drainage pattern**

The project scope comprises construction of two major bridges and four minor bridges. This will impact on surface water hydrology, creating obstruction to the free flow of water. Change in morphology, longitudinal profile and hydrological character of river is possible due to narrowing of river, construction of piers and guide bunds or flood protection/stream bank protection works along the river banks for the protection of bridge from floods. *Impact is direct, moderate magnitude, local and short term in nature. So, the impact is ranked as significant.*

- **Air, Noise and Water Pollution**

- **Air Pollution**

Air is mainly polluted from dust during the construction works from sub base and base, erosion of unpaved area, stockpiles of construction materials, drilling, site clearance, movement of vehicles, operation of quarry, etc. Dust is also raised by plying of construction vehicles, operation of machineries. Emission from vehicles will pollute the surrounding atmosphere. Also, dust layer accumulates on the leaves of roadside vegetation limiting their growths and assimilation capacities and affects the roadside settlements. These all may cause nuisance to roadside walkers and nearby residents. The air pollutants are responsible for causing many respiratory problems and eye diseases to people exposed for long duration. Low quality of fuel, age and poor quality of vehicles, lead from petrol engines are the other causes of pollution.

*The anticipated impacts on air will be direct, moderate magnitude, local and short term in nature. So, the impact is ranked as significant.*

- **Noise Pollution**

The noise level may increase to some extent causing nuisance to the locals and sensitive receptors at the construction site due to construction activities such as excavation, blasting, movement of heavy vehicles, construction equipment, etc. Noise is also generated from vehicles engines, friction between tire of vehicles and road surface, excessive honking, etc. Expose to chronic noise can lead to communication problems, increase in stress levels as well as associated behavioral and health effects especially around sensitive receptors like school, hospital, army camp, health post, etc.

*The anticipated impacts on noise pollution will be direct, moderate magnitude, local and short term in nature. So, the impact is ranked as significant.*

- **Water Pollution**

During construction activities such as cutting and filling, disposal of construction waste and spoil, erosion and soil movement due to quarrying and borrowing etc., improper sanitation of workers or local inhabitants, disposal of wastewater from labor camp, unauthorized washing of vehicles and unauthorized garbage dump sites, accidents of

tankers carrying oil and other environmental hazards chemicals may cause increase in turbidity of stream, rivers, blockage of natural drainage system and pollute them causing health hazards to the downstream water users, impact on local fisheries. Increased silt content could cause unnecessary sediment deposition in downstream areas which causes the rising of river beds resulting flood in downstream areas. Accidents of the tanker carrying oil and chemicals, such as bitumens causing spillage might contaminate the water sources. The polluted water may become unfit for bathing, drinking, animal consumption, irrigation, etc. and affect fish and other aquatic life.

*The anticipated impacts on water pollution will be direct, of moderate magnitude, local and short term in nature.*

- **Generation of Waste**

Various construction activities such as demolition of structures, cutting of earth and rock mass for widening in some sections of project road, scarification of existing pavement will result to generation of huge quantity of construction waste. Further, substantial amount of domestic waste will also generate from workers camps. Improper disposal of these wastes may obstruct water flow resulting in reduction in water carrying capacity of the water body. Unscientific disposal of domestic waste may cause filthy smell resulting in health problems in workers and local residents. *The impact is direct, medium magnitude, site specific and short term in nature.*

### 7.3.2.2 Chemical Environment

- **Issues on Use, Storage and Handling of toxic materials/fuel, chemical and bitumen**

The use of fuels, lubricants, oils, acids and other chemicals for construction can cause serious environment problems if spread out through leakage in storage places. On the other hand, bitumen storage should be done with proper care as it is highly combustible and can cause severe hamper to skin and eyes.

*The impact will be indirect, high magnitude if properly not handle, site specific and short term. So, the impact is ranked as very significant.*

- **Soil, Land and Water Pollution from asphalt plants; trash and garbage; fuel and oil spills**

The use of fuels, lubricants, oils, acids and other chemicals for road construction is frequent environment problems that can be only met by special precautionary measures. They can easily spread out through leakage in storage places. If they are not properly handled before and after use, then it can lead to serious environment problems. Accidents of tankers carrying oil and other environmental hazards chemicals may cause increase in turbidity of stream, rivers, blockage of natural drainage system and pollute them causing health hazards to the downstream water users, impact on local fisheries.

*The impact will be indirect, moderate magnitude, site specific and short term. So, the impact is ranked as insignificant.*

### 7.3.2.3 Biological Environment

- **Disturbances to wildlife habitats and movement due to construction related activities**

The project road passes through five community forests which might cause disturbance to the wild lives inhabited in that forest. Commonly identified wildlife in the project area are Leopard cat (*Felis bengalensis*), Jungle cat (*Felis chaus*), Jackal (*Canis aureus*), Monkey (*Macaca Assamensis*), Langur monkey (*Presbytis entellus*), Squirrel (*Funambulus pennati*), squirrel

(*Funalbalus* sp.), Fox (*Vulpes bengalensis*), hare (*Lepus migricollis*) and Porcupine (*Hystrix hodgsoni*) etc. They are occasionally observed at the project site as reported by the locals. So, there is a likely disturbance to wildlife habitat due to increased vehicular movement and disturbance by construction crews during construction activities. The excessive intrusion of human activities or intensive extraction of resources may also disturb the wildlife habitat. *The impact is direct, moderate magnitude, local and short term in nature. So, the impact is ranked as significant.*

- **Impact on nearby forest due to increase in demand for firewood, timber and NTFPs**

Skilled, semiskilled and unskilled workforce will be involved in the construction of the proposed project. The labor force and their dependents will use firewood from local forest for cooking their food and timber for making their shed in different locations. Likewise, the non-workers gathered for economic opportunities will cut down the trees to build residences and shades. This will put additional pressure on local forest. *The impact is indirect, high magnitude, site-specific and long term. So, the impact is very significant.*

- **Impacts on biodiversity due to hunting and poaching activities**

Poaching will be one of the likely impacts on wildlife due to the presence of construction workers and the families' dependent on them. The local hunters or hunters among the workforce will be attracted to hunt wildlife like Barking Deer (*Muntiacus vaginalis*), Badel (*Wild boar*), Clouded Leopard (*Neofelis nebulosa*) and Rabbit (*Hispid hare*). This will lead to the loss of the species from near by the forest area.

*The magnitude of impact is considered to be indirect, high magnitude; local and short term in nature. So, the impact is very significant.*

- **Issues on Rare and Endangered Species of Flora and Fauna**

Sal (*Shorea robusta*), Simal (*Bombax ceiba*) and Khair (*Acacia catechu*) are considered as protected plant of Nepal and is found along the proposed road alignment. Similarly, Neem (*Azadirachta indica*), Harro (*Terminalia Chebula*) and Amala (*Phyllanthus emblica*) which are considered as medicinal plant prioritized for research and development were also observed along the proposed road. These tree species and NTFPs need to be felled down during the construction phase. However, the project area is not near to the habitat of endangered species of fauna and bird species.

*The impact is direct, high magnitude, site specific, long term in nature. So, overall the impact is ranked as very significant.*

- **Disturbance to aquatic biodiversity**

Fish species available in the Trishuli and Marshyangdi River are Bam (*Amphiphous cucbia*), Asala (*Schizothorax molesuworthii*), Katla (*Catla catla*), Hile (*Channa stewartii*) etc. Road/bridge may serve as barrier to movement of migratory aquatic species, especially where culverts are used. Often migratory fish species are intensively fished/overfished at sites where culverts and bridges tend to block the natural migratory pathways. Erosion from poorly constructed and rehabilitated sites can lead to downstream siltation, ruining spawning beds for fish. Constrictions of flows at water crossing can make the current too fast for some species. Disposal of excavated materials on water bodies may increase turbidity of water and result in reduction in dissolved oxygen content. It is common to see the inappropriate driver practices connected with vehicle washing in streams and rivers which can cause local water pollution by leakage of fuel, lubricants and hydrocarbons that may not only affect the aesthetic value of the water body, but also put hazards on people and animals using these as drinking sources. *The*

*impact is indirect, high magnitude, site specific to local and short term in nature. So, the impact is ranked as very significant.*

- **Occurrence of forest fire incidents**

There are 5 community forests along the project road that will be affected by the widening of the project road. Other than clearance of tree vegetation (2000 nos.) along the road side, the area near forest may be occupied by the project road for establishment of construction facilities such as labor camps, stockpiling, spoil disposal, etc.

Workforce may also create pressure on the forest and forest resources include firewood collection to meet their energy need for their meal in cooking etc. The activity of construction labors may lead to forest and other bush fires, which will have sudden, severe and wide-ranging impacts on all kind of living organisms. Fire hazards are common at construction sites, workshops where activities related with fire (such as welding) is carried out. *The impact is indirect, moderate magnitude, local and short term in nature. So, the impact is ranked as significant.*

#### 7.3.2.4 Socio-Economic and Cultural Environment

- **Health hazards due to environmental pollution**

During the construction of the road works, there is chance to increase in dust particles from the earthworks and increase in noise level due to movement of construction vehicles and use of construction equipment and water pollution. The increase in dust particles will deteriorates the ambient air quality thereby causing the respiratory problems, eyes disease among all ages especially children's and old age people. The increase in noise level may evoke emotions and lead to sleep disruption, high blood pressure, elevated stress hormones, etc. When the haphazard disposal of waste, construction spoil and leakage of chemical waste comes in contact with water, water pollution will occur. The polluted water when used will affect the health of people. Water borne diseases are commonly associated with unsafe drinking water, poor sanitation and poor labor camp conditions causing spread of endemic diseases such as dysentery, diarrhea, and cholera within the labor camp and surrounding of the project area. *The impact is indirect, moderate magnitude, site specific and short term in nature. So, the impact is ranked as insignificant.*

- **Occupational health and safety hazard**

The unmanaged construction activities may cause injuries, fatal accidents, disabilities among the labors and the road and bridge users. Without adequate safety measures, labor forces are exposed to various safety risks and health hazards during handling of hazardous materials, bitumen works, tree felling works, slope stabilization works, etc.

Accidents may occur during construction work due to poor road condition such as pot holes, road side ditches, cracks, construction spoils along the road alignment, movement of cranes and heavy vehicles without adequate warning, traffic congestion due to closure or limited lane section of the road, etc. Also, similar impacts are envisaged in the bridge section in case of accidents or injuries. Dust rose from earthworks and dust blown by air may pose health risks to the workers. The noise generated from the construction equipment during construction works may cause hearing loss among the workers. The health of workers also depends upon the quality of labor camp such as quality of living space, facility of clean drinking water, sanitary practices with toilets and solid waste management system, etc.

*The impact is direct, high magnitude, site specific and short term in nature depending upon the causality. The impact is ranked as very significant.*

- **Issue on road and Bridge Safety**

The number of vehicles plying on the road will be increased with respect to the existing traffic. Widen and improved geometry of road makes ease in driving and encourages drivers to speed up the vehicles speed. So, with improved road condition and more vehicles plying on the road may result in the increase in speed of the vehicles and road accidents. Road accidents will cause injuries, disabilities, deaths among drivers, passengers, pedestrians, animals and nearby structures. To mitigate these impacts, physical measures to maintain traffic and the vulnerable road users (school children, pedestrians) safety along the school zones and markets of the project road, have been incorporated in the design of this road. Moreover, the design of all the ramp crossings at the footpath is such so as to be universally accessible including for persons with disabilities. *The impact is indirect, high magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

- **Issues on loss of agricultural land/ corps**

The upgrading road works will acquire agriculture land during the widening and improvement of existing road. There will be permanent loss of 2.25 ha agriculture land that lies within RoW of road. This will impact on livelihood of the local people. *The impact is direct, high magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

- **Issues related to gender, vulnerable and indigenous people**

Discrepancy is prevalent in project area in wage distribution among the male and female labor forces. This is also prevalent to vulnerable and indigenous group. There is a high chance that the project contractors, project employee will discriminate female, vulnerable and indigenous groups on a very low salary compared to their male counterparts and other ethnic groups during construction of road. Along with that, the project contractor discriminate the vulnerable and indigenous people by excluding from trainings and other opportunities. The list of the vulnerable household is given in Table 5.17.

*The envisaged impact is considered to be indirect, moderate in magnitude, local in extent and short term in duration. So, the impact is ranked as significant.*

- **Child Labor Issues**

The proposed project requires approximately 108,000 person days of skilled manpower (150 persons per day) and 360,000 person days of unskilled manpower (500 persons per day) for 30 months during construction period. So, there is possibility that the Contractor may use poor family children in unskilled works in consent or without consent with children family members. The children working for their homes may support the family for a time being but in long run they are depriving them of the possibilities of studying and becoming more productive adults, hindering their future livelihoods. The children working may also face irreversible physical or psychological damage that may threaten their lives. This in turn will result in poverty, compromises economic growth and equitable development.

