

Environmental Impact Assessment of upgrading the Kamala-Dhalkebar- Pathalaiya Road Section (130 Km) of East West (Mahendra) Highway

Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat and Bara Districts

Madhesh Province, Nepal



Submitted to

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March 2024

EXECUTIVE SUMMARY

Project Description

Ministry of Physical Infrastructure and Transport (MoPIT), Department of Roads (DOR), Development Corporation Implementation Division (DCID), Babarmahal, Kathmandu is the proponent for upgrading the Kamala-Dhalkebar-Pathalaiya (KDP) road section of East-West (Mahendra) Highway.

Kamala-Dhalkebar-Pathalaiya Road section starts from Kamala River of Siraha District (chainage 236+698 of Mahendra Highway) and ends at Pathalaiya of Bara District (chainage 366+887 of Mahendra Highway). This section of Mahendra Highway lies within Madhesh Province and passes through 6 districts viz. Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat and Bara including 15 municipalities and one sub-metropolitan city.

Proposed road is 130 km long and is proposed for upgrading to Asian Highway Standard Class I and Nepal Road Standards Class II. Existing 2 lane road will be upgraded to 4 lanes along with associated bridges as required. Right of way of the proposed road is 50 m (25 m both sides from central line) where 4 m width median will be constructed in the middle followed by 0.5 m, 7 m carriage way, 2.5 m paved shoulder and drain on both sides. In major settlements, after shoulder, 6.5 m service road and 2 m cycle track will be constructed on both sides along with footpath and other facilities as per site condition.

Study Methodology

This EIA Report has been prepared following the EPR 2077 and Scoping Document and ToR approved from Ministry of Forest and Environment on 2080/01/11 as per ministry level decision of GoN. In order to achieve the objectives of EIA, relevant literatures were reviewed and Zone of Influence of the Project was delineated. Study team collected information through various stages of field observation, survey and consultations with stakeholders. Beside FGDs and consultations at ward level, sample household survey among 858 households within direct impact area and household census survey among 64 households within RoW was conducted.

During field survey, information on existing environmental condition of project affected area was collected. The baseline air quality and noise level of the project area was monitored at five different locations (Dhalkebar, Lalbandhi, Paurahi, Nijgadh and Dudhaura) in the month of October 2022. For identifying ground water quality of project area 7 different locations and for surface water 6 different locations were selected from where water samples were collected and different water quality parameters were analyzed. For vegetation within project area, 41 quadrat samples were studied. All trees within right of way of the proposed road were counted species wise measuring their height and girth. Similarly, in order to study about the wild life and habitat of the project area, direct observation of their activities and habitat and study of their signs, footprints, faeces/ stool etc. were done.

Possible impacts due to construction and implementation of the proposed project and their mitigation measures were identified by the experts through field observation, analysis of collected information and impact identification, prediction, evaluation and assessment.

Project Benefits

About 250 local women will get the opportunity of skill training related to construction. It is estimated that this project will provide employment to around 1,000 workers out of which around 400 will be local and 600 will be migrant.

VUPs will be constructed at 5 different places (Birendrabazar, Lalbandi, Nawalpur, Hariwan and Nayaroad) to facilitate the crossings of vehicles. PUPs will be constructed at 5 different places (Birendrabazar, Lalbandi, Nawalpur, Hariwan and Nayaroad) to facilitate the crossings of people. Different road infrastructures like service road, traffic lights, zebra crossings, junction improvement have been arranged. Use of traffic signs will improve in road safety.

After the upgradation of the road, international trade (with India, Bangladesh, Bhutan, etc.) will increase along with economic development, job opportunities, income generation of local people (trade, agriculture, business and industry).

After the upgradation of the road, the quality of the road will be improved due to which there will be reduction in carbon emission and this will assist for cleaner environment.

Environment Impacts and Mitigation Measures

Physical Environment

Adverse Impacts

Major impacts in physical environment due to project activities are change in land use, air and noise pollution, impacts from labour camps, stockpiling yards and construction camps, operation of quarry and borrow pits, generation of solid and liquid wastes etc.

Located in terai, during rainy season, there is equal chance of flooding and soil erosion along the rivers and rivulets within the project area while upgrading/construction of bridges and culverts.

Mitigation Measures

So as to minimize change in land use, road width will be reduced in forest area and rural area and vegetation will be removed only where necessary. Air and dust due to project activities will be controlled by using good condition vehicles and equipment for the project and timely servicing, sprinkling of water along the dusty road, transporting construction materials by covering etc. Impact due to noise pollution will be reduced through proper barricade of construction area and scheduling construction works (mainly near schools and hospital areas).

For labour camps, stockpiling yards, construction camps etc., the contractor will be suggested for establishing in designated places. For this appropriate location is found between chainage 237+700, 241+430, 260+800, 290+500 and 325+100. Basic facilities such as proper waste management, potable water supply, healthy kitchen and dining room, sufficient toilet and bathrooms, wide and well-ventilated bed rooms, adequate fire precaution system, etc. will be provided in camps. It will be better if stockpiling yards are also kept adjoining to labour camps. Stockpiling yards will be barricaded. Construction materials will be stored by covering so that they will not be blown away by wind or washed by rain.

Chemicals will be stored and used in safe manner so as to prevent spillage in ground. Similarly, construction camps (crusher plants, hot mix plants, batching plants, workshops

etc.) required for the project will be kept away from settlements and water courses. For this area nearby chainages 237+400, 262+000, 305+500 and 343+600 are found to be suitable. For installing and operating different plants, approval from local stakeholders and municipality will be taken.

Design report has identified and recommended 11 appropriate locations for quarry and borrow pits. **Extraction of construction materials and operation of quarry and borrow pits will be done as per guidelines.** Only excess river bank materials above the existing water level will be extracted and no alternation in river morphology and flow pattern will be done. Materials will be covered with tarpaulin sheets during transportation.

Around 210 kg of solid waste is expected to be generated daily from project workers. Waste generated will be segregated at source itself and decomposable waste will be composted or buried in pit whereas recyclable waste will be sold. For other wastes, coordination will be done with municipalities and disposed in their landfill sites. Similarly, around 32,000 liters of waste water is expected to be generated daily from project workers. The septic tanks and sock pit will be constructed at camp sites and septic tanks will be cleaned on regular basis.

Chemicals including bitumen required for the project will be stored in puncture and leak proof containers and only designated workers will be allowed to use these chemicals. So as to reduce the impact of bitumen, automated asphalt plants will be used. Bitumen mixing plant will have in-built mechanisms for the absorption of gases.

During operation phase traffic movement/volume will increase. Hence there will be risk of air and noise pollution during operation phase too. To minimize the impact, plantation will be done in road side and median. Road will be regularly maintained and no horn sing will be erected in sensitive areas like schools, hospitals/health posts etc. So as to reduce the road accidents, road safety measures have been identified and incorporated into the design at required locations. Increase water flow (including impact of climate change) has been considered by design while designing drainage structures and size.

Biological Environment

Adverse Impacts

Though the proposed project will not acquire any forest land, while widening the road, trees within RoW needs to be cleared. In total 4,914 saplings (diameter 4.0425 cm to 14.56 cm) and 28,120 trees and poles including 8,954 poles (with dbh 14.56 to 24.26 cm) and 19,166 trees (with dbh >24.26 cm) may need to be felled down due to widening of existing road. **The project will also have impact in wildlife movement.**

Mitigation Measures

Compensatory plantation will be done for trees cut down in this project. For this coordination with DFOs will be done for planting 281,200 trees (in the ratio 1:10) and managed/cared for 5 years. Labours will be prohibited in entering forest area except working sites. Worker's activities within forest region will be monitored continuously. To minimize the impact in wildlife movement across KDP road alignment, existing bridges within forest sections where wildlife movement is high will be modified as underpasses to animals. Beside these other measures like rumble strips to control speed of vehicles, roadside reflectors and mirrors,

signage, variable message sign, installation of arboreal mammal canopy bridges, sound barriers etc. will be arranged.

So as to prevent forest land encroachment strong rules will be made and implemented. Awareness program focusing on importance of forest and prevailing laws related with forest will be organized.

Social and Cultural Environment

Adverse Impacts

It is noticed that 66 private structures of 64 HHs within RoW (DOR ownership land) will be directly affected. Among 64 projects affected HHs, 25 are losing residence, 35 losing business huts, 4 HHs are losing both residential cum business structures. Further, 204 other extended housing structures (sheds like) and 4 extended parts (oil dispenser) of petrol pump needs to be removed or shifted from the RoW.

Additional 216 community/public structures including 35 small temples, 8 wells, 55 Bar/Peepal Chautara, 69 waiting sheds, 5 Gates, 12 boundary walls, 4 police posts, 3 public toilets, 2 extended structures of two school (Mahendra Adarsha Secondary School and Nepal Rastriya Secondary School), 3 market/ Hat Bazar sheds, 1 Army check post, 2 Police check post, 1 police waiting shed and 16 structures within Army barrack may be affected due to road widening.

Besides these, 2,221 electric poles and 33,160 m water pipe lines can be disturbed.

Mitigation Measures

For compensation of all the affected private structures, Resettlement Action Plan (RAP) has prepared and will be compensated as per this plan. For this, NRs. 8,541,000 has been estimated in RAP. Similarly, all the affected community/public structures will be relocated/rehabilitated. NRs. 100,056,054.400 has been estimated and allocated in project cost (BOQ) for relocation/rehabilitation of these structures.

For shifting electric poles, coordination with NEA will be done. Similarly, for rehabilitation of water supply pipelines, coordination with DWSS and respective water supply communities will be done. Cost for shifting electric poles and rehabilitation of water supply pipelines along with other utilities is included in BOQ and will be done through contractor.

For addressing issues of indigenous peoples, the project has prepared separate Indigenous Peoples Development Plan (IPDP) that includes organizing eye camps, orientations for the marketing of local products through radio, hoarding boards and managing local gift shop and orientation program to control school drop-out children of the Majhi communities. The project has allocated NRs. 2,185,000 for implementation of IPDP and included in project cost (BOQ).

Similarly, the project will have proper arrangement for Occupational Health and Safety (OHS) of workers and Community Health and Safety.

To minimize the impact of the growing population, a suitable settlement plan and adequate infrastructure facilities will be developed. Project-affected wards and municipalities will be involved in the implementation of these plans.

Conclusion

As Kamala-Dhalkebar-Pathalaiya road section is a part of Asian Highway, upgraded road section will enhance the trade facility also. Located in the Terai region, this project has proposed adequate river protection works to prevent floods and soil erosion, and drainage and cross drainage structures for proper draining of rainwater. The total cost of environmental and social management plan (ESMP) is estimated to be NRs. 3,908,813,377.07 (in words: Three billion nine hundred eight million eight hundred thirteen thousand three hundred seventy-seven rupees and seven paisa) including RAP, BMP, IPDP and 18 underpasses for large and size medium animals. The proponent is committed in constructing and operating the proposed road section by adopting the environmental protection measures as mentioned in this report.

कार्यकारी सारांश

आयोजनाको विवरण

प्रस्तावित पूर्व-पश्चिम (महेन्द्र) राजमार्ग अन्तर्गत कमला-ढल्केबर-पथलैया सडक खण्ड (१३० कि.मि.) स्तरोन्नति कार्यको प्रस्तावक भौतिक पूर्वाधार तथा यातायात मन्त्रालय सडक विभाग, विकास सहायता कार्यान्वयन महाशाखा, बबरमहल, काठमाडौं रहेको छ । कमला-ढल्केबर-पथलैया सडक खण्ड सिराहा जिल्लाको कमला नदी (महेन्द्र राजमार्गको चेनेज २३६+६९८) बाट सुरु भई बारा जिल्लाको पथलैया (महेन्द्र राजमार्गको चेनेज ३६६+८८७) मा अन्त्य हुन्छ । महेन्द्र राजमार्गको यो खण्ड मधेश प्रदेशका सिराहा, धनुषा, महोत्तरी, सर्लाही, रौतहट र बारा गरि ६ जिल्ला भएर जान्छ, जसमा १५ नगरपालिका र १ उपमहानगरपालिका पर्दछन् । प्रस्तावित सडक १३० कि.मि. लम्बाईको रहेको छ । विद्यमान सडकलाई एशियाली राजमार्गको मापदण्डमा स्तरोन्नति गर्न प्रस्ताव गरिएको छ । यसका लागि हालको २ लेन सडक र आवश्यकता अनुसार पुलहरूलाई ४ लेन स्तरमा स्तरोन्नति/निर्माण गरिने छ । प्रस्तावित सडकको क्षेत्राधिकार (Right of Way) ५० मि. (मध्य रेखा बाट दुवै तर्फ २५-२५ मि.) को रहेको छ जसमा सडकको बीचमा ४ मि. को median र त्यस पछि दुवै तर्फ ०.५ मि को kerb, ७ मि. को carriageway, २.५ मि. को paved shoulder र नाली निर्माण गरिने छ । मुख्य बस्ती क्षेत्रहरूमा दुवै तर्फ shoulder पछि ६.५ मि. को service road, २ मि. को साइकल ट्र्याक र ठाउँ अनुसार फुटपाथ र अन्य सुविधाहरू निर्माण गरिने छ ।

अध्ययन विधिहरू

यस वातावरणीय प्रभाव मूल्याङ्कन वातावरण संरक्षण नियमावली २०७७, राष्ट्रिय वातावरणीय प्रभाव मूल्याङ्कन निर्देशिका १९९३ तथा मिति २०८०-०१-११ मा वन तथा वातावरण मन्त्रालयको (मा. मन्त्रीस्तरीय) निर्णयद्वारा स्वीकृत क्षेत्र निर्धारण प्रतिवेदन र कार्यसूचीको अधीनमा रही तयार गरिएको छ । यस वातावरणीय प्रभाव मूल्याङ्कन अध्ययनका उद्देश्यहरू प्राप्त गर्न आवश्यक संदर्भ सामग्रीहरूको पूर्व अध्ययन गरिएको थियो र आयोजनाको प्रभावित क्षेत्र रेखाङ्कन गरिएको थियो । अध्ययन टोलीले विभिन्न चरणहरूमा आयोजना क्षेत्रको स्थलगत अध्ययन, सर्भे, र सरोकारवालाहरू सँग छलफल गरी जानकारी सङ्कलन गरेको थियो । यस बाहेक बडा स्तरमा समूहगत छलफल, आयोजना प्रभावित घरधुरीहरू मध्ये ८५८ घरधुरीमा नमुना सर्वेक्षण गरिएको र सडक क्षेत्राधिकार भित्रका आयोजनाबाट प्रत्यक्ष प्रभावित ६४ घरधुरीमा घरधुरी सर्वेक्षण गरिएको थियो । स्थलगत सर्वेक्षणको क्रममा आयोजना प्रभाव क्षेत्रको विद्यमान वातावरणीय अवस्था सम्बन्धी जानकारी सङ्कलन गरिएको थियो । प्रस्तावित आयोजना क्षेत्रको विद्यमान वायु गुणस्तर तथा ध्वनिको मापन २०२२ को अक्टुबर महिनामा सडक छेउका ५ ठाउँ (ढल्केबर, लालबन्दी, पौराही, निजगढ र दुधौरा) मा मापन गरिएको थियो । जमिन मुनिको पानीको गुणस्तर मापनका लागि ७ वटा विभिन्न क्षेत्रहरू र जमिनको सतहमा रहेको पानीको गुणस्तर मापनका लागि ६ वटा विभिन्न क्षेत्रहरू छानिएको थियो र यी क्षेत्रहरू बाट पानीको नमुना सङ्कलन गरि विभिन्न सूचकहरू मापन गरिएको थियो । आयोजना क्षेत्रको वनस्पति सर्भेका लागि ४१ वटा quadrat

samples माफत अध्ययन गरिएको थियो भने प्रस्तावित सडकको क्षेत्राधिकार भित्रका सम्पूर्ण रुखहरूको प्रकार, गोलाइ र उचाइ मापन गरिएको थियो । त्यस्तै आयोजना क्षेत्रको वन्यजन्तु तथा वासस्थान बारे अध्ययन गर्नका लागि तिनिहरूको गतिविधि र वासस्थानको प्रत्यक्ष अवलोकन तथा पदचिन्ह, विस्ताहरू आदिको अध्ययन गरिएको थियो ।

विज्ञहरूद्वारा स्थलगत अवलोकन, प्राप्त तथ्याङ्कहरूको विश्लेषण, प्रभावको पहिचान, आँकलन तथा मूल्याङ्कन गरी आयोजना निर्माण तथा सञ्चालनले पार्न सक्ने सकारात्मक प्रभावहरू तथा नकारात्मक प्रभाव र न्यूनीकरणका उपायहरू पहिचान गरियो ।

आयोजनाका सकारात्मक प्रभावहरू

- स्थानीय २५० जना महिलाहरूले निर्माणसंग सम्बन्धित तालिमको अवसर पाउने छन् ।
- यस आयोजनाले लगभग १००० जना कामदारलाई रोजगारी दिने अनुमान गरिएको छ जसमा करिब ४०० जना स्थानीय र ६०० जना अन्य क्षेत्रबाट आउने छन् ।
- मोटरगाडीहरू सहज तरिकाले वारपार गर्न ५ स्थानमा (वीरेन्द्रबजार, लालबन्दी, नवलपुर, हरिवन र नयाँरोड) VUP को व्यवस्था गरिएको छ ।
- मानिसहरूको सहज वारपार गर्न ५ स्थानमा (वीरेन्द्रबजार, लालबन्दी, नवलपुर, हरिवन र नयाँरोड) PUP को व्यवस्था गरिएको छ ।
- Service Road, traffic lights, zebra crossings, चोक सुधार जस्ता सडक पूर्वाधारहरूको व्यवस्था गरिएको छ ।
- ट्राफिक चिन्हहरूको प्रयोगको कारण ट्राफिक सुरक्षाको अवस्थामा सुधार हुने छ ।
- सडकको विस्तार पश्चात् अन्तराष्ट्रिय व्यापार (भारत, बंगलादेश, भुटान आदि) अभिवृद्धि तथा आर्थिक विकासका साथै स्थानीय जनताको जीविकोपार्जनमा अभिवृद्धि, रोजगारीको सृजना, आय आर्जन (व्यापार, कृषि, व्यवसाय र उद्योग) मा टेवा पुग्नेछ ।
- सडकको स्तरोन्नति पश्चात् सडकको गुणस्तरमा सुधार भई कार्बन उत्सर्जनमा कमी आउने र स्वच्छ वातावरण अभिवृद्धि गर्न मद्दत मिल्नेछ ।

वातावरणीय प्रतिकूल प्रभाव र न्यूनीकरणका उपायहरू

भौतिक वातावरण

प्रतिकूल प्रभाव

भू-प्रयोगमा परिवर्तन, वायु र ध्वनी प्रदूषण, कामदार शिविर, भण्डारण क्षेत्र र निर्माण शिविरको प्रभाव, खानि क्षेत्र सञ्चालन, ठोस र तरल फोहोरको उत्पादन आदि हुन् ।

तराई क्षेत्रमा अवस्थित यस आयोजना अन्तर्गत रहेका ठूला तथा साना नदीनालाहरूमा पुल पुलेसाको स्तरोन्नति दौरान वर्षातको समयमा बाढी र माटोको कटान समस्या आउन सक्ने सम्भावना समेत उत्तिकै रहेको छ ।

न्यूनीकरणका उपायहरू

भू-प्रयोगमा हुने परिवर्तन कम गर्न वन क्षेत्र र ग्रामीण क्षेत्रमा सडकको चौडाइ घटाइने छ र आवश्यकता अनुसार मात्र वनस्पति हटाइनेछ । निर्माणका गतिविधिबाट निस्कने धुवा र धुलोलाई

नियन्त्रण गर्न राम्रो अवस्थाका सवारी साधन र उपकरण प्रयोग गर्ने र समयमै सर्भिसिङ गर्ने, धुलो सडकमा पानी छर्कने, छोपेर मात्र निर्माण सामग्री ढुवानी गर्ने आदि अपनाइने छ ।