*The impact is direct, medium significant, site specific and long term in nature depending upon the child physical and psychological condition. So, the impact is ranked as significant.*

- **Impact on Religious, Cultural and Historical Assets**

Though there are no famous religious, cultural and historical assets in the project corridor, there are 4 small/medium-sized temples which are likely to be affected during construction of the project. Locally, these temples bear religious value; however, there is no historical or archaeological importance in these temples. Locations of the temple are at Ch. (0+050, 0+505, 1+060, 5+080 and 7+850). The detail is located in the Table 5.33.

*So, the impact is direct, high magnitude, site specific and short term in nature. So, the impact is ranked as very significant.*

### **7.3.3 Operation and Maintenance Phase**

#### **7.3.3.1 Physical Environment**

- **Changes in topography and land use cover and patterns**

During the operational phase the instability, landslides and soil erosion result not only from the road and its structure but also from the heavy rainfall, seismic activities and from general vehicle movement on the road. The impacts from slope instability are blockage of drainage structures, modification of water paths leading to concentrated flows, high gradient in cut or fill slopes and cleared areas which have been left without re-plantation or other appropriate rehabilitation measures. Embankment with open cuts and without vegetation when exposed to rain will cause soil erosion. This can become a major source of silt that the monsoon runoff carries away. *The impact is indirect, high magnitude, local and short term in nature. So, the impact is ranked as very significant.*

- **Damage to Road Section and Bridges**

There is possibility that the poor workmanship and material defects during the construction phase may damage the road section on its operation phase causing traffic congestion, accidents, pot holes and cracks on the road surface. The possible cause of damage to the road section is improper and inadequate drainages, wear and tear of the pavement surface, etc. *The impact is direct, high magnitude, site specific and short term in nature. So, the impact is ranked as very significant.*

#### **7.3.3.2 Biological Environment**

- **Disturbance to Wildlife Habitat and Barrier to Wildlife Movement Corridor**

A road with wider width and higher vertical alignment may cause a physical and psychological barrier for wildlife and act as a barrier across their movement corridor. When a road intersects or blocks a wildlife corridor, the result is either cessation of use of the corridor because animals are reluctant to cross the road, and increase of mortality due to collision with vehicles, or a delay in migration which may result in the weakening or disappearance of an entire generation of the population from predators, good food supplies, better travel conditions, and so forth. This often leads to accidental death and poaching. On busy roads, the death rate for the local amphibian, reptiles or other slow-moving animal populations can be high. *The impact is direct, moderate magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

- **Issues of Forest encroachment and easy access to forest**

A road that passes through forest converts forest area into built up area. Development of settlement in the forest area increased pressure on forest resources like firewood and timber and increase high risk of forest fire. With road connection, forests become easily accessible and render animal grazing, collection of firewood and NTFPs. Road may also considerably contribute and/ or accelerate logging activities and timber exports. Development stimulated by the road may promote activities such as use of firewood to meet the demand of both locals and tourists who consume forest resources and increase pressure on it. *The impact is indirect, moderate magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

- **Impact on aquatic biodiversity**

Erosion from poorly constructed and rehabilitated sites, unattended borrow pits can lead to downstream siltation, ruining spawning beds for fish. Roads may also serve as barrier to movement of migratory aquatic species, especially where culverts are used. Disposal of waste on water bodies may increase turbidity of water and result in reduction in dissolved oxygen content. *The impact is direct as well as indirect, low magnitude, site specific and long term in nature. The impact is ranked as insignificant.*

### 7.3.3.3 Socio-Economic and Cultural Environment

- **Possible township and market development and RoW encroachment**

The upgrading, widening of the road project developed township slowly in the project area as there developed ribbon settlement along the project area if not controlled by the government. This may lead to regular traffic congestion, road accidents, and reduced carrying capacity of arterial roads. This leads to expansion of towns, where services like schools, hospitals, banks, offices, etc. are costly. This may develop market area in the main center of the road alignment. There may be high chance in RoW encroachment for the market development. This also leads to the overcrowding of the people in service-related areas. This also, leads to high cost in water, sewerage and electricity. And meanwhile, interior areas are left underdeveloped causing wastage of valuable land. *The impact is indirect, high magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

- **Impact of new road alignment on economy and business of Mugling bazaar**

The main market of the existing road alignment of Mugling Abukhaireni lies in south side of the project road alignment, as there is the existing highway of the Mugling-Pokhara. But, the track of new road alignment of the Mugling Abukhaireni changes drastically, crossing the Trishuli Bridge to the east and again crossing the Marshyandi River to the west and joining the existing Mugling-Pokhara road. The new road alignment will directly impact on existing business and market and local people.

*The impact is indirect, high magnitude, site specific and long term in nature. So, the impact is ranked as very significant.*

## 7.4 Issues from Public Hearing

- **Construction of Public Toilet, Solar, Other Public Utilities and Structures**

Project should construct public toilet, provide solar lamp, drinking water facility and protect temple with fence.

- **Priorities to Local Workers**

Priorities should be given to local labours in construction works and construction materials should be use from local site.

- **Protection of the Water Resources**

There is a water source available near the downhill of Karantar School. So, the contractor should ensure not to hamper the water resources.

➤ **Stability of Bridge**

The geological structure of the location where Trishuli Bridge had been proposed, is weak and made up of sandy soil. So, proper measures should be taken in order to maintain stability of the bridge.

➤ **Minimal effect to Private and Public Properties**

The construction of the road should be done with the minimal effect to private and public utilities.

➤ **Unease Access to the People in case of one-way road in Gorkha**

Local people complain that it would be very uneasy to them if the new construction of the road in Gorkha district is of one-way service.

➤ **To change the location of the Marshyangdi Bridge**

To change the location of the Marshyangdi bridge from Powerhouse to Abukhaireni Rural Municipality ward no. 2 and Sahid Laxan Rural Municipality Ward no. 3, Namjungtar in order to get maximum benefits of transportation and other developmental activities to both the people of Gorkha and Tanahu district.

➤ **Impact on economy**

The road alignment will affect the business of people living in Mugling, and consequently the market will be displaced.

➤ **Construction of the road following EMP**

The people of the Abukhaireni demanded that the construction work should be done following the EMP guidelines and its mitigation measures.

➤ **Relocation of the Public Utilities**

Relocation of the all destructed public utilities like telephone, drinking water pipes, electric poles, community structures, temples, hall and toilets.

➤ **Alternative alignment should be chosen**

Proposed Motorable Bridge from Simaldhara is not suitable due to high risk of landslide. The proposed alignment will also affect the income of people living in Mugling area, causing unorganized relocation of the people. So, the alignment should pass through Area Police Office, Mugling to connect with Triveni Bhagwati Temple, Gorkha.



## **CHAPTER 8: MEASURES TO REDUCE OR CONTROL THE IMPACT OF THE IMPLEMENTATION OF THE PROPOSAL ON ENVIRONMENT**

An effective implementation of beneficial augmentation measures and adverse impacts mitigation measures would enhance the benefits expected from the project and avoid/minimize the adverse impacts from the project. This section describes the practical and cost-effective mitigation measures to minimize and compensate the adverse impacts to an acceptable level. The project proponent shall implement the measures during pre-construction, construction and operation phases of the project. The Contractor shall be responsible for carrying out the enhancement and mitigation measures under close supervision/monitoring by the CSC. The proponent, the CSC and the Contractor, all shall follow the Conditions of Contract (CoC) and procurement document during all phases of the construction.

### **8.1 BENEFICIAL AUGMENTATION AND IMPACTS MITIGATION MEASURES**

Adverse Impact mitigation measures can be divided into three categories. They are:

- **Compensatory Measures:**  
Compensatory measures are actions undertaken to compensate for the unavoidable adverse impacts.
- **Corrective Measures:**  
Corrective measures are adopted to reduce the adverse impacts to acceptable level. For example, installation of pollution controls devices, erosion control and re-vegetation of slopes.
- **Preventive Measures:**  
The preventive measures introduced in other to reduce or eliminate adverse impacts before they occur.

In the previous Chapter 7, the beneficial as well as adverse impacts due to the construction of the proposed road has been identified and evaluated. In order to attain long-term and sustainable benefits from this widening and upgrading of this Road Project, its implementation should be guided by principle of environment friendly construction and operation. For this, the study team identified the most effective augmentation measures for beneficial impacts and mitigation measures for possible perceived adverse impacts to minimize the environmental impacts of Project implementation and have been described in this chapter.

**Table 8.1: Summary of Socio-economic, physical, biological and cultural environment impacts within DIZ**

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact	Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D) Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)	
<b>BENEFICIAL IMPACTS</b>							
<b>Socio-Economic and Cultural Environment</b>							
<b>Construction Phase</b>							
Employment opportunities for about 360,000 person days for unskilled manpower and 108,000 person days for skilled manpower.	Employment Opportunity for local people in accordance to their education, experience and efficiency.	D	H	L	ST	Very Significant (85)	<ul style="list-style-type: none"> <li>Wherever applicable, labor based methods of construction will be adopted.</li> <li>Priority will be given to local people for employment as far as possible.</li> <li>As far as practicable, the construction works will be scheduled during the agricultural offseason in order to enable local people to become engaged.</li> <li>Binding clause will be included in Contractor's Contract Document to give priority for local people with govt. accepted wage and recruit local labor impartially without gender discrimination.</li> </ul>
Enterprises like food, tea shops, groceries, lodges and restaurant will be developed.	Increase in Economic Opportunities such as business, and its impact on local economy.	IN	M	L	LT	Significant (60)	<ul style="list-style-type: none"> <li>Training regarding small business startup will be provided to the local affected people.</li> </ul>

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D)	Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5		
Demand in local products like milk, meat, pulses, fruits and vegetables which increase the local production and marketing.								
Project provides training on mason, carpentry and other construction related training to the able and qualified unskilled people.	Relevant trainings to unskilled labor in project activities for improving their efficiency.	D		M	SS	LT	Significant (50)	<ul style="list-style-type: none"> <li>Local people will get trainings for various skill enhancement activities like bio-engineering, construction, technical knowledge to handle personal equipment.</li> <li>Training and awareness on personal protective equipment</li> </ul>

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<b>Operation and Maintenance Phase</b>							
Various micro-enterprises like tea shops, hotels that were developed during construction phases, will further increase in operation phase.	Increase in Economy	D	M	L	LT	Significant (60)	<ul style="list-style-type: none"> <li>• Training regarding small business startup will be provided in the local level to the project affected people.</li> <li>• Priority will be given to affected vulnerable-indigenous people and affected households through pilot capacity- building program</li> </ul>
Increase of the land value of Sahid Lakhan RM, Icchakamana RM and Abukhaireni RM near	Increase in Land Values	IN	H	L	LT	Very Significant (100)	<ul style="list-style-type: none"> <li>• Limited loan from the banks will be provided to the people to control the vigorous increment on land values.</li> </ul>

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road alignment.								
Increase in facilities and services in Sahid Lakhan RM, Abukhaireni due to better access of road.	Local Area Development	IN	M	L	LT	Significant (60)	<ul style="list-style-type: none"> <li>Promote development of community structures like health clinic, health post, schools, hotels, micro-enterprises, community-based organization, and non-community-based organization.</li> </ul>	
The upgrading of the road will access to reach the famous place Pokhara and Manakamana temple.	Increase in Tourism	IN	H	R	LT	Very Significant (140)	<ul style="list-style-type: none"> <li>Promotions of culture, historical and scenic values and promote more tourism.</li> <li>Enhancement of facilities and services that allure both national and international tourists.</li> </ul>	
Increase road access will save travel time and vehicle access time.	Increased mobility through project access road	D	H	R	LT	Very Significant (140)	<ul style="list-style-type: none"> <li>Periodic and routine maintenance of the road</li> <li>Promotion of market linkages and networking for better market</li> <li>Provision of zebra crossing with warning signs, disabled- friendly footpaths, Sheltered</li> </ul>	

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								bus stops (26 nos.) with proper road sign posts and signals
<b>Adverse Impacts</b>								
<b>Pre-Construction phase</b>								
<b>Physical Environment</b>								
The upgrading and the new construction of the road disturbances to 153 electrical poles/telephone poles and 5 transformers.	Disturbances to public utilities	D	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>Demarcate the extension of road width clearly on the ground</li> <li>Relocation of the affected utilities as per the resettlement plan report in consultation and concurrence with the community.</li> <li>Scheduling the dismantle activities after consulting and permission from the community usage pattern</li> </ul>	
Project use 5 ha of land for Quarry and Borrow area, 2 ha for stockpiling, 1 ha for labour camp,	Disturbances to Land Use (Necessary Permits from Concerned Authorities/Parties/Persons for Placement and	IN	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>Project should take necessary permits to concerned authorities for Quarry and Borrow areas and other land use.</li> <li>Stockpiling should be done at right side of road alignment at Ch. 1+000, 1+460, 5+440, 6+870, 7+800 and 8+620 and 3+310 on the barren land away from the water sources.</li> </ul>	