निर्माण क्षेत्रमा आवश्यकता अनुसार छेकबार गरिने छ र महत्वपूर्ण क्षेत्रहरू (जस्तै विद्यालय, अस्पताल आदि) मा स्थानीय र सरोकारवालाहरू सँग समन्वय गरेर निर्माण तालिका बनाई सोहीअनुसार निर्माण कार्य गरिने छ । कामदार शिविर, सामग्री भण्डारण क्षेत्र, निर्माण शिविर आदिका लागि निर्माण व्यवसायीलाई तोकिएको स्थानमा स्थापना गर्न र प्रयोग गर्न सुझाव गरिने छ । कामदार शिविर र निर्माण सामग्री भण्डारणका लागि चेनेज २३७+७००, २४१+४३०, २५९+२००, २९०+५०० र ३२५+१०० वरिपरिका क्षेत्रहरू उपयुक्त देखिएको छ । कामदार शिविरमा फोहोर मैलाको उचित व्यवस्थापन, पिउने पानीको आपूर्ति, स्वच्छ खाना खाने ठाउँ, पर्याप्त शौचालय र नुहाउने ठाउँ, फराकिलो र पर्याप्त हावा चल्ने र पानी नचुहिने सुत्रे कोठाहरू, पर्याप्त अग्नि नियन्त्रण प्रणाली, आदि सुविधाहरू उपलब्ध गराइने छ । निर्माण सामग्री भण्डारण पनि कामदार शिविर सँगै जोडिएको जमिनमा गर्दा उपयुक्त हुने देखिन्छ । निर्माण सामग्री भण्डारण क्षेत्रलाई छेकबार गरिने छ । निर्माण सामग्री भण्डारण गर्दा हावाले नउडाउने र पानीले नबगाउने गरी राखिने छ । रासायनिक पदार्थहरू भण्डारण गर्दा र प्रयोग गर्दा सुरक्षित तरिकाले जमिनमा नपोखिने गरी गरिने छ । आयोजनाका लागि आवश्यक निर्माण शिविरहरू (क्रसर प्लान्ट, हट मिक्स प्लान्ट, ब्याचिड प्लान्ट, वर्कशप आदि) बस्तीहरू, पानीका स्रोतहरू र खोला नालाबाट टाढा राखिने छ । यसका लागि चेनेज २३७+४००, २६२+०००, ३०५+५०० र ३४३+६०० नजिकैको क्षेत्रहरू उपयुक्त हुने देखिन्छ । आयोजनाका लागि आवश्यक प्लान्टहरू स्थापना र सञ्चालन स्थानीय सरोकारवाला र नगरपालिकाबाट अनुमति लिइनेछ ।

आयोजनाले बाढी र माटोको कटान रोक्न पर्याप्त नदी संरक्षण कार्यहरू प्रस्ताव गरेको छ, र वर्षाको पानीको उचित निकासका लागि ड्रेनेज र क्रस ड्रेनेज संरचनाहरू प्रस्ताव गरेको छ ।

डिजाइन प्रतिवेदनमा यस आयोजनाका लागि उपयुक्त खानी तथा उत्खनन क्षेत्रहरूमा ११ वटा ठाउँहरू सिफारिस गरिएको छ । निर्माण सामग्री उत्खनन तथा खानि सञ्चालन गर्दा तोकिएको मापदण्ड अनुसार गरिने छ । खानि सञ्चालनको समयमा नदीको बहावमा असर गरिने छैन र खाल्टो नबनाई र नदीको पानीको सतह भन्दा माथि थुप्रिएको भाग मात्र उत्खनन गरिने छ । सामग्री ढुवानीको समयमा धूलो उत्सर्जन रोक्नका लागि त्रिपालले ढाकिने छ ।

आयोजना निर्माणको क्रममा आयोजनाका कामदारहरूद्वारा ठोस फोहोर उत्पादन प्रति दिन २१० के.जी. हुनेछ । फोहोरमैलालाई श्रोतमै वर्गीकरण गर्ने व्यवस्था मिलाइने छ र वर्गीकृत फोहोर मध्ये कुहिने फोहोरलाई कम्पोस्ट मल बनाइने छ वा खाल्टो खनेर पुरिने छ भने बिक्री हुने फोहोरलाई बिक्री गरिने छ । अन्य फोहोरलाई नगरपालिकाहरू सँग समन्वय गरी उनीहरूको फोहोर फाल्ने क्षेत्रमा लगेर फालिने छ । त्यसै गरी आयोजना निर्माणको क्रममा आयोजनाका कामदारहरूद्वारा फोहोर पानी उत्पादन प्रति दिन ३२,००० लिटर हुने अनुमान गरिएको छ । कामदार शिविरहरूमा सोकपिट युक्त सेप्टिक ट्याङ्की निर्माण गरिनेछ र ट्याङ्कीहरू नियमित रूपमा सफा गरिनेछ । आयोजनाका लागि आवश्यक पर्ने बिटुमिन लगायतका केमिकललाई पञ्चर र

लिक प्रुफ कन्टेनरमा भण्डारण गरी तोकिएका कामदारले मात्रै ती रसायन प्रयोग गर्न पाउनेछन्। बिटुमिनको प्रभावलाई कम गर्न स्वचालित अस्फाल्ट प्लान्टहरू प्रयोग गरिनेछ। बिटुमिन मिक्सिड प्लान्टमा ग्याँस सोस्नका लागि इन बिल्ट उपकरणहरू प्रयोग गरिने छ।

सञ्चालन चरणको समयमा सडकमा गुड्ने गाडीहरूको संख्यामा वृद्धि हुने छ जसको कारण वायु र ध्वनि प्रदूषणको जोखिम पनि बढ्नेछ। यसको प्रभाव कम गर्न सडक किनारमा र median मा रुख बिरुवाहरू रोपिने छ। सडकको नियमित मर्मत सम्भार गरिने छ र संवेदनशील क्षेत्रहरू (विद्यालय, अस्पताल, स्वास्थ्य चौकी आदि) मा हर्न निषेध चिन्हहरू राखिने छ। दुर्घटना कम गर्न आवश्यक स्थलहरूमा सडक सुरक्षाका उपायहरू पहिचान गरी डिजाइनमा समावेश गरिएको छ। ढल निकासको संरचनाको आकार पानीको बढ्दो मात्रा (जलवायु परिवर्तन समेत) लाई समायोजित गर्ने गरी डिजाइन गरिएको छ।

जैविक वातावरण

प्रतिकूल प्रभाव

प्रस्तावित आयोजनाले कुनैपनि वन क्षेत्र प्रयोग नगर्ने भएपनि सडक चौडाई बनाउँदा आफ्नो क्षेत्राधिकार भित्र भएका रुखहरू काटिने छन्। प्रस्तावित सडकको स्तरोन्नति गर्दा ४,९१४ लाक्षा (४.०४२५ से.मि. देखि १४.५६ से.मि. व्यास) र २८,१२० रुख र बल्लाबल्लीहरू काटिनु पर्नेछ, जसमा ८,९५४ बल्लाबल्ली (१४.५६ देखि २४.२६ से.मि. व्यास भएको) र १९,१६६ रुखहरू (२४.२६ से.मि. भन्दा बढी व्यास भएको) रहेका छन्। आयोजनाले वन्यजन्तुको आवतजावतमा पनि प्रभाव पार्नेछ।

न्यूनीकरणका उपायहरू

यस आयोजनामा काटिएका रुखहरू (बल्लाबल्ली समेत) का लागि क्षतिपूर्ति वृक्षारोपण गरिने छ। यसका लागि डिभिजन वन कार्यालय सँग समन्वय गरी २८१,२०० रुखहरू (१: १० को दरले) रोपिने छ र ५ वर्ष सम्म हेरचाह गरिने छ। कामदारहरूलाई काम गर्ने स्थल बाहेक अन्य वन क्षेत्रमा प्रवेश निषेध गरिने छ। वन क्षेत्र नजिकै काम गर्दा कामदारहरूको गतिविधिको निरन्तर अनुगमन गरिनेछ। यस आयोजना क्षेत्रमा वन्यजन्तुको आवागमनमा पर्ने प्रभावलाई कम गर्नका लागि वन्यजन्तुको चहलपहल धेरै रहेको वन क्षेत्रमा रहेका पुलहरूलाई अन्डरपासको रूपमा परिमार्जन गरिनेछ। यस बाहेक वन क्षेत्रमा सवारी साधनको गति नियन्त्रण गर्न rumble strips बनाउने, बाटो छेउ reflectors and mirrors, signage, सूचना मूलक होर्डिड बोर्डहरू, arboreal mammal हरूका लागि canopy bridges, ध्वनि रोधक आदिको व्यवस्था गरिनेछ। वन अतिक्रमण रोक्नका लागि कडा नियम बनाई कार्यान्वयन गरिनेछ। वनको महत्व र वन सँग सम्बन्धित प्रचलित कानूनहरूको बारेमा सचेतनामूलक कार्यक्रम सञ्चालन गरिने छ।

सामाजिक तथा सांस्कृतिक वातावरण

प्रतिकूल प्रभाव

प्रस्तावित सडकको क्षेत्राधिकार भित्र ६४ घरधुरीका जम्मा ६६ वटा संरचनाहरूलाई यस आयोजनाले प्रत्यक्ष असर गर्ने देखिन्छ। प्रभावित ६४ घरधुरी मध्ये २५ घरधुरीले आवास मात्र

गुमाउने छन्, ३५ घरधुरीले व्यापारिक घरहरू गुमाउने छन् र अन्य ४ घरधुरीले आवास तथा व्यवसाय गुमाउने छन् । यसको साथै २०४ जति अन्य विस्तारित आवास संरचनाहरू (घरको छहारी आदि) र ४ वटा पेट्रोल पम्पका विस्तारित संरचनाहरू हटाउनुपर्ने देखिन्छ ।

यस आयोजनाबाट थप २१६ वटा सार्वजनिक/सामुदायिक संरचनाहरू जस्तै: ३५ साना मन्दिर, ८ इनार, ५५ बरपिपल चौतारा, ६९ प्रतीक्षालय, ५ गेट, १२ पर्खाल, ४ पुलिस बिट, ३ सार्वजनिक शौचालय, २ विद्यालय (महेन्द्र अदर्स मा. बि. र नेपाल राष्ट्रिय मा. बि. पथलैया) को विस्तारित संरचनाहरू, ३ हाटबजारको छानो, १ सैनिक सुरक्षा जाँच पोष्ट, २ प्रहरी जाँच पोष्ट, १ प्रहरी प्रतीक्षालय र १६ वटा सैनिक ब्यारेकका संरचनाहरू प्रभावित हुनेछन् । यस बाहेक सडक चौडा बनाउँदा २२२१ विद्युतीय पोल र ३३१६० मि. पानीको पाइप लाइनमा बाधा पुग्न सक्छ ।

न्यूनीकरणका उपायहरू

प्रभावित हुने निजी संरचनाहरूको क्षतिपूर्ति दिनको लागि पुनर्वास कार्य योजना बनाइएको छ र यसै कार्ययोजना अनुसार क्षतिपूर्ति दिइनेछ । यसको लागि पुनर्वास कार्य योजनाले रु ८,५४१,००० लागत लाग्ने अनुमान गरेको छ । त्यस्तै प्रभावित सार्वजनिक/सामुदायिक संरचनाहरूको पुनर्स्थापना गरिनेछ । यी संरचनाहरूको पुनर्स्थापनाका लागि कुल अनुमानित स्वरूप लागत रु १००,०५६,०५४.०० आयोजना लागत (BOQ) मा व्यवस्था गरिएको छ ।

विद्युतीय पोल सार्नका लागि नेपाल विद्युत प्राधिकरण सँग समन्वय गरिने छ भने खानेपानी पाइपलाइनका लागि ढल तथा खानेपानी विभाग र सम्बन्धित खानेपानी समुदायसँग समन्वय गरिने छ । विद्युतीय पोल सार्न र त्यस्तै खानेपानी पाइपलाइन र अन्य सार्वजनिक उपयोगिताहरूको पुनर्स्थापना निर्माण व्यवसायीद्वारा गराइनेछ र यसको व्यवस्था आयोजना लागतमा समावेश गराइएको छ । आदिवासी जनजातिको समस्यालाई सम्बोधन गर्न आयोजनाले छुट्टै आदिवासी जनजाति विकास योजना तयार गरिएको छ जसमा आँखा शिविर, तालिमहरू, होर्डिंग बोर्ड जडान गर्ने काम, माझी समुदायमा विद्यालय छोडेका बच्चाहरूको लागि सचेतना आदि गरिने छ । यो योजना कार्यान्वयन गर्न आयोजनाद्वारा ने. रु. २,१८५,००० छुट्याइएको छ र आयोजना लागतमा (BOQ मा) व्यवस्था गरिएको छ ।

त्यसैगरी, आयोजनामा कामदारको व्यवसायजन्य स्वास्थ्य र सुरक्षा र सामुदायिक स्वास्थ्य र सुरक्षाको व्यवस्थापन गरिनेछ ।

बढ्दो जनसंख्याको प्रभाव न्यूनीकरण गर्न उपयुक्त बस्ती योजना र पर्याप्त पूर्वाधार सुविधाको विकास गरिनेछ । आयोजना प्रभावित वडा र नगरपालिका यी योजनाहरूको कार्यान्वयनमा संलग्न हुनेछन् ।

११. निष्कर्ष

कमला-ढल्केबर-पथलैया सडक खण्ड एसियाली राजमार्गको एक हिस्सा भएकोले स्तरोन्नति पछि यस सडकले व्यापार व्यवसायमा पनि वृद्धि गर्नेछ । तराई क्षेत्रमा अवस्थित यस आयोजनाले बाढी र माटोको कटान रोक्न पर्याप्त नदी संरक्षण कार्यहरू प्रस्ताव गरेको छ, र वर्षाको पानीको उचित निकासका लागि ड्रेनेज र क्रस ड्रेनेज संरचनाहरू प्रस्ताव गरेको छ । वातावरणीय र

सामाजिक व्यवस्थापनको कुल लागत पुनर्वास कार्य योजना, जैविक विविधता व्यवस्थापन योजना, आदिवासी/जनजाती विकास योजना र वन्यजन्तु हिँडडुल/आवतजावतको लागि १८ वटा अन्डरपास समेत गरी कूल रु. ३,९०८,८१३,३७७.०७ (शब्दमा तीन अरब नब्बे करोड अठासी लाख तेह्र हजार तीन सय सतहत्तर रुपैयाँ सात पैसा) अनुमान गरिएको छ । यस प्रतिवेदनमा उल्लेख भए बमोजिम वातावरण संरक्षणका उपायहरू अवलम्बन गरी प्रस्तावित सडक खण्ड निर्माण र सञ्चालन गर्न प्रस्तावक प्रतिबद्ध रहेको छ ।

ABBREVIATION/ACRONYMS

AADT	Annual Average Daily Traffic
AD	Anno Domini
ADB	Asian Development Bank
AH2	Asian Highway 2
AHDS	Asian Highway Design Standard
APHA	American Public Health Association
BMP	Biodiversity Management Plan
BOQ	Bill of Quantity
BS	Bikram Sambat
CBD	Convention on Biological Diversity
CBS	Central Bureau of Statistics
CEG	Consulting Engineers Group Ltd.
CFC	Compensation Fixation Committee
Ch	Chainage
CIAS	Civil Informatics and Solutions Pvt. Ltd.
CITES	Convention on International Trade in Endangered Species of wild Fauna and Flora
CRN	Core Road Network
CSC	Construction Supervision Consultant
DCID	Development Corporation Implementation Division
DFO	Division Forest Office
DG	Diesel Generator
DHM	Department of Hydrology and Meteorology
DIA	Direct Impact Area
DLP	Defect Liability Period
DOR	Department of Roads
DWSS	Department of Water Supply and Sewerage
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPR	Environment Protection Rule
ESA	Environment and Social Assessment
ESIA	Environment and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environment and Social Standard
ESS	Environmental and Social Standards
FGD	Focus Group Discussion
GBV	Gender Based Violence
GESI	Gender Equality and Social Inclusion
GESU	Geo-Environment and Social Unit
GIS	Geographic Information System
GON	Government of Nepal

GRID	Green, Resilient, and Inclusive Development
HFL	High Flood Level
iBAT	Integrated Biodiversity Assessment tools
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Association
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IIA	Indirect Impact Area
IPDP	Indigenous Peoples' Development Plan
IPF	Investment Project Financing
IPPF	Indigenous Peoples Planning Framework
JV	Joint venture
KDP	Kamala Dhalkebar Pathalaiya
KII	Key Informant Interview
Km	kilometer
LA	Labour Act
LBL	Lowest Bed Level
LMP	Labor Management Procedures
LS	Lump Sum
M	Meter
MoALD	Ministry of Agriculture and Livestock Development
MoFE	Ministry of Forests and Environment
MoICS	Ministry of the Industry Commerce and Supply
MOPIT	Ministry of Physical Infrastructure and Transport
MSA	Millions Standard Axles
NAAQS	National Ambient Air Quality Standard
NBC	National Building Code
NDWQS	National Drinking Water Quality Standards
NEA	Nepal Electricity Authority
NEIAG	National Environmental Impact Assessment Guidelines
NNM	Nagdhunga Naubise Mugling
NP	Nepal
NRS	Nepal Road Standards
NTFP	Non-Timber Forest Products
OHS	Occupational Health and Safety
PBM	Performance Based Maintenance
PCU	Passenger Car Unit
PM	Particulate Matter
PPE	Personal Protective Equipment
PUP	People Under Pass
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
RoW	Right of Way
RPF	Resettlement Policy Framework
SCDP	Safe Corridor Demonstration Program

SEA/SH	Sexual Exploitation and Abuse/Sexual Harassment
SEP	Stakeholder Engagement Plan
SQL	Structured Query Language
SRCTIP	Strategic Road Connectivity and Trade Improvement Project
STATA	Statistics and Data
TOR	Terms of References
TSP	Total Suspended Particles
TSP	Total Suspended Particulate
USDA	United States Department of Agriculture
USSR	Union of Soviet Socialist Republics
VPD	Vehicle Per Day
VUP	Vehicle Under Pass
WB	World Bank
WWF	World Wildlife Fund
ZOI	Zone of Influence

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

1.1 Name and Address of the Project Proponent

Ministry of Physical Infrastructure and Transport (MoPIT), Department of Roads (DOR), Development Corporation Implementation Division (DCID), Babarmahal, Kathmandu is the proponent for upgrading the Kamala-Dhalkebar-Pathalaiya (KDP) road section of Mahendra Highway. DCID is going to upgrade this road section through the Strategic Road Connectivity and Trade Improvement Project (SRCTIP) funded by the World Bank (WB under IDA credit no 6673-NP & 6674-NP)

The address of the Proponent is:

Government of Nepal
Ministry of Physical Infrastructure and Transport
Department of Roads
Development Corporation Implementation Division (DCID)
Babarmahal, Kathmandu, Nepal
Phone No.: 977 1 5541686
Email: dorfcb@dor.gov.np

1.2 Name and Address of the Consultant

Joint venture of Consulting Engineers Group Ltd. and Civil Informatics and Solutions Pvt. Ltd. (CEG-CIAS JV) is the Consultant for preparation of Environment and Social Impact Assessment (ESIA) Study of Kamala-Dhalkebar-Pathalaiya Section with associated Bridges of the Mahendra Highway, including Environmental Impact Assessment (EIA).

Full address of the Consultant is as follows:

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Chakupat, Lalitpur, Nepal
Tel: +977-1-5260314
Fax : +977-1-5260152
Email: info@cias.com.np, Web : www.cias.com.np

Approved TOR is given in **Annex 1** and study team composition as per TOR and their declaration is given in **Annex 2**.

1.3 Rationale for EIA

As per Schedule 3 (E) 6, Transport Infrastructure Sector pertaining to Rule 3 of EPR 2077, EIA is required for upgrading, rehabilitating or reconstructing a national highway or feeder road with a length of more than 50 km. As the proposed road section is part of Mahendra Highway (National Highway) with length 130 km, EIA is required before upgrading the proposed road section. As per Nepal Gazette published in 2030/03/20 BS, area within 25 m left and 25 m right from central line of the road lies within the jurisdiction of the road. Construction works will be limited only within this area only and no forest land or other land

from protected area is required for the proposed project. The project is funded by the World Bank; hence, the report is prepared in English language.

Around 60.61 km of road alignment section is adjoining to forest land. Similarly, Parsa National Park lies towards norther part of the road alignment from chainage 350+050 to 363+750 (beyond RoW of Project Road). Upgrading works will be done within RoW of the road only and no extra forest land is required for the project.

EIA of the proposed project is also required to address the environmental concerns such as air, noise and water pollution arising from road construction, as well as its consequences to local communities, traffic congestion, and disruption to highway traffic flow. EIA also addresses issue regarding disturbances to wildlife habitat and their movements and clearance of vegetation.

1.4 Objective of EIA Study

In general, the objective of EIA study is to establish environmental baseline information, identify both beneficial and adverse environmental impacts, analyze their significance, determine nature, magnitude, extent, and duration of impacts and mitigation measures, formulate appropriate enhancement and mitigation measures, propose environmental management and monitoring plan for effective implementation and make easier for decision makers to take decision on the project selection from environmental perspective. More specifically, the objectives of the EIA study are:

- to identify, study and document the existing physical, chemical, biological, economic and social and cultural environmental baseline conditions in the project area
- to identify, predict and evaluate both the beneficial and adverse impacts in terms of both direct and indirect, including definition of their magnitude, duration and extent in the context of areas affected and durability of impacts that are likely to arise from the implementation of the road project
- to formulate and propose suitable augmentation measures for enhancement of beneficial impacts and, appropriate and practical mitigation measures for adverse impacts incorporating provision of necessary environmental and social safeguards during project design, construction and operation plans
- to formulate an environmental management and action plan ensuring implementation of mitigation measures with proposed responsibilities including monitoring provisions

1.5 Limitation of the Study

The study is limited to one-time data collection. Further, household survey for collection of socio-economic study is limited to 20% household survey within direct impact zone.

CHAPTER 2: INTRODUCTION OF THE PROPOSAL

2.1 Background

East-West Highway also known as Mahendra Highway is one of the major highways of Nepal that runs east to west throughout the country on the southern side just below the chure range. This highway is also a part of Asian Highway (AH2) that originates from Dhaka in Bangladesh and ends in New Delhi in India. Proposed Kamala-Dhalkebar-Pathalaiya road section (130 km) is a part of Mahendra Highway: Chainage 236+698 to 366+887.