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2 ha for spoil disposal, 3 ha for crusher plant and 5 ha for concrete batching plant.	Operation of Project Utilities such as Quarry sites and Borrow Pits, Stockpiling, etc.)							<ul style="list-style-type: none"> <li>Labour camp and Spoil Disposal is done as per Table 2.12 and Table 2.14 in unproductive barren land away from water resources.</li> </ul>
<b>Biological Environment</b>								
Clearance of 9.525 ha of forest area.  Clearance of 2,000 nos. of trees within corridor of impact (COI).	Clearance of vegetation/road side trees within RoW.	D	H	L	LT	Very Significant (100)	<ul style="list-style-type: none"> <li>Mark out extent of clearing within approved worksite areas taking care to avoid religious, rare, threatened, and banned trees.</li> <li>Modify the road alignment where possible to avoid cutting of rare, banned, religious trees in due consultation and approval from consultant.</li> <li>Tree falling will be limited to those which could not be saved even by design measures.</li> <li>Compensation of forest land will be done and 1600 species of the plant will be planted per hectare and sapling care for 5 years based on Forest act 2076.</li> <li>The loss of the trees will be based on 1:10 ratio and sapling care for 5 years as the Forest</li> </ul>	

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								act 2076 and Forest Clearance Guideline, 2019. <ul style="list-style-type: none"> <li>• Compensatory plantation will be done in respective districts as supervised by DFO.</li> <li>• Compensatory plantation plan will be prepared in coordination with DFO during project implementation.</li> <li>• If project is unable to implement CAP (Compulsory Assessment Programme) , required budget will be provided to respective DFO or authority.</li> <li>• Land Compensation Cost will be provided as per Forest Act 2076.</li> </ul>
<b>Socio-Economic and Cultural Environment</b>								
Acquisition of 75 residential structures, 58 residential and commercial structures, 78 commercial	Acquisition of Private and Community Structures	D	H	L	LT	Very Significant (100)	<ul style="list-style-type: none"> <li>• Proper compensation will be provided to the private structures as per the prevailing laws of district rates and the compensation committee complying with Land Acquisition Act. 2034.</li> <li>• Relocation of the affected community structures as per the resettlement plan report.</li> </ul>	



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structures , 11 sheds, 5 private toilets (Private Structures) Acquisition of 2 resting places, 2 police building and post, 4 temples, 1 Aama Samuha, 1 Canteen and 1 Public toilet (Community Structures)								<ul style="list-style-type: none"> <li>Relocation of the temples in suitable places and as per the land provided by the local people.</li> </ul>
Handover of 9.525 ha of forest land for the upgrading and new	Handover of forest and public lands to the project	D	H	L	LT	Very Significant (100)	<ul style="list-style-type: none"> <li>Modify the road alignment where possible to avoid cutting of rare, banned, religious trees in due consultation and approval from consultant</li> </ul>	

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
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construction of road.								<ul style="list-style-type: none"> <li>• Undertake vegetation/ trees clearance only with prior approval of local stakeholders, DFO, FUG, municipality, etc. as appropriate.</li> <li>• Compensatory plantation will be done in the ratio of 1:10 for each cleared tree, as per decision of DoF and protection cost for 5 years to the concerned Division Forest Offices (DFO).</li> <li>• Land compensation cost will be provided as per Forest Act 2076</li> </ul>
<b>Construction Phase</b>								
<b>Physical Environment</b>								
Construction of cross-drainage structures, extension and replacement of existing culverts, box culverts and pipe culverts.	Changes in topography, land use pattern and land cover	D	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>• The contractor will be obliged for the application of specific/additional protective measures that the remaining lands will not be lost due to erosion and other detrimental effects (Caused or not caused by the road development).</li> <li>• The cutting and filling requirements will be balanced through route choice, so as to avoid the production of excess spoil material and reduce the need for borrow pits.</li> </ul>	

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		Direct (D)	Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5		
Generation of 327,496 cum quantity of the construction spoil. Generation of wastes from construction activities and from the labour camps.	Pollution due to excavated spoil disposal, constructed wastes and Haphazard Storage of Construction Materials, Solid Waste and Wastewater Disposal	D		H	L	ST	Significant (75)	<ul style="list-style-type: none"> <li>• 28,647.57 cum of the Spoil will be used to bury the road for the embankment purpose and excess spoil will be strictly done at the proposed site in Table 2.14.</li> <li>• Spoil Disposal will be done in barren, stable land, away from the water resources.</li> <li>• In other to protect the spoil from slide, trees plantation will be done at spoil disposal area.</li> <li>• Stockpiling will be strictly done at the proposed site in Table 2.13.</li> <li>• The land for storing the construction materials will be far from the agricultural land and water bodies</li> <li>• Awareness activities for the proper disposal of solid waste and waste water.</li> <li>• Besides these, the contractor will develop a code of conduct and enforce strict penalty to the violator of the code of conduct.</li> </ul>
Removal of 2,605 cum thickness of topsoil for upgrading and new	Loss of top soil	D		H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>• Top soil will be saved by either stockpiling it adjacent to the proposed road formation batter sides.</li> </ul>

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construction of road.								
Extraction of 2,075,500 m <sup>3</sup> of Quarry materials.	Issues due to quarry and borrow activities Overextraction of the quarry materials will lead to deepening of river bed, river course to change and river edge to fall into the river.	IN	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>Quarry sites will be selected avoiding protected and sensitive areas nearby settlements, water sources and in forest areas and fertile agricultural lands.</li> <li>The potential sites will be the waste and low quality of barren lands.</li> <li>Quarry site will be the Municipal approve area.</li> </ul>	
Construction of two major bridges and four minor bridges. Narrowing of river, construction of piers and guide bunds along the river banks.	Disruption of natural drainage pattern Change in the morphology, longitudinal profile and hydrological character.	D	M	SS	ST	Insignificant (35)	<ul style="list-style-type: none"> <li>Proper maintenance and enhancement of natural drainage will be done to improve the capacity of natural drainage to hold the flow.</li> </ul>	

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Air pollution mainly occurred from the dust during construction works like drilling, operation of quarry, site clearance, movement of vehicles	Air Pollution	D	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>Water spraying will be done in all earthen roads two times a day.</li> <li>Prohibit open storage and spillage of loose soil in and around construction site.</li> <li>Appropriately cover the stockpiled and spoil materials with polythene sheets.</li> <li>Cover loaded trucks during transportation.</li> <li>Use of face masks to the construction workers in dust prone areas such as crushing plants, evacuation sites etc.</li> </ul>	
During Construction and Upgrading of the road, excavation, blasting, movement of vehicles and construction equipment can cause nuisance to	Noise Pollution	D	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>Batching plant and other noisy construction requirements away from settlement and wildlife habitat areas to possible extent will be established.</li> <li>Noise barrier such as bund or vegetative barrier at construction site will be constructed.</li> <li>Large noise producing machineries such as compressors, batch mixes, etc will be fitted with noise reduction mechanism.</li> </ul>	

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the local people and workers.								<ul style="list-style-type: none"> <li>• Ear plugs to each construction workers in the noise prone areas such as blasting for hard rock excavation will be provided.</li> </ul>
During construction phase, activities like improper sanitation of workers, disposal of wastewater from labour camp, unauthorized washing of vehicles, unmanaged disposal of construction waste and accident of tanker carrying oil	Water Pollution Causing turbidity, blockage of the natural drainage, impact on local fisheries and can cause flood in downstream.	D		M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>• Disposal of solid waste, sludge, and other wastes directly into water bodies will be avoided.</li> <li>• Disposal of waste fuel, oil, grease into water and cleaning of construction vehicles and machineries in rivers will be prohibited.</li> <li>• Urination and defecation in open areas and near water bodies by construction workers with the installation of sanitation facilities will be prohibited.</li> <li>• Plastic or other impermeable layer of protection under the stocked materials such that no seepage takes place to the groundwater will be prohibited.</li> </ul>

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and chemical pollute the water.								
Upgrading and new construction of road involves demolition of structures, cutting of earth and rock mass	Generation of Waste from the construction work	D	M	SS	ST	Insignificant (35)	<ul style="list-style-type: none"> <li>• Debris from the maintenance of the road will be either reused if possible or disposed in proper designated locations.</li> <li>• Certain group of labours are provided with the dustbins or earthen pits for maintenance of cleanliness in the labour camp and workplace.</li> <li>• Labors at the camps are requested to segregate the decomposable and non-decomposable waste.</li> <li>• Contractor will be responsible to send all the non-decomposable waste to recycle centre.</li> <li>• Provision of the dustbins to travellers on different section of the road to maintain cleanliness of the road.</li> <li>• Provision of Sign-board, showing not to dump waste other than dustbins.</li> <li>• Handover of the work, waste segregation and the waste management to the local club or community group for sustainable and healthy waste maintenance.</li> </ul>	
<b>Chemical Environment</b>								

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
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Use and storage of fuels, lubricants, oils, acids and other chemicals.	Issues on Use, Storage and Handling of toxic materials/fuel, chemical and Bitumen Leakage of the fuels, acids and other chemicals from storage place can cause serious environment problems.	IN	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>Chemicals such as oils, chemicals, paints, acids etc. will be stored in leak proof container and disposed in pit safely after use.</li> <li>The vehicles will not be washed directly into the water bodies. The vehicles and the equipment will be maintained time to time to ensure any leakage from them.</li> <li>The bitumen storage will not be done on fertile land and nearby water bodies. If bitumen has spread over the land accidentally in improper place then it will be cleared immediately</li> <li>The bitumen will not be discharged into the drain structure while overlaying on the sub-base materials. Bitumen related work will not be carried out during the rainy condition.</li> </ul>	
Use of fuels, lubricants, oils, acids and other chemicals for road construction and upgrading	Soil and Land Pollution from asphalt plants; trash and garbage; fuel and oil spills	IN	M	SS	ST	Insignificant (35)	<ul style="list-style-type: none"> <li>Asphalt plants will be installed on barren land, away from water resources approved by the local people.</li> <li>Awareness on proper management garbage and trash.</li> <li>Prohibition of establishment of the labour camp near the productive land.</li> </ul>	
<b>Biological Environment</b>								



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Disturbances in movement for wildlife like leopard cat, jungle cat, Jackal, monkey, squirrel, fox, hare, porcupine during construction activities.	Disturbances to wildlife habitats and movement due to construction related activities	D	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>• Control in speed of vehicle movement and honking near the forest area</li> <li>• Construction activities (including drilling) will not be done during night hours near the forest area</li> <li>• Project will make aware in activities like not to disturb and tease to wildlife, through cigarette butts inside forest</li> <li>• Plantation in locations away from road impact zone, which may provide additional habitats and migratory routes for local animals</li> <li>• Restriction on construction labors for hunting and poaching the wildlife approaching the road corridor</li> </ul>	
Labour force may use firewood from the nearby forest for cooking ,timber and business purpose	Impact on nearby forest due to increase in demand for firewood, timber and NTFPs. It can cause additional pressure on local forest.	IN	H	SS	LT	Very Significant (90)	<ul style="list-style-type: none"> <li>• Fuel wood will be banned for construction works and other purposes such as cooking.</li> <li>• Contractor will be instructed to use alternate energy as kerosene, LPG, etc.</li> <li>• Contractor will prevent illegal cutting of forest wood by labor force and who's ever found guilty will also be liable for penalties.</li> </ul>	

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								<ul style="list-style-type: none"> <li>• Project will closely coordinate with forest office and its outlet to control illegal trade of forest resources</li> <li>• Project officials, labor force, contractors, consultants and other stakeholders will abide the forest act and its regulation</li> </ul>
Local hunters and the workforce may hunt wildlife like Barking Deer, Badel, Clouded Leopard and Rabbit.	Impacts on biodiversity due to hunting and poaching activities	IN	H	L	ST	Very Significant (85)	<ul style="list-style-type: none"> <li>• Construction workforce will be restricted for wildlife poaching, who ever found guilty will be also be liable for penalties</li> <li>• Awareness activities will be conducted for regarding illegal activities like poaching, hunting and intimidation of wildlife</li> <li>• Project will coordinate with forest office and its outlets to control illegal poaching and trapping.</li> </ul>	
Protected plant species like Sal ( <i>Shorea robusta</i> ), Simal ( <i>Bombax ceiba</i> ) and Khair	Issues on Rare and Endangered Species of Flora	D	H	SS	LT	Very Significant (90)	<ul style="list-style-type: none"> <li>• Modify the road alignment where possible to avoid cutting of rare, tree species in due consultation and approval from consultant</li> <li>• Undertake vegetation/ trees clearance only with prior approval of local stakeholders, DFO, FUG, municipality, rural municipality etc. as appropriate.</li> </ul>	