The section of Kamala – Dhalkebar (21 Km) of Mahendra Highway was constructed in the year 1970, which was funded by the Government of India. The section from Dhalkebar-Pathalaiya (109 Km) was constructed later in 1974 with assistance from the then USSR. Both of these sections were upgraded to two-lane standards only in 1990. The existing bridges at Kamala- Dhalkebar section are of two-lane standard while the bridges at Dhalkebar - Pathalaiya section are of intermediate lane (5.5 m width) standard. The bridges are the prime cause of the traffic congestion on that section of the highway. The passenger and freight traffic have been increasing as a result of trade enhancement. The recent regional trade agreements with neighboring countries for further enhancement of trade necessitates the standard of road needs to be upgraded to match with the Asian Highway Standards (Class I) and Nepal Road Standards 2070 (Class II). In order to enhance road capacity and efficiency in the road transport, GON, DoR intends to upgrade the KDP section (130 Kms) of the Mahendra Highway under the proposed project from 2-lane to 4-lane road under SRCTIP Project.

2.2 Relevancy of the Proposal

Kamala-Dhalkebar-Pathalaiya Road section is a part of East-West (Mahendra) highway which is further a part of Asian Highway that connects Nepal with India and Bangladesh. This highway has been playing the major role in trade enhancement of the country along with regional connectivity and possible transit corridor. Further, with an increase in the country's population, there has been an associated increase in the number of vehicles and frequency of travel. At present, most of the road section is hardly 2 lane and most of the bridges are bottle neck creating traffic nuisances. Further, the pitch condition of different sections of the road is deteriorated and have developed potholes. Hence, upgrading existing highway to Asian Highway Standard (2 lane to 4 lane) with safety measures is must.

2.3 Description of the Project

2.3.1 Salient Features of the Project

The proposal is to upgrade KDP road section (130 km) to Asian Highway Standards (Class I) and Nepal Road Standards (Class II). The Green, Resilient, and Inclusive Development (GRID) approach involving a fundamental shift in managing risk and development: from a reactive response to a deliberate and proactive recovery strategy for long-term green growth, climate resilient, and sustainable and inclusive development for all, will be adopted where applicable during different phases of the proposed road development. The road will be upgraded from 2 lanes to 4 lanes (18 m width, 7 m on either side with 4 m center median). Service roads of width 6.5 m each will also be constructed in either side in urban areas.

Depending upon the nature of area where the road section passes, two types of cross-sections are proposed to upgrade the existing road: Cross-section for urban areas and cross-section for rural areas (**Annex 3**)

Salient features of the Project are given in **Table 2-1**:

Table 2-1: Salient Features of the Project

Name of the Project		Upgrading of Kamala-Dhalkebar-Pathalaiya Road section of Mahendra Highway	
Location			
Province		Madhesh	
Start Point		Kamala Bridge (Ch: 236+698) 26°52'40.73"N latitude and 86° 8'24.20"E longitude	
End Point		Pathalaiya Junction (Ch: 366+887) 27°11'57.66"N latitude and 84°58'50.76"E longitude	
Name of District and Municipalities		Siraha District: a) Karjanha Dhanush District: a) GaneshmanCharnath Municipality, b) Dhanusadham Municipality, d) Mithila Municipality Mahotari District: a) Bardibas Municipality, b) Gaushala Municipality Sarlahi District: a) Ishworpur municipality, b) Lalbandi municipality, c) Hariwan Municipality, d) Bagmati Municipality Rautahat District: a) Brindaban Municipality, b) Chandrapur Municipality, c) Gujara municipality Bara District: a) Nijgadh Municipality, b) Kolhabi Municipality and c) Jitpur Simarasub Metropolitan City.	
Major Settlement		Godar Bazar, Birendra Bazar, Dharapani, Puspapur, Dhakebar, Badahari, Lalgadh, Bardibas, Phuljor, Raniganj, Lalbandi, Nawalpur, Harion, Bagmati, Chandrapur, Nijagadh and Pathalaiya.	
Geographical Feature			
Terrain		Plain	
Geology		Alluvial deposit with deep to very deep, poorly drained, high-water table, and silt to silt loam textures	
Altitude (maximum and minimum)		Maximum 227 at Ch 266+300, Bardibas and minimum 105 at start (Kamala river)	
Climate		Tropical/Subtropical	
		Existing	Proposed
Road Classification			
Classification		Class II as per NRS 2070	Class II as per NRS 2070 and Class I as per AHDS
Length of Road		130 km	130 km
Road Pavement			
Sub-base Material		15 cm	20 cm
Base Material		10 cm	25 cm
Dense Bituminous Macadam		0 cm	9 cm for 40 and 60 MSA and 10 for 75 MSA
Wearing Course		DBST (5-10 cm)	Asphalt Concrete (4 cm for 40 MSA and 5 cm for 60 MSA and 75 MSA)
Cross-section			
Right of Way		50 m	50 m
Carriageway Width		7.0m (Average)	18 m (7.0 m on either side with 4 m center median), further 6.5 m service

Upgrading of Kamala-Dhalkebar-Pathalaiya Road section of Mahendra Highway		
Name of the Project		
		road width in either side of roads in urban areas.
Formation Width	(10 – 12) m	24 m
Shoulder Width	1.2 m	2.5 m
Side Drain (Width)	Side Drains are available at Dense settlement area	Open drain in rural areas and trench type with cover for footpath in urban areas
Design Standard		
Standard		NRS-2070
Design Speed		100 kmph
Gradient (Maximum and Minimum)		5 %
Minimum Radius of the Horizontal Curve		Maximum as per design and minimum should be at least 870 m as per NRS-2070.
Camber		2.5 %
Super Elevation		7 %
Crossings		
Bridges (Locations)	76	60
Culverts (Locations)	122	148
Causeway (Locations)	23	0
Cut and Fill		
Cut		221,591 cubic meters
Fill		5,018,645 cubic meters
Traffic Data (January 2022, Base Year Traffic)		
AADT, Vehicle/day	13249 at Kamala-Dhalkebar section and 8306 at Nijgadh-Pathalaiya section	
AADT, PCU/day	15386 at Kamala-Dhalkebar section and 12067 at Nijgadh-Pathalaiya section	
Total Project Cost	NPR 36,924,008,363 (In words: Thirty-six billion nine hundred twenty-four million eight thousand three hundred sixty-three)	

Source: Detailed Design Report, 2023

Upgradation works will also address bridges within the road section. It is noticed that there are bridges within 76 crossings (rivers/streams) along the road alignment. 60 additional bridges will be constructed among 60 locations of these crossings. Based on hydraulic calculations total fifteen (15) bridges are converted in to culverts. The bridge branch under DOR is constructing new four lane bridge across - Dudhaura River at present. Details of these bridges is given in **Annex 4**.

It is noticed that most of the streams and rivers within project area are of aggrading nature with siltation/sedimentation problem while only few rivers are either stable or degrading. Major siltation problems observed are in Charnath, Baluwa, Jalad, Basai, Ratu, Bhapsi, Gaushala, Bankhe, Betini, Lakhandei, Lamaha, Dhansar, Pasaha, Dudhaura etc.

For addressing wildlife movement, the project will modify some bridges as animal underpass. For this, 8 bridges will be modified for larger animal movement and additional 9 bridges and one culvert will be modified for medium sized animal movement. These structures have been designed in accordance to Wildlife Friendly Infrastructure Construction Directives, 2022.

2.3.2 Location and Accessibility

KDP road section is a part of Mahendra Highway (Chainage 236+698 to 366+887). The proposed road section starts from Kamala 26°52'40.73"N latitude and 86° 8'24.20"E longitude and ends at Pathalaiya 27°11'57.66"N latitude and 84°58'50.76"E longitude. The road stretch lies within Madhesh Province covering 6 Districts (Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara), 15 Municipalities (Karjanha, GaneshmanCharnath, Dhanusadham, Mithila, Bardibas, Gaushala, Ishworpur, Lalbandi, Hariwan, Bagmati, Brindaban, Chandrapur, Gujara, Nijgadh and Kolhabi) and one sub-metropolitan city (Jitpur Simara).

The Project location along with proposed road alignment and proposed road alignment in google earth is shown in **Annex 5**. Start point of the road section, Kamala is 209 km far from Kathmandu via Kathmandu-Banepa-Dhulikhel-Bardibas (BP-Highway) road and end point of the road section, Pathalaiya, is 110 km far from Kathmandu via Kathmandu-Kulekhani-Hetauda Road. Nearest airport from the road section is at Simara, which is around 6 km far from Pathalaiya. Similarly, Janakpur airport is around 24 km far from Dhalkebar (Ch 257+200).

2.3.3 Existing and Projected Traffic

The traffic survey was carried out for the project in the month of January 2022 by the design team. The entire project road was divided into six homogeneous sections for traffic survey. These homogeneous sections were Kamala-Dhalkebar, Dhalkebar-Bardibas, Bardibas-Nawalpur, Chandrapur-Nijgadh, and Nijgadh-Pathalaiya. The traffic data was collected for continuous from these homogeneous road sections. The vehicles consist of motorised and non-motorised vehicles. The motorized vehicles consist of trucks, buses, cars, utilities vehicles, two wheelers, three wheelers and tractors. However non-motorised vehicles consist of rickshaws, bicycles, and bullock carts. The non-motorised vehicles particularly bullock cart was mainly present in rural areas. The slow-moving vehicles that are rickshaws, bicycles, and bullock carts may face safety issue after improvement of the KDP road as traffic on four lane road will be fast moving traffic. Total traffic was distributed into 11 categories for survey purposes that is Multi-axle Truck, Heavy Truck, Mini truck, Large-bus, Mini bus, Micro-bus, Car, Motorcycle, Utility vehicle, Four-wheeler, and Tractor.

Table 2-2: Traffic Count Result along KDP Road Alignment

S/N	Vehicle Type	ADT, VPD					
		Kamala-Dhalkebar	Dhalkebar-Bardibas	Bardibas-Nawalpur	Nawalpur-Chandrapur	Chandrapur-Nijgadh	Nijgadh-Pathalaiya
1	Multi-axle Truck	1277	1244	851	866	865	796
2	Heavy Truck	731	795	576	682	731	741
3	Mini-truck	133	146	213	229	312	461
4	Large-bus	560	680	716	663	661	791
5	Mini-bus	100	104	134	163	188	138
6	Micro-bus	659	562	371	335	283	180
7	Car	707	719	696	722	722	882
8	Motorcycle	6694	7365	5994	8779	9481	3188
9	Utility vehicle	676	813	670	622	531	449
10	Four-wheel drive	927	1061	754	736	652	711
11	Tractor	165	160	139	284	402	133

Source: Detailed Design Report 2023

On the basis of this data, past trend, and seasonal variation factor the design has estimated Annual Average Daily Traffic (AADT) for each homogeneous road sections. Estimated AADT for base year (i.e. Jan 2022) is given in **Table 2-3**.

Table 2-3: Traffic Estimation for Base Year

S/ N	Vehicle Type	Traffic Jan 2022, VPD					
		Kamala-Dhalkebar	Dhalkebar-Bardibas	Bardibas - Nawalpur	Nawalpur-Chandrapur	Chandrapur-Nijgadh	Nijgadh-Pathalaiya
1	Multi-axle Truck	1200	1169	800	814	813	748
2	Heavy Truck	687	747	542	641	687	697
3	Mini-truck	125	137	201	216	294	434
4	Large-bus	526	639	673	623	621	744
5	Mini-bus	94	97	126	153	176	129
6	Micro-bus	620	529	348	315	266	170
7	Car	665	676	655	679	679	829
8	Motorcycle	6293	6923	5634	8252	8912	2996
9	Utility vehicle	635	764	630	585	499	422
10	Four-wheel drive	872	997	708	692	613	668
11	Tractor	155	150	131	267	378	125

Source: Detailed Design Report 2023

The existing average daily traffic (ADT) was maximum at Chandrapur-Nijgadh section that is 14,828. The existing average daily traffic (ADT) was minimum at Nijgadh-Pathalaiya Section that is 8,470. Further, traffic forecast was performed based on the predetermined growth rates. The Pathalaiya – Nijgadh section of the Project Road was also analyzed for the diverted traffic because the Project Road will have significant influence on diverted traffic after the construction of Kathmandu-Terai Fast Track Expressway originating from Kathmandu and merging the KDP at the Nijgadh. Final Traffic Forecast as for each homogeneous road section is given in **Table 2-4**.

Table 2-4: Traffic Forecast for the Year 2046

S/ N	Vehicle Type	AADT Jan 2046, VPD					
		Kamala-Dhalkebar	Dhalkebar-Bardibas	Bardibas - Nawalpur	Nawalpur-Chandrapur	Chandrapur-Nijgadh	Nijgadh-Pathalaiya
1	Multi-axle Truck	2656	2588	1769	1801	1800	2660
2	Heavy Truck	1521	1654	1199	1419	1521	2294
3	Mini-truck	277	304	444	477	650	1213
4	Large-bus	1043	1266	1333	1235	1231	1874
5	Mini-bus	186	193	250	303	350	402
6	Micro-bus	1228	1048	691	624	528	455
7	Car	2372	2411	2335	2421	2422	4548
8	Motorcycle	40892	44990	36614	53624	57912	19445
9	Utility vehicle	1173	1411	1162	1079	921	891
10	Four-wheel drive	3354	3837	2726	2661	2359	2711
11	Tractor	369	357	310	634	897	297

Source: Detailed Design Report 2023

The projected traffic for the year 2046 AD was maximum at Chandrapur-Nijgadh section that is 70591. The projected average daily traffic for the year 2046 AD was minimum at Nijgadh-Pathalaiya Section that is 36970.

The major settlements in project area are Dhalkebar, Bardibas, Nijgad and Pathalaya. However, second largest traffic was observed in Nawalpur- Chandrapur section and third highest were observed in Dhalkebar-Bardibas section.

It is noticed that 43% of road accidents from FY 2015-16 to 2020-21 occurred in Mithila, Chandrapur and Charnath (Mithila-17%, Chandrapur-15% and Charnath-11%). Lalbandhi and Harion in Sharlahi region experienced 9% and 8% of total accidents on the stretch. Bridge locations had around 9% of total accidents. It is also noted that vulnerable road users (VRUs) are being the most affected in accidents with proportion of 55% (most of them are motorcycles) involved in accidents while 35% vehicular traffic involved in accidents (Detailed Design Report 2023). Mithila, Chandrapur and Charnath locality seems to be accident hot-spots and special attention has been given in the proposed design of these locations in providing facilities in order to minimize accidents.

2.3.4 Construction Approach and Methods

It is suggested that the general construction method of highway construction will be mechanical, however; will be environment friendly. The Green, Resilient, and Inclusive Development (GRID) approach involving a fundamental shift in managing risk and development: from a reactive response to a deliberate and proactive recovery strategy for long-term green growth, climate resilient, and sustainable and inclusive development for all, will be adopted where applicable during design and construction of the proposed road project. Best available technology will be adopted during road upgradation with minimum impact in the environment. Beside compensatory plantation, avenue tree plantations and maintaining greenery in median section will be done. All the structures, mainly bridges and culverts, have been designed considering increased precipitation, runoff and stream flow due to climate change. Beside this, possible disasters, pollution, land degradation, unsustainable land use change and biodiversity loss issues have been considered in the impact and mitigation sections. For construction materials, suitable locations have been identified and extraction of these materials in sustainable manner without disturbing the natural hydrology and geomorphology of river have been proposed. For efficient management of traffic during construction, traffic management plan has been proposed (**Annex 33**) and this plan will be further updated by contractor considering the site-specific issues.

2.3.5 Project Related Activities

Pre- Construction Phase

The project activities identified during this phase are: finalization of design, bidding and selection of the construction contractor and deployment of the supervision consultant, compensation of land (if any), relocation of public utilities, tree felling process including identification and numbering of trees to be felled, identification of land for setting up of temporary contractor camp, labor camps, quarry site and borrow pit identification, material storage yard, preparedness, awareness to contractor's staff, location of storage yards and others etc. As Right of Way (RoW) of the proposed road section is already under DOR and

all the construction activities will be done within RoW, no extra permanent land is required for the project.

Construction phase

The project activities during this phase are:

- Cutting of trees and site clearance,
- Setting up of all construction and labour camps and plants including batching plants, hot mix plants, crushers etc.,
- Commencement of quarrying, and crushing activities,
- Civil works such as earth works, foundation excavation, structure construction, material storage and handling, construction yards and worker's yards construction, grading, pavement, drainage and cross drainage, road embankment, movement of vehicles and equipment, operation of Diesel Generator (DG) sets, crushers etc.
- Construction of structures related to animal pass, water holes (water ponds as water sources for animals), social structures etc.
- Road side plantation, Greenery, etc. (within and beyond RoW)
- Examine the construction induced impacts
- Implementation of Environmental Management Plan (EMP)

Detail activities to be done during construction phase are shown in construction schedule section (section 2.11 below).

Operation Phase

The activities to be performed during operation phase of proposed road are as follows:

- Reinstatement of environment camps, quarry sites, borrow pits, labor camp, material storage yards etc.
- Management of water holes, animal crossings
- Pavement maintenance and rehabilitation works.
- Road furniture.
- Maintain the green area along the road alignment.
- Implementation of EMP

2.3.6 Construction Materials

For construction of the road and other road component, construction material (Sand, Gravel, Stone, Cement, Aggregates, Concrete, Bitumen, lumber, steel etc.) are required. Tentative quantities of major construction materials required for the project are given in **Table 2-2** below.

Table 2-5: Construction Materials Required

Material	Unit	Quantity Required
Soil	Cum	5,185,510.983
Steel	MT	17,499.868
Aggregate	Cum	3,016,627.724
Bitumen	Ton	29,952.594

Material	Unit	Quantity Required
Cement	Ton	220,347.940
Sand	Cum	187,896.742

Source: Detailed Design Report 2023

Rivers along the proposed road alignment have plenty of construction materials (sand, aggregates and stones) that can be used for the project with consent from concerned municipality. Most of the municipalities have even conducted and approved Initial Environmental Examination (IEE) for extraction of river bed materials in sustainable way.

Detailed Design Report of this project has suggested 7 different locations for base and sub base materials – Kamala River (26°55'30.52"N, 86° 8'45.32"E), Ratu Khola (26°59'54.43"N, 85°54'50.19"E), Banke Khola (27°1'10.89"N, 85°44'34.49"E), Maraha Khola (27°0'40.26"N, 85°47'38.00"E), Bagmati River (27° 7'20.95"N, 85°28'37.48"E), Bakaiya River (27°12'31.87"N, 85°10'14.01"E) and Rapti River (27°25'57.48"N, 84°59'11.23"E). Similarly, 4 different locations are suggested for embankment filling materials – Lakhandehi Khola (27° 4'16.87"N, 85°34'34.27"E), Lamaha Khola (27°9'3.43"N 85°17'49.57"E), Dhansar Khola (27° 9'23.52"N, 85°14'43.78"E) and Chandi Khola (27° 7'1.07"N, 85°22'26.05"E). The detailed of these quarries and borrow pit sites are described in **Annex 6**.

These materials will be extracted as per standards related with extraction sale and management of stone, aggregates and sand, 2077. Beside this, construction materials can also be sourced from authorized suppliers/crusher plants. Other materials like bitumen, cement, steel etc. can be sourced from market centers along East West Highway.

2.3.7 Associated/Ancillary Facilities

For the proposed project, different associated/ancillary facilities are required like labor camps, construction camps (including construction equipment storage yards, workshops, stockpiling yards, crusher plant sites, hot mix plants, batching plants etc.) and quarry and borrow pit area. As establishment of these facilities can have significant impact in land use, their site selection needs to be done considering distance from dense settlement areas, water bodies, sensitive areas like schools and hospitals etc. For labor camps, construction equipment storage yards, workshops and stockpiling yards, lands adjoining the road alignment will be leased (possible chainages at 237+700 (26°52'34.67"N, 86° 8'2.29"E), 241+430 (26°53'26.93"N, 86° 6'2.02"E), 260+800 (26°57'4.60"N, 85°55'51.88"E), 290+500 (27° 2'17.62"N, 85°40'21.64"E), 311+000 (27° 7'6.87"N, 85°29'39.29"E), 325+100 (27° 6'50.21"N, 85°22'14.70"E) and 346+900 (27°10'48.36"N, 85°10'19.33"E)). For labor camps, existing house along the road alignment can also be rented. Even for crusher plant sites, hot mix plants, batching plants, lands away from dense settlements will be leased (possible chainages at 237+400 (26°52'35.18"N, 86° 8'11.59"E), 262+000 (26°57'41.53"N, 85°55'47.90"E), 305+500 (27° 5'33.74"N, 85°32'23.89"E) and 343+600 (27°10'8.30"N, 85°12'0.66"E)). It is estimated that around 7 ha of land is required temporarily for these associated/ancillary facilities. Quarry sites and borrow pits locations have been discussed above in section 2.2.6.