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(Acacia catechu) need to be fell down during construction activities								<ul style="list-style-type: none"> <li>• Awareness activities will be conducted regarding illegal cutting/ felling of rare, endemic, endangered, protected and threatened species of flora.</li> <li>• CFUGs will report/ complain to DFO/ Project Consultant Supervisor/ Project Construction Manager if any construction staff found within the forest premises doing illegal activities</li> </ul>
Construction of road and bridge may cause disturbance to movement of migratory aquatic species. Vehicle washing in streams and rivers.	Disturbance to aquatic biodiversity	IN	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>• The Consultant will ensure that contractor does not dispose the construction waste or material in the water bodies</li> <li>• The construction camps will be located sufficiently away (at least 100 m distance) from the river.</li> <li>• Septic tanks will be provided to prevent the direct discharge of waste water effluent from sanitary facility into the river.</li> <li>• Washing of clothes, vehicles near-by water bodies will be restricted</li> <li>• Open field defecation will be avoided</li> <li>• Stream re-channeling will be avoided as much as possible</li> </ul>	

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							<ul style="list-style-type: none"> <li>• Careful attention will be taken to erosion control techniques near watercourses</li> <li>• Culvert crossings will be designed with needs of migratory aquatic species</li> <li>• Avoid fishing activities by construction workers and crews</li> <li>• Bioengineering will be carried out on the cut slope to prevent flow of soil into the surface water which can raise turbidity and BOD of water and which will subsequently damage the aquatic ecosystem</li> <li>• Haphazard quarry excavation from river bed will be prohibited.</li> </ul>	
The activity of workforce like smoking, cooking and firing can cause forest fire.	Occurrence of forest fire incidents	IN	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>• Smoking will be restricted in the construction site near forest area</li> <li>• Burning of waste will be restricted</li> <li>• Barriers will be provided to control entrance to forest areas</li> <li>• Labor camp will not be established near or within the forest premises</li> <li>• Fire extinguisher, set fire alarms will be provided in all guard post</li> </ul>	

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								<ul style="list-style-type: none"> <li>Awareness session against fire hazards will be provisioned</li> </ul>
<b>Socio-Economic and Cultural Environment</b>								
Air pollution from dust particles due to earthworks. Noise pollution due to movement of construction vehicles and construction equipment.	Health hazards due to Environmental Pollution. These pollutions can cause respiratory problems, eye diseases, sleep disruption, high blood pressure, and water borne diseases.	IN	M	SS	ST	Insignificant (35)	<ul style="list-style-type: none"> <li>Sprinkle water to control dust at least four times a day</li> <li>Locate hot mix and batching plants as approved by the Engineer approximately 1km away from the receptive areas</li> <li>No construction activities during night hours that produce annoying noise</li> <li>Schedule the construction movement in the sensitive receptor area</li> <li>Notification via local media to the public about the construction work</li> </ul>	
Accidents mainly during construction activities. And also, the workforces might expose	Occupational Health and Safety Hazard	D	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>Provision of proper signs at construction site to avoid fatal accidents with moving and stationary equipment</li> <li>Mandatory use of relevant PPE by workers and staffs during construction activities</li> <li>Involve skilled persons in risky works such as bitumen works, tree felling works, etc.</li> </ul>	

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D)	Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5		
to various hazards during road construction.								<ul style="list-style-type: none"> <li>• Planning and safety approach for rescue during emergency</li> <li>• Provision of first aid and health facilities at the construction work site and camp</li> <li>• Provision of group accidental insurance</li> <li>• First aid training to the field staff</li> <li>• Conduct road safety awareness campaigns to communities along road corridor</li> <li>• Capacity building: Training and awareness program on use of PPE</li> <li>• Provision of alternate route to the road users</li> </ul>
Widen and Improved geometry of the road during upgrading and new construction of road.	Widen and Improved Geometry of the road encourages the drivers to speed up the vehicles causing road accidents.	IN	H	SS	LT		Very Significant (90)	<ul style="list-style-type: none"> <li>• Provision of safety and pedestrian- friendly design features in the road design like, traffic signal with pedestrian push button;</li> <li>• Provision of traffic signs;</li> <li>• Provision of proper sign at construction site to avoid fatal accidents with moving and stationary construction equipment and construction material;</li> <li>• Provision of signboard of speed limits, bus bays especially near settlement area, school, hospital, etc.</li> <li>• Provision of street lights (electric grid powered and solar powered);</li> </ul>

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D) Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)		
								<ul style="list-style-type: none"> <li>• Provision of road safety awareness campaigns to communities along road corridor targeting pedestrians, drivers, parents, school children, professional drivers;</li> <li>• Provision of footpaths with kerb-ramps are friendly to people with disabilities and wheelchair users as indicated;</li> </ul>
Permanent loss of 2.25 ha of agricultural land within RoW of road.	Issues on loss of agricultural land/corps. Impact on Livelihood of the local people.	D	H	SS	LT	Very Significant (90)	<ul style="list-style-type: none"> <li>• Provide advance notice (6months) to stop cultivating crops</li> <li>• Wait till harvest</li> <li>• Compensation for loss of fruit bearing trees for average fruit production (5 years)</li> </ul>	
Discrepancy in wage distribution among male and female labour force and also between vulnerable and indigenous people.	Issues related to gender, vulnerable and indigenous groups	IN	M	L	ST	Significant (45)	<ul style="list-style-type: none"> <li>• The project will provide about 30% of employment to the locals including women.</li> <li>• Harassments of female workers will be minimized by enforcing legal procedures for such acts.</li> <li>• Secure employment for the marginalized groups.</li> <li>• Project will provide skill development and income generating training like bio-engineering, mason, carpentry to the vulnerable and indigenous people.</li> </ul>	

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D) Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)		
								<ul style="list-style-type: none"> <li>The project has allocated vulnerable allowances to support them.</li> </ul>
Involvement of the child in unskilled work	Child Labour Issues The child will be depriving from education and inturn will result in poverty, hinders economic growth and equitable development.	D	M	SS	LT		Significant (45)	<ul style="list-style-type: none"> <li>Involvement of adults in the construction activities.</li> </ul>
Loss of 4 small/medium size temple.	Impact on Religious, Cultural and Historical Assets	D	H	SS	ST		Very Significant (75)	<ul style="list-style-type: none"> <li>Relocation of project affected community structures mentioned in Table 5.33 will be based on resettlement plan report.</li> </ul>
<b>Operation and Maintenance Phase</b>								
<b>Physical Environment</b>								
Movement of the vehicle. Heavy rainfall and seismic activities	Changes in topography and land use cover and patterns	IN	H	L	ST		Very Significant (85)	<ul style="list-style-type: none"> <li>Restoration of land use and land cover as before where possible.</li> </ul>



Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D) Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)		
Poor workmanship and material defects during construction phase can damage the road in operation phase.	Damage to Road Section and Bridges Pot holes and cracks on the road surface	D	H	SS	ST	Very Significant (75)	<ul style="list-style-type: none"> <li>• Periodic monitoring of the road, cross drainage structures and immediate maintenance will be carried out in case of identification of damage in the road section</li> <li>• Signboards of traffic diversion, work in progressed will be placed during the maintenance work</li> </ul>	
<b>Biological Environment</b>								
Upgrading and the widening of the road creates barrier for wildlife movement. Collision with vehicle	Disturbance to Wildlife Habitat and Barrier to Wildlife Movement Corridor Disappearance of an entire generation of the population. Accidental death and poaching.	D	M	SS	LT	Very Significant (50)	<ul style="list-style-type: none"> <li>• Restriction on hunting and poaching the wildlife approaching the road corridor</li> <li>• Hoarding board and sign board on the way near wildlife habitat.</li> <li>• Reduce vehicle speed.</li> <li>• No honking</li> </ul>	

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact	Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D) Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)	
Development of built up area near forest area.	Issues of Forest encroachment and easy access to forest Increase pressure on forest resources and increase risk on forest fire.	IN	M	SS	LT	Very Significant (50)	<ul style="list-style-type: none"> <li>• Regular monitoring by municipality/ rural municipality along the project road corridor.</li> <li>• Announcement on the restricted place for trade and business.</li> <li>• Prohibition of cutting down of trees.</li> </ul>
Disposal of waste on water bodies by local people can cause water turbid	Impact on aquatic biodiversity Water Turbidity result in reduction in dissolved oxygen. Poorly constructed road can lead to downstream siltation, ruining spawning beds for fish.	IN	L	SS	LT	Insignificant (35)	<ul style="list-style-type: none"> <li>• Prevent disposal of the leftover spoil and excavated materials in the river.</li> <li>• Washing of the clothes, vehicle washing nearby water bodies is strictly prohibited.</li> <li>• Open field defecation will be avoided.</li> </ul>
<b>Socio-Economic and Cultural Environment</b>							
Development of ribbon settlement.	Possible township and market development and	IN	H	SS	LT	Very Significant (90)	<ul style="list-style-type: none"> <li>• Maintain green belt in the RoW</li> </ul>

Activities	Issues of Beneficial and Adverse Impacts	Nature of Impact		Environmental Impacts			Impacts' Rank	Beneficial Impacts Maximization Measures/ Mitigation Measures
		Direct (D)	Indirect (IN)	Magnitude High (H)-60 Moderate(M)-20 Low (L)-10	Extent Regional (R)-60 Local(L)-20 Site specific (SS)-10	Duration Long term (LT)-20 Medium term (MT)-10 Short term (ST)-5	Insignificant (<45) Significant (45-75) Very Significant (>75)	
RoW encroachment for the market development	RoW encroachment Leads to regular traffic congestion, road accidents and reduced carrying capacity of arterial road.							<ul style="list-style-type: none"> <li>• Placement of Hoarding Board on major settlement areas not to encroach ROW of the road.</li> <li>• To make rural municipality participate to regularly monitor along the project corridor.</li> <li>• Announcement on the restricted place for trade and business.</li> </ul>
Reduce number of the vehicle flow in Mugling Abukhaireni road.	Impact of new road alignment on economy and business of Mugling bazaar	IN	H	SS	LT		Very Significant (90)	<ul style="list-style-type: none"> <li>• Hoarding board and the sign board of the old business and shops in the new road alignment.</li> </ul>

**Table 8.2: Impact Ranking Methodology**

Magnitude		Extent		Duration		Types
Description	Rank	Description	Rank	Description	Rank	
High/ Major	60	Regional	60	Long Term	20	Direct
Medium/ Moderate	20	Local	20	Medium Term	10	Indirect
Low/ Minor	10	Site specific	10	Short Term	05	

*Source: National Environmental Impact Assessment Guidelines, 1993*

**Table 8.3: Beneficial Measures Augmentation Tables and Adverse Impacts Mitigation Measures and Compensatory Estimated Cost and Responsible Agency**

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
<b>Beneficial Impacts</b>						
1	<ul style="list-style-type: none"> <li>Wherever applicable, labor based methods of construction will be adopted.</li> <li>Priority will be given to local people for employment as far as possible.</li> </ul>	Project Site	Construction Phase	-	-	Proponent/Consultant
2	<ul style="list-style-type: none"> <li>Training regarding small business startup will be provided to the local affected people.</li> <li>Trainings regarding various skill enhancement activities like bio-engineering, construction, technical, knowledge to handle personal equipment will be provided.</li> <li>Training and awareness on personal protective equipment (PPE).</li> </ul>	Project Site	Construction Phase and Operation Phase	9,00,000.00	-	Proponent, Consultant
3	<ul style="list-style-type: none"> <li>Promote development of community structures like, toilets, drinking water facilities, hotels, micro-enterprises, community-based organization, and non-</li> </ul>	Project Site and in the periphery of Triveni Temple	Construction Phase			Proponent, Consultant

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	community based organization					
4	<ul style="list-style-type: none"> <li>Promotions of culture, historical and scenic values and promote more tourism.</li> <li>Enhancement of facilities and services that allure both national and international tourists.</li> </ul>	Project Site	Operation Phase	4,00,000.00	-	Contractor, Proponent and Consultant
5	<ul style="list-style-type: none"> <li>Periodic and routine maintenance of the road</li> <li>Promotion of market linkages and networking for better market</li> <li>Provision of zebra crossing with warning signs, disabled-friendly footpaths, Sheltered bus stops (26 nos.) with proper road sign posts and signals</li> </ul>	Project Site	Operation Phase	-	Included in Civil Cost	Contractor, Proponent
<b>Adverse Impacts</b>						
<b>Physical Environment</b>						
6	<ul style="list-style-type: none"> <li>Demarcate the extension of road width clearly on the ground</li> <li>Relocation and re-establishment of the affected communities' utilities as per the shifting plan in</li> </ul>	Project Site	Pre-construction Phase	Included in the resettlement plan report	-	Contractor, Proponent