2.3.8 Source of Construction Water

Ground water is the main source of water that can be used for construction purpose. Ground water will be extracted from places where associated/ ancillary facilities will be installed. As

per detailed design report 2023, it is noticed that the ground water depth along project alignment ranges from minimum of 1 m to 13 m. Ground water will be used with necessary statutory permissions of concern department of GON. Beside ground water, surface water can also be used by contractors if available in the vicinity of the project area but only after receiving approval from local level.

2.3.9 Use of Energy and Energy Saving Measures During Project Implementation

The power requirement for construction will be approximately 2000 KVA will be made available through national grid supply and for power backups Diesel Sets will be used. During project implementation, the construction contractor should provide the alternative sources of energy for workers, such as gas or kerosene stoves to prevent pressure on natural forests in the project area. Contractor will avoid using fuelwood for the construction purpose and for cooking purpose in labour camps. Contractor will establish fuel storage yard near the proposed campsites to manage and control the sustainable use of diesel and other energy resources required during construction. Other measures will include economy of energy and resources, when possible in the project cycle to minimize energy use and avoid pressure on natural resources.

2.3.10 Labour and Working Conditions

The proposed project will involve a large number of skilled and unskilled labors during the construction in various phases. It is estimated that around 1000 labours per day will be engaged in this road project among which there will be about 600 migrant workers.

Occupational Health and Safety (OHS) risk is likely to be high based on previous project experience. The expected risks relate to potential for injury, traffic-related accidents, fall from height, poor working and living conditions of workers, use of hazardous chemicals, handling of heavy load, long working hour, risk of radiant heat and cold, exposed to mechanical risk, electric risks, and lack of PPEs.

Specific requirements to manage or mitigate risks associated with labour influx, related to the interaction between project workers and local communities, such as communicable diseases and gender-based violence, most specifically sexual exploitation, abuse and sexual harassment, will be managed through contractual requirements, code of conduct and training set out in this document. These procedures are guided by LA, 2017 and ESS2.

Detail about occupational health and safety, labour welfare and labour working condition as per GON and guidelines of WB ESS2 are given in **Annex 7**.

2.3.11 Construction Schedule

It is estimated that the construction of proposed road section will be completed within three years. Construction Schedule of the proposed road upgradation works is given in **Annex 8**. The construction of proposed road project will be implemented through the contractors under different packages. **Delays in road construction, as witnessed in other areas, pose significant environmental risks, included prolonged exposure to pollution, habitat fragmentation, and economic decline in towns and destinations. Hence, strict clauses will be added in bidding documents to ensure timely completion of the project within the construction schedule and implemented strictly by the proponet.**

CHAPTER 3: METHODOLOGY ADOPTED

This EIA Report has been prepared following the Environment Protection Act (EPA) 2076, Environment Protection Rule (EPR) 2077 and Scoping Document and ToR approved from Ministry of Forest and Environment on 2080/01/11 as per ministry level decision of GoN. Following approach and methodology were adopted during the EIA report preparation.

3.1 Desk Study

Secondary information was collected through published and unpublished reports and interpretation of maps and photographs. The sources of information were World Bank and DoR/GESU documents and manuals, municipal profiles, other line agencies, related NGOs and other project offices in the ward, review of national and international legislations,

Climate Data was collected from Department of Hydrology Meteorology (DHM). For this, precipitation, temperature, humidity and average wind speed data from year 1985 to 2022 from DHM stations at Simara Airport (index no. 909) and Karmaiya (index no. 1121) were collected and analysed.

Further, rainfall analysis and catchment characteristics of major drainage outlets within project area have been taken from Detailed Design Report of KDP 2023.

Altitude and Landscape data of the subproject area were taken from topographic map, survey data and observation. Land use pattern of the study area were derived from review of topographical map, Google map and GIS map of the area.

For geological analysis of the project area, reference from geological map of Nepal (modified from Dahal 2006) and ICIMOD (rds.icimod.org) was obtained. Further, geotechnical analysis from Detailed Design Report of KDP 2023 has been referred.

For seismic data, reference from seismic zoning factor as per National Building Code (NBC 105:2020) has been collected.

For socio-economic and cultural environment, demographic data were collected from CBS, municipality profiles and websites of project municipalities.

3.2 Delineation of Project Area

The delineation of the project area is important for identifying the potential environmental and social risks associated with the project, and for developing strategies to mitigate those risks. The project affected municipalities are considered to be within the Project Influence Area or Zone of Influence (ZOI). The impact area has been further categorized into following as per ToR.

3.2.1 Right of Way (RoW)

Twenty-five meters both sides from center line of the proposed road have been considered within RoW of the proposed road. As per the declaration published in Gazette in 2034 BS. (1977 AD), all the land within 50 m (i.e. 25 m either side from central line of the road) is considered to be within the boundary of the road (**Annex 9**). As the road widening will be done within RoW only, no extra land is required permanently for the project.

3.5 Field Study

3.5.1 Walk Through Survey

The EIA team have performed walk through survey throughout the proposed road alignment and its surrounding visiting the significant environmental features and make necessary measurements, inspect/observe and discuss it with the local stakeholders at different time intervals throughout the study time. The information was collected covering the physical, biological, socio-economic and cultural aspects of the environment.

3.5.2 Physical Environment

Air quality, noise level, water quality and soil quality of the project area (within DIA) have been monitored for establishing baseline data. The study was carried out from 2022/10/16 to 2022/10/25. Beside this, critical sections along the road alignment like water logging areas, sedimentation problem in rivers, river bank erosion etc. were observed during the field survey.

3.5.3 Biological Environment

EIA biological team was mobilized from 25th to 27th January 2022, 31st May to 5th June & February 7th to 14th 2023 for collection of baseline information on biological environment. Further, field level assistants and surveyor were mobilized for field work and survey during month of May and June. As a part of field work tree census within RoW (measuring diameter and height of each vegetation type), and quadrat survey and wildlife survey within DIA were carried out.

For vegetation analysis, all together 41 quadrats of size 10x10 were laid down adjacent to the road corridor. All herbs, shrubs and trees falling within each quadrat were noted down.

Visual observation of mammals both by eye and using 10x binoculars; registration of field signs of wild mammals, including animal tracks, faeces, digging, burrows, dead animals, etc. and photographing the animals, their tracks and traces of their vital activity, typical habitats facilitated by geotagged photographs with GPS enabled camera SONY DSC-HX300 were done. Similarly, attempts were made to assess the status of reptiles and amphibians in the study area (specification of the species, territorial distribution, including places of concentration, the state of habitats). The field survey conducted a mix of stationary point surveys and transect surveys which were focused on representative habitats across the proposed Project area.

3.5.4 Socio-economic and Cultural Environment

All the structures within RoW and that are to be damaged due to project activities were identified and consulted with affected households/communities. Similarly, cultural sites within and near the RoW were also observed. Census survey within all the households directly affected due to project activities (i.e. 64 households within RoW) have been done. Further, in order to access the socio-economic status of households within the project area, sampled household survey was carried out within the direct impact zone (DIA) of the project area. For this, households within DIA were divided into seventy-one clusters as per the settlement pattern. All the households within these clusters were considered as universe. All together there were 4,290 households within the universe or DIA. Among the universe, one out of five

households (20 percent households, in total 858 HHs) were selected using systematic random sampling method for household survey. The selected household was interviewed using structured questionnaire for household survey to collect socio-economic data/information at household level. Both qualitative and quantitative data/information was collected for baseline condition and likely impact assessment.

3.5.5 Verification of Secondary Data

Secondary data collected during desk study mainly for environmental factors, including geology, land use, climate, river networks and crossings, as well as topography and terrain were further verified during the field visit. Visual observation and consultations were carried out for verifying these data.

3.6 Sample Collection and Analysis

Air Quality and Noise Level: For collection of baseline data of air quality and Noise level, the 5 representative locations along the alignment were identified (**Annex 11**). The high-volume air sampler was used for air quality monitoring of the project area. The air sample for 24 hours collected and analysed for Particulate Matter (PM10), Particulate Matter (PM2.5), Total Suspended Particulate Matter (TSP), Sulphur Dioxide (SO2) and Nitrogen Dioxide (NO2). Similarly, Noise Level Meter (REED R8080) was used for noise level monitoring. Decibel (dB) recording interval was set to 2 seconds.

Water Quality: For water quality, samples of river water from 4 locations, drinking water/ground water from 7 locations, pond water from 1 location and wetland water from 1 location (as given in **Annex 11**) were collected and analysed in lab. Temperature and dissolved oxygen (DO) were measured at site itself where as other parameters were analysed in lab. The analysis was done as per American Public Health Association (APHA) 23rd edition. **Soil Quality:** For soil quality, soil samples from 5 different locations (agricultural lands) were collected and analysed in laboratory. Sampling locations, chainages and sampling dates are given in **Annex 11**.

Representative locations were chosen as per distance between sampling locations and nature of sampling sites.

3.7 Data Analysis

The data collected through various tools and sources were analyzed using both descriptive and statistical methods. Qualitative data of physical, biological and socio-economic and cultural environment were analyzed using software like EXCEL, WORD, GIS etc. Further, databases such as iBAT (Integrated Biodiversity Assessment tools) was used to generate list species found within 50 km buffer from the proposed road alignment and screened as per secondary literatures, consultations and field verification. For socio-economic analysis, the collected data were compiled and analysed using data analysis application software called Ms-Access and STATA. All the hard copies of filled questionnaires were coded and converted into digital data through the data entry application developed in Ms-Access software. After completion of data entry, data cleaning work was performed in Ms-Access by using SQL queries tools. Outlier data were removed/cleaned. After data cleaning, data were converted into STATA format for data analysis, where all the variables were decoded and

levelled as per STATA. The outcomes or result were then tabulated in excel format with frequencies and percent for reporting. The analyzed data were then interpreted and discussed in appropriate sections of EIA. Necessary tables, figures and charts have been presented in the related sections.

3.8 Methods of Identification, Prediction and Evaluation of Environmental Impacts

i. Impact Identification: Based on field visit observation, measurements, and consultation meeting with local, issues that may trigger due to subproject intervention was identified and prioritized.

ii. Impact Prediction: Extrapolative (i.e. predictions on the basis of past and present data, and trend analysis), and experts experience and judgment (applying past experience and knowledge of the experts) methods were applied for impact prediction on the basis of identified impacts.

iii. Impact Evaluation: Checklists and expert judgments were used for identifying and predicting impacts. The numerical scales for impact evaluation are shown in the **Table 3-1** below.

Table 3-1: Numerical Scales for Impact Evaluation

Magnitude	Score	Extent	Score	Duration	Score
High/Major	60	Regional	60	Long- term	20
Moderate	20	Local	20	Mid -term	10
Minor	10	Site specific	10	Short-term	5

Source: National EIA Guideline, 1993

The cumulative scores level of significance greater than 75 was considered to be very significant, from 45 to 75 was considered to be significant and less than 45 was considered to be insignificant as per National Environmental Impact Assessment Guidelines (NEIAG), 1993.