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<p>consultation and concurrence with the community.</p> <ul style="list-style-type: none"> <li>• Scheduling the dismantle activities after consulting and permission from the community usage pattern</li> </ul>					
7	<ul style="list-style-type: none"> <li>• Project should take necessary permits to concerned authorities for Quarry and Borrow areas and other land use.</li> <li>• Stockpiling should be done at Ch. 1+000, 1+460, 5+440, 6+870, 7+800 and 8+620 and 3+310 right side of road alignment at Chin barren land away from the water sources.</li> <li>• Labour camp and Spoil Disposal is done as per Table 2.12 and Table 2.14 in unproductive barren land away from water resources.</li> </ul>	Project Area	Pre-Construction Phase	-	-	Contractor /Consultant
8	<ul style="list-style-type: none"> <li>• Tree falling will be limited to those which could not be saved even by design measures.</li> <li>• Compensation for clearance of trees will be based on the ratio of 1:10 ratio and protection</li> </ul>	Project Area	Pre-Construction Phase	17,250,000.00		Contractor /Consultant

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<p>care for 5 years as the Forest act 2076, Rule (42).</p> <ul style="list-style-type: none"> <li>• Compensatory plantation will be done in respective districts as supervised by DFO.</li> <li>• Compensatory plantation plan will be prepared in coordination with DFO during project implementation.</li> <li>• If project is unable to implement CAP (Compulsory Afforestation Programme), required budget will be provided to respective DFO or authority.</li> </ul>					
9	<ul style="list-style-type: none"> <li>• Proper compensation will be provided to the private structures as per the prevailing laws of district rates and the compensation committee complying with Land Acquisition Act.</li> <li>• Relocation of the affected community structures as per the resettlement plan report.</li> </ul>	Project Area	Pre-Construction Phase	As per prevailing laws and resettlement plan report		Contractor /Consultant
10	<ul style="list-style-type: none"> <li>• The contractor will be obliged for the application of specific/additional protective measures that the remaining lands will not be lost due to</li> </ul>	Project Area	Construction, Operation and Maintenance Phase	-	Included in Civil Cost	Contractor



S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<p>erosion and other detrimental effects (Caused or not caused by the road development).</p> <ul style="list-style-type: none"> <li>The cutting and filling requirements will be balanced through route choice, so as to avoid the production of excess spoil material and reduce the need for borrow pits.</li> </ul>					
11	<ul style="list-style-type: none"> <li>28,647.57 cum of the Spoil will be used to bury the road for the embankment purpose and excess spoil will be strictly done at the proposed site in Table 2.14.</li> <li>Spoil Disposal will be done in barren, stable land, away from the water resources.</li> <li>In other to protect the spoil from slide, trees plantation will be done at spoil disposal area.</li> </ul>	Project Area	Construction Phase	-	Included in Civil Cost	Contractor , Consultant, Local Stakeholders
12	<ul style="list-style-type: none"> <li>Stockpiling will be strictly done at the proposed site in Table 2.13.</li> <li>The land for storing the construction materials will be far from the agricultural land and water bodies</li> </ul>	Project Area	Construction Phase	-	-	Contractor

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<ul style="list-style-type: none"> <li>Awareness activities for the proper disposal of solid waste and waste water.</li> <li>Besides these, the contractor will develop a code of conduct and enforce strict penalty to the violator of the code of conduct.</li> </ul>					
13	<ul style="list-style-type: none"> <li>Top soil will be saved by either stockpiling it adjacent to the proposed road formation batter sides.</li> </ul>	Project Area	Construction Phase	-	-	Contractor and Local Stakeholders
	<ul style="list-style-type: none"> <li>Quarry sites will be selected avoiding protected and sensitive areas nearby settlements, water sources and in forest areas and fertile agricultural lands.</li> <li>The potential sites will be the waste and low quality of barren lands.</li> <li>Quarry sites will be government approved sites.</li> </ul>	Project Area	Construction Phase	-	-	Contractor
14	<ul style="list-style-type: none"> <li>Proper maintenance and enhancement of natural drainage will be done to improve the capacity of natural drainage to hold the flow.</li> </ul>	Project Area	Construction Phase	-	Included in Civil Engineering Cost	Contractor

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
15	<ul style="list-style-type: none"> <li>Water spraying will be done in all earthen roads two times a day.</li> <li>Prohibit open storage and spillage of loose soil in and around construction site.</li> <li>Appropriately cover the stockpiled and spoil materials with polythene sheets.</li> <li>Cover loaded trucks during transportation.</li> <li>Use of face masks to the construction workers in dust prone areas such as crushing plants, evacuation sites etc.</li> </ul>	Project Area	Construction Phase	22,27,500.00		Contractor
16	<ul style="list-style-type: none"> <li>Batching plant and other noisy construction requirements away from settlement and wildlife habitat areas to possible extent will be established.</li> <li>Noise barrier such as bund or vegetative barrier at construction site will be constructed.</li> </ul>	Project Area	Construction Phase	-	-	Contractor

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<ul style="list-style-type: none"> <li>• Large noise producing machineries such as compressors, batch mixes, etc will be fitted with noise reduction mechanism.</li> <li>• Ear plugs to each construction workers in the noise prone areas such as blasting for hard rock excavation will be provided.</li> </ul>					
17	<ul style="list-style-type: none"> <li>• Disposal of solid waste, sludge, and other wates directly into water bodies will be avoided.</li> <li>• Disposal of waste fuel, oil, grease into water and cleaning of construction vehicles and machineries in rivers will be prohibited.</li> </ul>	Project Area	Construction Phase	-	-	Contractor
18	<ul style="list-style-type: none"> <li>• Periodic monitoring of the road, cross drainage structures and immediate maintenance will be carried out in case of identification. of damage in the road section</li> <li>• Signboards of traffic diversion, work in progressed will be placed during the maintenance work.</li> </ul>	Project Area	Operation and Maintenance Phase	-	Included in Civil cost	Contractor/ DRO (Department of Road Office)

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
19	<ul style="list-style-type: none"> <li>Certain group of labours are provided with the dustbins or earthen pits for maintenance of cleanliness in the labour camp and workplace.</li> <li>Provision of the dustbins to travellers on different section of the road to maintain cleanliness of the road.</li> <li>Provision of Sign-board, showing not to dump waste other than dustbins.</li> </ul>	Project Area	Construction and Operation Phase	-	-	Contractor/ DRO (Department of Road Office)
20	<ul style="list-style-type: none"> <li>Asphalt plants will be installed on barren land, approved by the local people.</li> </ul>	Project Area	Construction Phase	-	Included in Civil Engineering Cost	Contractor
<b>Biological Environment</b>						
21	<ul style="list-style-type: none"> <li>Construction workforce will be restricted for wildlife poaching; who ever found guilty will be liable for penalties.</li> <li>Awareness activities will be conducted for regarding illegal activities like poaching, hunting and intimidation of wildlife.</li> <li>Project will coordinate with forest office and its outlets to</li> </ul>	Project Area Forest	Pre-Construction, Construction and Operation and Maintenance Phase	-	-	DFO

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	control illegal poaching and trapping.					
22	<ul style="list-style-type: none"> <li>• Septic tanks will be provided to prevent the direct discharge of waste water effluent from sanitary facility into the river.</li> <li>• Washing of clothes, vehicles near-by water bodies will be restricted</li> </ul>	Project Area	Construction Phase	-	Included in Civil Engineering Cost	Contractor
23	<ul style="list-style-type: none"> <li>• Construction activities (including drilling) will not be done during night hours near the forest area</li> <li>• Project will make aware in activities like not to disturb and tease to wildlife, through cigarette butts inside forest</li> <li>• Plantation in locations away from road impact zone, which may provide additional habitats and migratory routes for local animals</li> <li>• Restriction on construction labors for hunting and poaching the wildlife approaching the road corridor</li> </ul>	Project Road Area	Construction, Operation and Maintenance Phase	Included in Civil Cost	-	Contractor, DRO

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
24	<ul style="list-style-type: none"> <li>Fuel wood will be banned for construction works and other purposes such as cooking.</li> <li>Contractor will be instructed to use alternate energy as kerosene, LPG, etc.</li> <li>Contractor will prevent illegal cutting of forest wood by labor force and who's ever found guilty will also be liable for penalties.</li> </ul>	Project Area	Construction Phase	-	-	Contractor DFO, Community Forest User Groups
25	<ul style="list-style-type: none"> <li>Smoking will be restricted in the construction site near forest area</li> <li>Burning of waste will be restricted</li> <li>Barriers will be provided to control entrance to forest areas</li> <li>Labor camp will not be established near or within the forest premises</li> <li>Fire extinguisher, set fire alarms will be provided in all guard post</li> <li>Awareness session against fire hazards will be provisioned</li> </ul>	Project Area	Construction and Operation Phase	-	-	Contractor
<b>Chemical Environment</b>						

S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
26	<ul style="list-style-type: none"> <li>Chemicals such as oils, chemicals, paints, acids etc. will be stored in leak proof container and disposed in pit safely after use.</li> <li>The vehicles will not be washed directly into the water bodies. The vehicles and the equipment will be maintained time to time to ensure any leakage from them.</li> </ul>	Project Area	Pre-Construction Phase, Construction and Operation Phase	-	-	Contractors
<b>Socio-Economic and Cultural Environment</b>						
27	<ul style="list-style-type: none"> <li>Proper compensation will be provided to the private structures as per the prevailing laws of district rates and the compensation committee complying with Land Acquisition Act.</li> <li>Relocation of the affected community structures as per the resettlement plan report.</li> </ul>	Project Area	Construction Phase	As per the prevailing laws and resettlement plan	-	Contractor, Local Stakeholders
28	<ul style="list-style-type: none"> <li>Provide advance notice (6months) to stop cultivating crops</li> <li>Wait till harvest</li> <li>Compensation for loss of fruit bearing trees for average fruit production (5 years)</li> </ul>	Project Area	Pre-Construction and Construction Phase	Included in Resettlement plan	-	Contractor, Compensation Committee Team



S.N.	Environment Protection Measures	Implementation Location	Implementation Time	Estimated Cost (Nrs.) (Consultant's Estimated Cost)	Estimated Cost (Nrs.) BoQ Cost	Responsible Agency
	<ul style="list-style-type: none"> <li>• Compensation cost for sapling</li> </ul>					
29	<ul style="list-style-type: none"> <li>• Maintain green belt in the RoW</li> <li>• Regular monitoring by municipality/ rural municipality along the project road corridor</li> <li>• Announcement on the restriction for trade and business on road corridor</li> </ul>	Project Area	Operation Phase	-	Included in Civil Cost	Rural Municipality
30	<ul style="list-style-type: none"> <li>• Hoarding board and the sign board of the old business and shops in the new road alignment</li> </ul>	Project Area	Operation Phase		Included in Civil Cost	Contractor and Local People

## CHAPTER 9: MATTER TO BE MONITORED WHILE IMPLEMENTING THE PROPOSAL

Monitoring of the implementation of environmental protection measures provides a basis for logical comparison of the predicted and actual impacts of a proposal. Environmental monitoring involves the systematic collection of data to determine the actual environmental effects of the project, compliance of the projects with regulatory standards, and the degree of implementation and effectiveness of the environmental protection measures (Iohani et. al., 1997). Such monitoring also provides an opportunity to further identify any unpredicted impacts and implement necessary measures to avoid costly mistakes, if any.

In accordance with Rule 39 of the EPR 1997, the concerned agency- the Ministry of Physical and Transport (MoPIT) in this case-is the legally responsible monitoring agency. This rule also empowers MoPIT to issue additional environmental control measures and directives to the Project to adopt measures to reduce or control impacts if the actual impacts are higher than the ones specified in the conditions prescribed at the time of approving the proposal for implementation. With these considerations, the following sub-section described the types of monitoring, parameters, indicators, locations, schedules and responsibilities for monitoring.

### 9.1 Types of Monitoring

The National EIA Guidelines of 1993 and EIA Guidelines for Forestry Sector of 1995 propose three types of monitoring. They are baseline monitoring, compliance monitoring and impact monitoring.

#### a. Baseline Monitoring:

A baseline monitoring helps to develop baseline condition of the environmental resources. In general, it is carried out if there is significant time lapse between the preparation of the EIA report and the construction stage or a change on environmental quality is noticeable. Baseline information of the reference sites should also be collected for future comparison.

#### b. Compliance Monitoring:

The compliance monitoring is essential in order to ensure that environmental protection measures and other requirements set-forth are complied with, and this monitoring is not considered with determining actual effects of the project activities on the environment. While impact monitoring helps to evaluate the effectiveness of the recommended mitigation measures and verify the impacts predicted and actual level of impacts occurred in the field. Furthermore, this type of monitoring helps to increase understanding of cause-effect relationships between the human activity and environmental changes. In sum, environmental monitoring approaches to verify the accuracy of prediction, and determine the effectiveness of measures to mitigate adverse impacts of project on the environment.

#### c. Impact Monitoring:

Impact Monitoring is generally carried out to determine the effectiveness of the environmental protection measures. Hence an impact monitoring evaluation study is proposed to carry out at the end of the project construction phase or within two years of project implementation. Impact monitoring evaluation will focus each impact predicted and effectiveness of environmental protection measures.

**9.2 Indicators, Methods, Schedule, Responsible Monitoring Agency**

Based on the level of site-specific information or existing data series and impacts prediction, efforts are made to make the indicators measurable and diagnostic with low natural variability and broad applicability. In this context, following indicators will be monitored during project construction and operation phase of the road project with different methods, location, cost and monitoring agency. The detail is presented in table below:

**Table 9.1: Types of Monitoring, Parameters, Methods, Location, Schedule, Cost and Monitoring Agency**

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
<b>A. Baseline Monitoring</b>						
<ul style="list-style-type: none"> <li>Acquisition of private land and property</li> </ul>	<ul style="list-style-type: none"> <li>Compensation Record to Household Affected People in Project Office/DAO.</li> <li>Detransfer</li> <li>RP Entitlement Matrix</li> </ul>	<ul style="list-style-type: none"> <li>Public Discussion</li> <li>Photos</li> <li>Cadastral Mapping</li> </ul>	<ul style="list-style-type: none"> <li>Project Area</li> </ul>	<ul style="list-style-type: none"> <li>Pre-Construction Phase</li> </ul>	Included in monitoring cost	<ul style="list-style-type: none"> <li>Compensation Team, Community Forest Office, Proponent, Consultant</li> </ul>
<ul style="list-style-type: none"> <li>Training and skill enhancement for employment opportunity to the severely affected and vulnerable people before</li> </ul>	<ul style="list-style-type: none"> <li>Job Placement to the local people PAFs</li> <li>Enterprises developed and self employed to PAFs.</li> <li>Trace Study</li> <li>Training Utilization Study</li> </ul>	<ul style="list-style-type: none"> <li>Training Participation Record, Training Record, Training Report, Evaluation of participation views about training</li> </ul>	<ul style="list-style-type: none"> <li>Project Area</li> </ul>	<ul style="list-style-type: none"> <li>Pre-Construction Phase</li> </ul>	Included in monitoring cost	<ul style="list-style-type: none"> <li>Proponent</li> </ul>

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
construction of the road.						
• Water Pollution,	• Lab Report of Water quality	• Laboratory Analysis of Water, Records of Datas, Discussion with technical experts and local about the environment management, ,	• Downstream of the Proposed Trishuli and Marshyangdi river	• Pre-Constructio n Phase	Included in monitoring cost	• Proponent, Consultant
• Air and Noise Pollution,	• Lab Report of Air and Noise Quality	• Laboratory Analysis of Air and Noise Quality Test, Records of Datas,	• Major Settlement areas in Mugling, Karantar and Abukahireni	• Pre-Constructio n Phase	Included in monitoring cost	• Proponent, Consultant
• Solid Waste Management	• Placement of dustbins in camp project and contractor office.	• Direct Observation, Public Discussion,	• Along the road Alignment	• Pre-Constructio n Phase		• Proponent, Consultant
• Slope Stability	• Landslides and soil erosion in different sections of road.	• Direct Observation, Public Discussion,	• Along the road Alignment	• Pre-Constructio n Phase		• Proponent, Consultant
• Conservation of flora and fauna	• Parks, Rescue Center, Hunting Records in DFO and Illaka Office	• Discussion with Forest Officer, Direct Observation, Public Discussion,	• Along the road Alignment	• Pre-Constructio n Phase		• Proponent, Consultant
• Trees Cutting	• Trees Marking	• Field Visit	• Along the road alignment	• Pre-Constructio n Phase	Included in BoQ	• Proponent, Consultant

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
• Acquisition of Land	• Grievance Record	• Field Visit, Public Discussion	• Along the road alignment	• Pre-Construction Phase	Included in Resettlement plan	• Proponent, Consultant
<b>B. Impact Monitoring</b>						
• Disposal of construction waste	• Haphazard presence of construction waste • Waste Management Area. • Spoil Management Sites	• Field Observation, • Photos of Land use	Spoil Disposal Site	• Construction Phase	Included in monitoring cost	• Proponent, Consultant
• Extraction places of Quarry Materials	• Reinstated Quarry areas	• Field Observation • Photos of river	Quarry Extracted Site	• Construction Phase	Included in monitoring cost	• Proponent, Consultant
• Water Quality	• Lab Report of Water Quality	• Water Quality Test from Source	Water Sources	• Construction Phase	Included in monitoring cost	• Local Beneficial Forum
• Air Quality	• Lab Report of Air Quality	• Air Quality Measurement in major air polluting source	Air Polluting Source	• Construction Phase	Included in monitoring cost	• Local Beneficial Forum

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
• Noise Quality	• Lab Report of Noise Quality	• Noise Quality Measurement in major noise polluting sources.	Noise Polluting Source	• Construction Phase	Included in monitoring cost	• Local Beneficial Forum
• Land Pollution	• Haphazard presence of waste • Waste Management Area • Placement of dustbins	• Site Observation • Interview with concerned stakeholders and local people • Plan/Procedure of collecting chemical spillage • Plan/Procedure of waste disposal in the approved sites.	Project Area	• Construction Phase	-	• Consultant
• Forest and Vegetation	• Forest Inventory Report	• Direct Observation • Record from District Forest Office • Photos • Interview with stakeholders	Project Area,	• Construction Phase	Included in Monitoring Cost	• Proponent and Consultant
• Wildlife	• Presence of Wildlife	• Direct Observation • Photos • Interview with stakeholders, locals and District Forest Officers	Forest near road alignment	• Construction Phase	Included in Monitoring Cost	• Proponent, Consultant and District Forest Office

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
• Human Health	<ul style="list-style-type: none"> <li>• Clinical report.</li> <li>• Complaints from the locals</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion with locals, health professionals, clinical records</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>• Construction Phase, every month</li> </ul>	-	<ul style="list-style-type: none"> <li>• District Coordination Committee, Public Health Clinic</li> </ul>
• Road Safety	<ul style="list-style-type: none"> <li>• Zebra Crossings with warning</li> <li>• Kerb Ramp (at major junction)</li> </ul>	<ul style="list-style-type: none"> <li>• Detail Design Report</li> <li>• Disabled friendly footpath</li> </ul>	Project Road Alignment	<ul style="list-style-type: none"> <li>• Construction Phase</li> </ul>	-	<ul style="list-style-type: none"> <li>• Contractor, Consultant</li> </ul>
• Business and Trade	<ul style="list-style-type: none"> <li>• Increment of Local shops and enterprises along road alignment</li> </ul>	<ul style="list-style-type: none"> <li>• Direct Observation</li> <li>• Photos</li> <li>• Interview with local people</li> <li>• Income record of local people</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>• Construction Phase</li> </ul>	-	<ul style="list-style-type: none"> <li>• Proponent and Municipality Officer</li> </ul>
• Damage to road section and bridges during defect liability period	<ul style="list-style-type: none"> <li>• Pot holes</li> <li>• Erosion and Landslide</li> <li>• Number of accidents records</li> <li>• Photos Record</li> </ul>	<ul style="list-style-type: none"> <li>• Site observations</li> <li>• Complaints records</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>• Operation and Maintenance Phase</li> </ul>	-	<ul style="list-style-type: none"> <li>• Consultant/ Project</li> </ul>
• Embankment Instability	<ul style="list-style-type: none"> <li>• Erosion in embankment</li> <li>• Gully Erosion</li> <li>• Bioengineering works</li> </ul>	<ul style="list-style-type: none"> <li>• Site observation</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>• Operation and Maintenance Phase</li> </ul>	-	<ul style="list-style-type: none"> <li>• Consultant/ Project</li> </ul>

Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
	<ul style="list-style-type: none"> <li>Grievance Record</li> <li>Complaints from Public in Project Area</li> </ul>					
<ul style="list-style-type: none"> <li>Obstruction to natural drainage</li> </ul>	<ul style="list-style-type: none"> <li>Observation</li> <li>Impact to aquatic species.</li> <li>Grievance Record</li> </ul>	<ul style="list-style-type: none"> <li>Site observation</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>During construction phase</li> </ul>	-	<ul style="list-style-type: none"> <li>Consultant/ Project</li> </ul>
<ul style="list-style-type: none"> <li>Damage to Physical integrity of the bridges due to high traffic</li> </ul>	<ul style="list-style-type: none"> <li>Potholes in bridge</li> <li>Complaints from Traffic and local people about its defect.</li> <li>Grievance Record Register of Project</li> </ul>	<ul style="list-style-type: none"> <li>Site observation</li> <li>Consult with traffic</li> <li>Record checking</li> </ul>	Project Area	<ul style="list-style-type: none"> <li>Operation and Maintenance Phase</li> </ul>	-	Traffic police
<b>C. Compliance Monitoring</b>						
<ul style="list-style-type: none"> <li>Compensation and relocation of the public utilities and infrastructures</li> </ul>	<ul style="list-style-type: none"> <li>Compensation Records</li> <li>Photo Record</li> </ul>	<ul style="list-style-type: none"> <li>Public Consultation</li> </ul>	<ul style="list-style-type: none"> <li>Project Area</li> </ul>	<ul style="list-style-type: none"> <li>At the end of the construction Phase</li> </ul>	Included in Monitoring cost	<ul style="list-style-type: none"> <li>Compensation Determination Committee, Proponent and Consultant</li> </ul>



Monitoring Parameters	Indicators	Methods	Location	Time Schedule	Estimated Cost	Monitoring Agency
<ul style="list-style-type: none"> <li>Environment Management Action Plan Compliance with Road Design</li> </ul>	<ul style="list-style-type: none"> <li>Final Road Design Report</li> <li>Environment Management Action Plan</li> </ul>	<ul style="list-style-type: none"> <li>Field Survey</li> </ul>	<ul style="list-style-type: none"> <li>Project Area</li> </ul>	<ul style="list-style-type: none"> <li>At the end of Detail Design of Road</li> </ul>	5,00,000.00	Department of Road and MoFE
<ul style="list-style-type: none"> <li>Sufficient Technical and Environment Supervision</li> </ul>	<ul style="list-style-type: none"> <li>Photos, Consultation with land owners and community stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Site Observation</li> </ul>	<ul style="list-style-type: none"> <li>Project Area</li> </ul>	<ul style="list-style-type: none"> <li>At the end of the construction Phase</li> </ul>	-	Proponent, Consultant
<ul style="list-style-type: none"> <li>Air Pollution</li> </ul>	<ul style="list-style-type: none"> <li>Lab Report of Air Quality</li> </ul>	<ul style="list-style-type: none"> <li>Air Quality Measurement and comparison with Standards</li> </ul>	<ul style="list-style-type: none"> <li>Project Area and sensitive areas</li> </ul>	<ul style="list-style-type: none"> <li>During construction phase</li> </ul>	Included in Monitoring Cost	Proponent, CBOs
<ul style="list-style-type: none"> <li>Water Pollution</li> </ul>	<ul style="list-style-type: none"> <li>Lab Report of Water Quality</li> </ul>	<ul style="list-style-type: none"> <li>Water Quality Measurement and Comparison with standards</li> </ul>	<ul style="list-style-type: none"> <li>Water sources</li> </ul>	<ul style="list-style-type: none"> <li>During construction phase</li> </ul>	Included in Monitoring Cost	Proponent, CBOs
<ul style="list-style-type: none"> <li>Noise Pollution</li> </ul>	<ul style="list-style-type: none"> <li>Lab Report of Noise Quality</li> </ul>	<ul style="list-style-type: none"> <li>Noise Quality Measurement and Comparison with standards</li> </ul>	<ul style="list-style-type: none"> <li>Noise polluting source, sensitive areas</li> </ul>	<ul style="list-style-type: none"> <li>During construction phase</li> </ul>	Included in Monitoring Cost	Proponent, CBOs

### **9.3 Environment Management Plan**

The Environment Management Plan (EMP) is a management tool that identifies the key issues likely to arise from the project implementation, and proposes the mitigation measures, including monitoring schedule and responsibility. The issues that arise are accordingly addresses with regard to the sequence of operations. Taking into account these considerations, the EMP guides the project management in such a way that environment protection measures are adequately implemented.

### **9.4 Organization Structure for EMP**

According to EPR 2077, Rule 45, the proponent is responsible for self monitoring the environmental impacts cause by the Mugling-Abukhaireni road project during its construction and implementation phase and should submit its report to Ministry of Physical Infrastructure and Transport (MoPIT) or Department of Road (DoR). Also, the ADB will do self monitoring in every six month of construction phase and 2 times in operation phase. Other organizations responsible for the environmental monitoring are Division Forest Office, Community Forest Users Group. Figure 9.1 outlines 'Project Organization Structure Chart for EMP Monitoring responsible for environmental management and its monitoring.

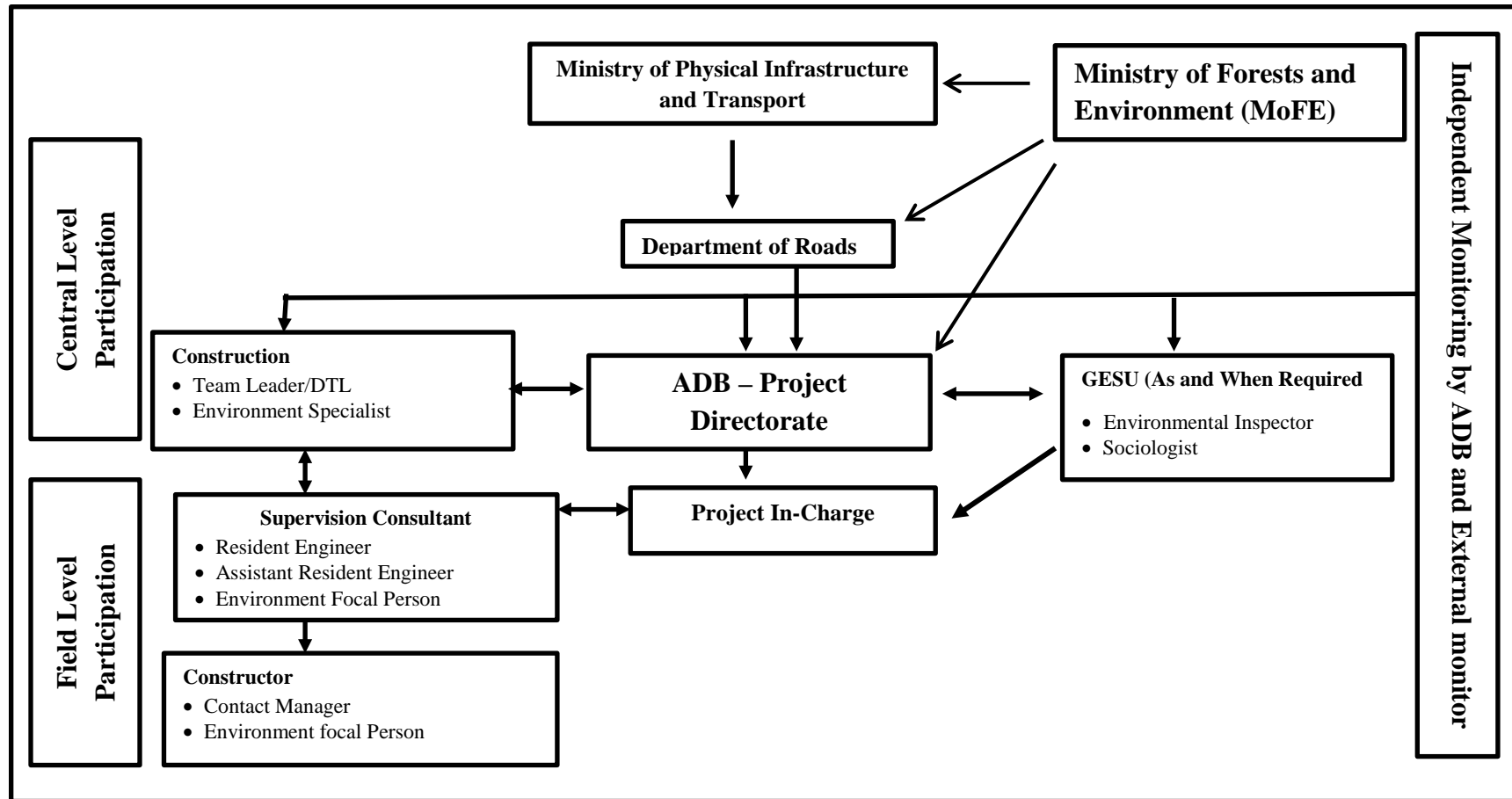


Figure 9.1: Organization Structure responsible for EMP Implementation

## 9.5 Environmental Monitoring Plan (EMoP)

Environmental monitoring is an essential component of the implementation of EIA recommendation. The environmental monitoring programme (EMoP) is prepared to monitor the implementation performance of the EMP.

Environmental monitoring plan is prepared focusing 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/EIA 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

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. The contractor will be responsible for carrying out the air, noise and water quality monitoring.

## 9.6 Environmental Monitoring Cost

The cost of Environmental Monitoring is briefed in the Table 9.2.

**Table 9.2: Environmental Monitoring Cost**

S.N.	Description	Amount (NRs.)
A.	Manpower Cost	13,365,000.00
B.	Air quality, Water quality and Noise level analysis cost	1,080,000.00
C.	Monitoring Cost for MoPIT/DoR/MoFE	1,100,000.00
D.	External Monitoring Cost by Independent Expert	30,00,000.00
E.	Miscellaneous	2,00,000.00
	<b>Grand Total (A+B+C+D)</b>	<b>18,745,000.00</b>

## 9.7 Costs of Executing the Environmental Management Plan

The cost estimate for the suggested mitigation measures such as slope stabilization, spoil management, bioengineering measures and tree plantation, etc. was incorporated in this section. Most of the mitigation measures suggested is a part of road design and construction without additional cost. Most of the proposed mitigation measures are integrated in the project design so that these measures may automatically form part of the construction and operational phases of the project.

## 9.8 Environmental Management Budget

The cost of capacity building of construction workers and concerned groups and environmental 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.

**Table 9.3: Environment Management Plan Budget**

Items	Enhancement Measures/ Mitigation Measures	General Cost (NRs.)	Construction Specific cost (NRs.)	Remarks
<b>A. Enhancement Cost</b>				
Skill enhancement	<ul style="list-style-type: none"> <li>Capacity Building and skill enhancement training</li> </ul>	8,00,000.00	-	Livelihood supporting programs and various skill enhancement training like bio-engineering, technical knowledge to locals ( Part of BoQ H1.02)
Enhancement of Social Services	<ul style="list-style-type: none"> <li>Construction of Public Toilet in periphery of Triveni temple</li> </ul>	24,00,000.00	-	Community Support Programs (Part of BoQ H1.02)
	<ul style="list-style-type: none"> <li>Drinking water facilities in periphery of Triveni Temple</li> </ul>	10,00,000.00		
Safety Measures	<ul style="list-style-type: none"> <li>Cost for PPE and training on occupational health</li> </ul>	80,000.00		Part of BoQ H1.02
	<ul style="list-style-type: none"> <li>Provision of First Aid and Safety Measures like fire extinguishers, set fire alarms in all guard post</li> </ul>	20,00,000.00		
Cultural Enhancement	Improvement/ Enhancement of community structures, temples, etc.	4,00,000.00	-	Part of BoQ H1.02
<b>Sub-Total</b>		<b>66,80,000.00</b>		

Items	Enhancement Measures/ Mitigation Measures	General Cost (NRs.)	Construction Specific cost (NRs.)	Remarks
<b>B. Compensation Cost</b>				
Land Acquisition	<ul style="list-style-type: none"> <li>• Compensation to Private land acquisition</li> </ul>	50,65,150.00	-	Resettlement Plan, Table 26, S.N. 2
Property Acquisition	<ul style="list-style-type: none"> <li>• Compensation for loss of private structures</li> </ul>	-	-	Resettlement Plan, Table 26, S.N. 1
Impact on Vulnerable, Indigenous People and Dalits	<ul style="list-style-type: none"> <li>• Business disruption allowance</li> <li>• Displacement allowance for residential families</li> <li>• Support allowances for vulnerable people</li> </ul>	23,40,000.00	-	Resettlement Plan, Table 26, S.N. 3  Resettlement Plan, Table 26, S.N. 4
Permission for Clearance of Road Side trees and Forest Trees upto COI (2000 nos. trees)	Compensatory trees plantation "fruit trees" - (seedling cost @ rs. 25, plantation cost @ NRs. 20, protection and conservation cost for 5 yrs @300)	1,72,50,000.00	-	BoQ H1.03
Land Compensation Cost	Land Compensation Cost @ Nrs. 30,00,000.00 for forest land, @ 20,00,000.00 for Grassland and @ 25,00,000.00 for cultivated and grassland	2,28,15,000.00	-	
Compensatory Plantation Cost	Compensatory Plantation of 1600 plant species per	52,57,800.00		

Items	Enhancement Measures/ Mitigation Measures	General Cost (NRs.)	Construction Specific cost (NRs.)	Remarks
	hectare (seedling cost @ rs. 25, plantation cost @ NRs. 20, protection and conservation cost for 5 yrs @300)			
<b>Sub-Total</b>		<b>5,27,27,950.00</b>		
<b>C. Mitigation Measures Cost</b>				
Disruption of Public Utilities	Relocation of public utilities (electric poles, transformer, etc.)	-	2,80,47,448.00	Allocated in Resettlement plan (BoQ H1.01)
Road and Bridge Safety	Provision of traffic safety measures (for traffic signs, KM post, RCC New Jersey and reflective studs	-	9,80,65,174.00	BoQ Bill No. 5
Landslides, slope destabilization and soil erosion from excavation, fresh cut slopes	Provision of bioengineering		1,54,964.00	BoQ Bill No. 6
Damage to Road section, Bridges and other related structures during DLP period	Routine maintenance of Road and bridges for Construction Period For DLP		15,91,052.00 7,88,157.00	BoQ A1.06 (a and b)
Air Pollution	Water sprinkling cost		22,27,500.00	Part of BoQ H1.02
<b>Sub-Total</b>			<b>13,08,74,295.00</b>	
<b>D. Environmental Monitoring Cost</b>				
• Manpower cost		1,33,65,000.00	-	

Items	Enhancement Measures/ Mitigation Measures	General Cost (NRs.)	Construction Specific cost (NRs.)	Remarks
<ul style="list-style-type: none"> <li>• Air, water and Noise quality monitoring cost along with purchase of air and noise monitoring equipment</li> <li>• Monitoring cost for MoPIT/DoR and MoFE</li> <li>• External Monitoring Cost by Independent Expert</li> <li>• Miscellaneous</li> </ul>		10,80,000.00		
		11,00,000.00		
		30,00,000.00		
		2,00,000.00		
Sub Total		<b>1,87,45,000.00</b>		
• Auditing Cost		<b>25,11,575.00</b>		
<b>Total EMP cost (NRs.)</b>		<b>21,15,38,820.00</b>		

### 9.9 Summary Cost for Environment Management Plan

The total cost of environment management plan is summarized in the table below.

**Table 9.4: Cost for EMP**

S.N.	Activities/Measures	Total Cost (NRs.)
1	Enhancement Cost	66,80,000.00
2	Compensation Cost	5,27,27,950.00
3	Mitigation Measures Cost	13,08,74,295
4	Environmental Monitoring Cost	1,87,45,000.00
5	Auditing Cost	25,11,575.00
	<b>Total</b>	<b>21,15,38,820.00</b>

The costs involved for bioengineering, side drains and cross drainage structures, slope stabilization and erosion-controlled measures had already been included in Bill of Quantities/Civil Engineering Cost.

### 9.10 Grievance Re-dressal Mechanism

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.

If any issue of conflict arose along with project implementation the victim/affected people can make written complain to the project office/CSC office at the beginning, similarly if the issue remain unresolved then can be successively delivered to second level to fourth level under grievance redress mechanism of this project.

### 9.10.1 Proposed Grievance Redress Mechanism for the Project Road

The table below illustrated the purposed grievance redress mechanism of the Mugling-Abukhaireni road section.

**Table 9.5: Composition Grievance Redress Committes**

Field-Level Committee	Local-Level Committee	Project-Level Committee
<ul style="list-style-type: none"> <li>• Social mobilizers</li> <li>• Contractor Environmental/Social Focal Point</li> </ul>	<ul style="list-style-type: none"> <li>• DoR site engineer</li> <li>• Municipality or Rural Municipality Representative</li> <li>• CSC Social mobilizer</li> <li>• 2 representatives designated by affected community local level (man/woman)</li> </ul>	<ul style="list-style-type: none"> <li>• PM DOR</li> <li>• Chief District Officer</li> <li>• Local Development Officer</li> <li>• CSC Resettlement Expert</li> <li>• CSC Environmental Expert</li> </ul>

## CHAPTER 10: ENVIRONMENTAL AUDIT

### 10.1 Environmental Audit

Audit actually refers to the examination and assessment of a certain type of performance. In case of EIA, an audit assesses the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of the monitoring mechanisms. An audit should be performed after a project has been in operation for some time and is usually performed once or twice in the entire project cycle. The following types of audit are implemented in different phases of the EIA process:

1. **Decision point:** examines the effectiveness of EIA as a decision making tool.
2. **Implementation:** ensures that the approved conditions have been met.
3. **Performance:** examines the responses of the agencies concerned with project management.
4. **Project impact:** examines environmental changes arising from project implementation,
5. **Predictive technique:** examine the accuracy and utility of predictive techniques by comparing actual against predicted environmental effects and EIA procedures, critically examines the methods and approach adopted during the EIA study.

### 10.2 Agencies Responsible for Auditing

As per Rule 12, Section 1 of the EPA 2076, the Ministry or prescribed body should make an audit not later than 6 months after of the date of completion of two years of the commencement of project. As per Rule 39 (1) of EPA, 2076 Ministry of Forests and Environment (MOFE) in coordination with MoPIT, PD ADB will carry out Environment audit and monitoring. The auditing will be carried out as specified in National EIA Guideline (1993). The Guideline specifies that the result obtained from Environmental Impact Auditing should be made available to the project proponent and concerned agencies.

### 10.3 Elements to Environmental Audit Report

Main elements in the audit report include:

- Predicted impacts in EIA report for defined activities in the project development;
- Provide mitigation measures in EIA report to minimize the impacts of the defined activities in the project cycle;
- Implementation status of the mitigation measures in the project as per EMAP;
- Effectiveness of the employed mitigation measures to minimize the impact of the defined activities;
- Any corrective actions suggested or undertaken to mitigate the impacts of the defined activities;
- Compliance or non-compliance with EMAP;
- Compliance or non-compliance with national environmental standards with EMAP;
- Experience gained to strengthen impact prediction in future project for the defined activities.

While format of the Environmental Audit Report is as follows:

Chapter 1	Executive Summary
Chapter 2	Audit Administration and Audit Details, Interviews from Project Area, Audit Area and Methods, Environmental Monitoring, Audit Data and Details.
Chapter 3	Complete Audit Details
Chapter 4	Suggestion and Recommendation Applied in the Project Area
Appendix	Data and Details
Required Human Resources in Audit	
Technical	Expert Required
	Environmental Expert
	Social, Economic and Cultural Expert
	Project Area, Types and other expert regarding impacts from Project implementation
Environmental Checklist	
1. Physical Environment	
2. Biological Environment	
3. Socio-Economic Environment	

The total auditing cost for MA Road is allocated as **25,11,575.00**. Following table presents environmental audit of the proposal.

## Environment Audit Checklist

### Physical Aspect

**Table 10.1: Environmental Audit for the proposed work of road construction**

Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
Air Quality	➤ Storage of Construction Materials	<ul style="list-style-type: none"> <li>➤ Loaded truck for construction can cause air pollution</li> <li>➤ Untimely displacement of construction materials after construction</li> </ul>	In Project Area	➤ Cover loaded truck during transportation	Decreased air pollution	Grievances, increased dust and smog in the project area, Lab Report of Air Quality	Site Observation, Lab Report
Water Quality	➤ Disposal of construction waste on river water	<ul style="list-style-type: none"> <li>➤ Spreading of water borne diseases</li> <li>➤ Water pollution due to disposal of waste.</li> </ul>	Project Area	➤ Safely Disposal of hazardous waste	Decreased water pollution	Grievances, Increase turbidity of river water, Lab Report of Water quality	Site Observation, Lab Report
Noise Pollution	➤ Use of Crusher Plant and other machines in the project area	➤ Increment of vehicles in the road alignment	Project Area	<ul style="list-style-type: none"> <li>➤ Prohibition of horns in the settlement area</li> <li>➤ Prohibition of loaded vehicles in the settlement area</li> </ul>	Decreased Noise Pollution	Grievances, Lab Report of Noise Quality	Site Observation, Lab Report
Land Use	Conversion of agricultural land, settlement area, forest land into road	➤ Conversion of 9.525 ha of forest land into road	Project Area	➤ Compensation to land owners according to land acquisition Act 2076.	Proper Compensation	Grievance Record, Land Compensation Report	Site Observation

Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
Slope Instability	Cutting of the slope area for road construction	Conversion of the slopy land in six different chainage as Table 5.2	Project Area	Use of Bioengineer technique in slope areas during road construction	Decreased soil erosion	Landslides and soil erosion in different sections of road.	Site Observation

### Biological Aspect

S.N	Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
1	Forest Types	Site Observation	Destruction of the 9.525 ha of forest land Disturbances to 5 community forest	Forest near Construction Area	Awareness to the local people in conservation of forest	Conservation of forest	DFO Forest Record	Site Observation
2	Tree Species	Site Observation	Destruction of 2,000 trees species	Forest near Construction Area	Compensation of trees by planting with 1:10 ratio and taking care for 5 years	Consevation of forest	DFO Trees Record, Compensation Report of trees	Site Observation
3	Mammals and Reptiles	Site Observation	Disturbances to mammals and Reptile	Forest near Construction Area	Placement of Hoarding Board for slow driving for safe movement of wild animals	Protection of Mammals and Reptiles	DFO Record data	Site Observation, Interview with local, DFO

S.N	Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
4	NTFPs	Site Observation	Illegal Use of NTFPs	Forest near Construction Area	Prohibition of illegal use of NTFPs	Protection of NTFPS	DFO Record data	Site Observation, Interview with local, DFO
5	Aquatic Lives	Site Observation	Disturbances of Aquatic lives	Forest near Construction Area	Prohibition of fishing	Protection of Aquatic Lives	Record data from DFO	Site Observation, Interview with local, DFO
6	Vulnerable and Endangered Species	Site Observation	Poaching of vulnerable and Endangered Species	Forest near Construction Area	Prohibition of poaching of the vulnerable and endangered species.	Protection of vulnerable and Endangered species	Record data from DFO	Site Observation, Interview with local, DFO
7	Conservation Area	Site Observation	Disturbances of Conservation area	Conservation Area	Awareness for the conservation of conservation area	Protection of Conservation Area	Record data from DFO	Site Observation, Interview with local, DFO

### Socio-Economic and Cultural Aspect

S.N	Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
1	Agriculture	Interview with locals	Oil, Lubricants, Colors, Cements and other necessary materials use during construction can reduce the soil quality	Project Area	The farmers should adopt new agricultural techniques in order to get maximum benefits from the agriculture.	Change in Agricultural farming	Test Report of Soil	Field Observation, Interview, Soil Test Report
2	Employment	Interview with locals	Employment opportunity for 108,000 person days for skilled and 360,000 person days for unskilled person for 30 months from road project	Project Area	Priority for the local people. Skill development training to the local people.	Skill enhancement of the local people	Job Placement to the local people PAFs Enterprises developed and self employed to PAFs. Trace Study Training Utilization Study	Site Observation, Interview, Public Discussion
3	Migration	Interview with Local People	Increase pressure in local service and infrastructures due to increase in migration	Project Area	Operation of adequate infrastructures and services	Adequate number of infrastructures and services	Migration Record of respective ward	Interview, Public Discussion
4	Health and Sanitation	Interview with locals	Increase risk to health due to use of hazardous materials and lack of	Project Area	Provision of Safety and Health measures. Provision of clean drinking	Improvement of Health and Sanitation Facilities	Grievances, Hospital and Health	Field Observation and Public Discussion

S.N	Details	Project Activities	Estimated Impacts	Actual Impacts	Mitigation Measures	Effectiveness	Indicators	Source of Data
			awareness about the health		water and toilet services.		Post Record	
5	Gender Equality	Interview with locals	Inequality due to bias on wages and opportunity to both male and female.	Project Area	Equal opportunity and wages to both male and female	Equal Opportunities	Grievances , Wages Record	Field Observation, Interview and Public Discussion
6	Present Scenario of Religious and Cultural Environment	Interview and Public Discussion	Disturbances to the temples	Project Area	Relocation of the temples in suitable places as provided by local people		Grievances	Interview and Public Discussion

#### 10.4 Estimated Environment Audit Budget

According to Rule 12, Section 1 EPR 2076, the ministry should make environmental audit and analysis about adverse impacts on the environment as a result of implementation of the proposal, not later than 6 months after the completion of two years of commencement of the project. The estimated Environment Audit Cost in BoQ is **25,11,575.00**.



## CHAPTER 11: CONCLUSION

The proposed road has aimed for the construction of new road and bridges (two major and four minor) along with upgradation of existing road. The road has a total length of 9.384 km and is of one way single lane at Ch. 00+000 to 00+180, one way two lanes at Ch. 00+180 to 05+080, two-way four lanes without service lane at Ch. 05+080 to 08+100 and two-way 4 lanes with service lane at Ch. 08+100 to 09+384 in major settlement areas. The formation width is designed as per the land use types and hence have different road formation width according to chainages of the road; carriageway width is 3.7m for single lanes and 19m for four lanes with service lanes; and 0.75m shoulders width on both sides. The project includes Trishuli Bridge of 120m length and Marshyangdi Bridge of 125 m length. Both the bridges are of doubles lanes standard.

The EIA team has conducted and prepared this report as per requirement of the EPR, 2077. The team has identified the beneficial and adverse environmental issues based on the expert judgment and past project experiences of similar nature of project.

The likely beneficial issues identified include short-term employment opportunity for labors and increase in local economic activities. In addition, the local residing along the project corridor will be more benefitted from various project-based capacity-building programs such as awareness – raising programs, etc.

The significant impacts during construction stage are destruction of 227 private structures and 11 community structures. The private structures include 75 residential structures, 58 residential and commercial structures, 78 commercial structures, 11 shed and 5 private toilets. Out of 227 private structures, 119 are fully affected and 108 are partially affected structures. Similarly, the community structures include 2 resting place, 2 police building and post, 4 temples, 1 Aama Samuha Structure, 1 canteen (Chamena Griha), 1 Public toilet and temporary disruption of 153 electrical poles and 5 transformers. Labors and local people will be prone to adverse health effects and accidents relating to construction activities.

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 especially in Gorkha District. Surface water quality of the rivers (Trishuli and Marshyangdi) 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.

Further, the issues raised by various stakeholders in the public meetings/public hearing and the written concerns received have been incorporated in the report. The issues addressed by the stakeholders during public consultation meeting includes provision of road side drains, regular maintenance of roads, proper management of dust and smokes from the construction activities, provision of traffic signs and signals, tree plantation for the compensation of felled down trees, compensation for the affected structures and land, rehabilitation of public utilities, social upliftment programs, etc.

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.

The proposed road project is likely to have insignificant adverse environmental impact. Most of the adverse impacts identified and predicted are of moderate significant and of short term in nature. The beneficial impacts with the improved access and reduced transport cost and enhancement of social services in the area are more significant and are long lasting. The implementation of enhancement and mitigations measures listed in EMP will help to reduce the negative impacts on physical, biological, socio-economic and cultural aspects respectively. The total estimated EMP cost is NRs. **21,15,38,820.00** and it includes Management of tree cutting, traffic safety management, environmental mitigation works and bio-engineering engineer, and provision of safety gadgets to works. Resettlement Plan has been prepared to address land and property acquisition as well as compensation issues.

**REFERENCES**

- ADB, 2009. ADB Policy Paper: Safeguard Policy Statement. The Asian Development Bank, Manila.
- DoR, 2019. Resettlement Plan of Mugling-Abukhaireni Road, SASEC Highway Improvement Project, Department of Roads, Ministry of Physical Planning and Works
- DoR, 2018. Poverty and Social Analysis of Mugling-Abukhaireni Road, SASEC Highway Improvement Project, Department of Roads, Ministry of Physical Planning and Works
- DoR, 2067. Nepal Bridge Standard 2067, Department of Roads, Ministry of Physical Infrastructure and Transport, Kathmandu.
- DoR, 2013. Nepal Road Standard 2070, Department of Roads, Ministry of Physical Infrastructure and Transport, Kathmandu.
- FIDIC 2010, Conditions of Contract for Construction. International Federation of Consulting Engineers
- DoR, GESU. 2009. Roadside Geotechnical Problems: A Practical Guide to Their Solution, Geo-Environment and Social Unit, Department of Roads, Ministry of Physical Planning and Works, Kathmandu
- DoR, GESU, 2007. Environmental and Social Management Framework, Geo-Environment and Social Unit, Department of Roads, Ministry of Physical Planning and Works
- HMGN, Ministry of Physical Planning and Works 2001 (2058 BS). The National Transport Policy, Kathmandu
- HMGN, 2000. Environment Protection Act, 2053 (1997 AD) and Environment Protection Rules, 2054 (1997 AD) (with amendments). Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board of MoPE, Kathmandu.
- MoFS, 2012. Plants of Nepal: Fact Sheet, Department of Plant Resources, Ministry of Forest and Soil Conservation, Kathmandu.
- MOFE, 2076. Environment Protection Act, 2076 (2019 AD). Ministry of Forests and Environment, Government of Nepal. Kathmandu.
- MOFE, 2076. Environment Protection Rules, 2077 (2020 AD). Ministry of Forests and Environment, Government of Nepal. Kathmandu.
- ISSRC, 2014 -2015. District and VDC Profile of Nepal, A Socio- Economic Development Database of Nepal, Nepal.
- IUCN. 2005. Nepal's Illustrated Biodiversity Primer. The World Conservation Union, Kathmandu.