3.9 Preparation of Draft Report

Environment management plan and monitoring plan and were compiled and draft report was prepared. Impact mitigation measures were identified from the analysis of the negative environmental impacts that the project might induced on the local environment and included in the environmental study report as per Schedule-12 of EPR, 2020.

3.10 Public Consultations, Discussion, Interaction and Public Hearing

Forty six group discussions were carried at different locations of Ganeshman Charnath, Dhanushadham, Mithila, Bardibas, Lalbandi, Hariyon, Bagmati, Chandrapur, Nijgadh Municipality and Jitpur Simara Sub metropolitan City from May to June, 2022. Total 663 participants took part with Bahun/Chhetri-254, Adiwas/Janajati-186, Madhesi-172, Dalit-38, and Muslim-13. Along with consultations, key persons within the project area (Mayor, ward chief, local leaders, school teachers, division forest officers, warden and other officers of Parsa National Park etc.) were interviewed for knowing the environmental, biological and socio-economic and cultural setting within project area. Altogether, 44 KII were conducted along the road alignment.

The supplementary consultations were carried out at 12 different locations of the affected Municipalities focusing on directly affected people (21 females and 111 males out of 132 participants) in October 2022. Nine focused group discussions were also done among indigenous settlements within the project area (among the people of Tamang, Majhi, Magar, Bote, Newar and Danuwar community) for identifying their view on the project and their aspects from the project based on which IPDP has been prepared.

Public hearing at 7 different locations were conducted within the project area as per rule 6 (1) of EPR 2077 B.S. to collect comments and suggestions from related stakeholders including local people, users' groups, and local representatives. The notice for public hearing was published on 2080/01/28 in "Janakpur Express" (**Annex 12**). The meeting minutes and summary of Public Hearing are presented in **Annex 13**. Representatives from different stakeholders including Division Forest Offices, Community Forest User's Groups, Collaborative Forest User's Groups and Parsa National Park had taken part in these public hearings. Issues raised during public hearing and their incorporation from Project is also given in Annex 13. Similarly, separate meeting was held with officials from Parsa National Park on 2080/09/18. Meeting minute is shown in **Annex 13**.

3.11 Public Notice, Communication and Collection of Suggestions

As per rule 7(2) of EPR 2077, a 7 days' public notice (**Annex 14**) was pasted in offices of local level affected due to the project, health posts, educational organizations, etc. in the format provided in EPR Schedule 9 and deed of inquiry (Muchulkas) was obtained. After this, the similar notice was published on national newspaper (Prabhab National Daily on the date 23rd July 2023) as per rule 7(3) of EPR, 2077. To collect the suggestions and recommendation (**Annex 15**) the proponent sent a letter to local government. They provide the recommendation and suggestions to the proponent within 15 days of time frame as per rule 8(9) of EPR, 2077.

Suggestion from Division Forest Office Bara and Sagarnath Forest Development Project:

As this road alignment mostly passes through forest, wildlife friendly (including over pass, under pass, monkey canopy) road should be constructed for facilitating wildlife movement.

- Provision of under pass (8 for large mammals and 10 for medium sized mammals) and canopy bridges at 6 locations has been suggested.

Tree plantation in other location should be managed for removed trees while upgrading highway as per provision in law.

- The cost for the compensatory plantation and caring for 5 years has been estimated and will be deposited in the Forest Development fund as per the law. Suitable locations for plantation suggested.

Green belt should be made left and right side of the highway

- Avenue tree plantation suggested along the road alignment

Suggestion from Division Forest Office Rautahat:

As this road alignment mostly passes through forest, wildlife friendly (including over pass, under pass) road should be constructed for facilitating wildlife movement.

- Provision of under pass (8 for large mammals and 10 for medium sized mammals)

and canopy bridges at 6 locations has been suggested.

Tree plantation in other location should be managed for removed trees while upgrading highway as per provision in law.

- The cost for the compensatory plantation and caring for 5 years has been estimated and will be deposited in the Forest Development fund as per the law. Suitable locations for plantation suggested.

Green belt should be made left and right side of the highway

- Avenue tree plantation suggested along the road alignment

While upgrading the road, activities like camp establishment, heating of bitumen etc. should not be done within forest area.

- Locations far from forest area suggested

Unnecessary access roads/diversions should not be constructed in forest sections while constructing highway

- Suggested accordingly in mitigation section

Vehicles emitting less smoke dust should be used while upgrading the highway

- Suggested accordingly in mitigation section

Haphazard vehicle stoppage sites should not be constructed within forest sections

- This has not been considered in design and will further restricted during construction

Plantation to be done due to use of forest land should not be done in open space of forest, rather should be done by purchasing land and growing of plants should be done by road office.

- Proposed project will not require forest land as all the upgrading works will be done within RoW of the road. For felling of roadside trees, the project will transfer cost required for compensatory plantation in the ratio 1:10 and care for 5 years to Forest Development Fund.

Waste within forest sections during construction of highway should be managed by Road Office and hoarding board related to this should also be managed.

- All construction related waste will be managed by the project and has been included in mitigation section.

3.12 Final Report Preparation by Incorporation of Suggestions

Final report was prepared by incorporating all the possible suggestions and submitted for final approval.

CHAPTER 4: POLICIES, ACTS, RULES, GUIDELINES, INTERNATIONAL CONVENTIONS RELATED WITH THE PROJECT

The Environment Protection Act (EPA) 2019 is the umbrella act that forms the basis for environment protection of the nation. Environment Protection Rule (EPR) 2020 formed under EPA 2019 further elaborates procedures to be adopted for environment protection and punishments/fines in case of not meeting the criteria. Beside these, there are many general and sectoral policy, plan, acts, rules, guidelines, standards and conventions/agreements that has to be followed during planning, designing, constructing and implementing the proposed road project. These are mentioned hereunder

Constitution

- Constitution of Nepal

Policy and Plan

- National Gender Equality Policy 2077
- Fifteenth Plan (2076/77 – 2080/81)
- National Environmental Policy 2076
- National Climate Change Policy 2076
- National Occupational Health and Safety Policy, 2076
- National Forest Policy, 2075
- National Land Use Policy 2072
- Land Acquisition, Resettlement, and Rehabilitation Policy for Infrastructure Development Project 2071
- National Wetland Policy 2069
- National Child Policy 2069
- National Transport Policy 2058

Acts

- Environment Protection Act, 2076
- Forest Act 2076
- Land Use Act 2076
- The Act Relating to Children, 2075
- Local Government Operation Act 2074
- Labour Act, 2074
- The Act Relating to Rights of Persons with Disabilities, 2074
- The National Civil (Code) Act, 2074
- Control of International Trade of Endangered Wild Fauna and Flora Act, 2073
- The Sexual Harassment at Workplace (Prevention) act 2071 (Amendment 2075)
- Solid Waste Management Act, 2068
- Human Trafficking and Transportation (Control) Act, 2064
- Child Labor (Prohibition and Regulation) Act, 2056

- Water Resource Act, 2049
- Soil and Watershed Conservation Act, 2039
- Land Acquisition Act, 2034
- Public Road Act 2031
- National Parks and Wildlife Conservation Act, 2029
- Ancient Monument Preservation Act 2013

Rules and Regulations

- Forest Regulation 2079
- Land Use Regulation 2079
- Environment Protection Rule, 2077
- Disaster Risk Reduction and Management Regulations, 2076
- Control of International Trade of Endangered Wild Fauna and Flora Rule 2076
- Labour Rule 2075
- Solid Waste Management Rule 2070
- Child Labor (Prohibition and Regulation) Rule 2062
- Soil and Watershed Conservation Rule 2042
- National Parks and Wildlife Conservation Rule 2030

Guidelines

- Wildlife Friendly Infrastructure Construction Guidelines 2078
- Environmental and Social Management Framework (ESMF), 2077, SRCTIP – Trade Component, MoICS/MoALD
- Indigenous Peoples Planning Framework (IPPF), 2076, SRCTIP, Trade Facilitation Component, MoICS and MoALD
- Labor Management Procedures (LMP), 2076, SRCTIP, DCID, DOR, MoPIT
- Resettlement Policy Framework (RPF), 2076, SRCTIP, DCID, DOR, MoPIT
- Stakeholder Engagement Plan (SEP), 2076, SRCTIP, DCID, DoR, MoPIT
- Green Infrastructure Design for Transport Projects, A Road Map to Protecting Asia's Wildlife Biodiversity, 2075, ADB
- Gender Equality and Social Inclusion (GESI) Operational Guidelines 2074, MoPIT
- Forest Product Collection and Sale Distribution Guidelines 2073
- Nature Conservation National Strategic Framework for Sustainable Development 2072
- Accessible Physical Structure and Communication Service Directive for People with Disabilities 2069
- Environmental and Social Management Framework (ESMF) GESU-DoR, GoN 2064
- Environmental Management Guidelines, Geo Environmental Unit, DoR, 2053 (1997 AD)
- National Environmental Impact Assessment Guidelines 2050

Standards

- Tolerance limits for different industrial effluents discharged into Inland Surface Water, 2080

- National Drinking Water Quality Standards, 2079
- Standards related with extraction sale and management of stone, aggregates and sand, 2077
- Maximum Noise Level Standard at workplace, 2073
- Standards regarding removal of government trees 2071
- Nepal Road Standards 2070
- National Ambient Air Quality Standards 2069
- Noise Level Standard of Nepal 2069
- Nepal vehicle mass emission standard 2069
- National Diesel Generator Emission Standard 2069
- Nepal Bridge Standards 2067

Conventions/Agreements

- Paris Agreement under the United Nations Framework Convention on Climate Change, 2015 A.D.
- SIACM (2006) A.D.
- Rio de Janeiro Convention on Biological Diversity (CBD, 1992 A.D.)
- Convention 182 on The Worst Forms of Child Labour, 1999
- Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997 A.D.
- United Nations Framework Convention on Climate Change, 1992 A.D.
- Indigenous and Tribal Peoples Convention 1989 (No. 169)
- ILO Convention 169
- Basel Convention on The Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989
- Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES 1973 A.D.)
- The Ramsar Convention 1971

Brief review of these relevant national environmental legislations including constitution, policies and plans, acts and regulations, manuals/guidelines, international conventions and treaties, and standards has been carried out and presented in **Annex 16**.

CHAPTER 5: EXISTING ENVIRONMENTAL CONDITION

The baseline conditions are the standard against which projected future conditions are compared with project alternatives. In this chapter we are describing the baseline environmental and social conditions of KDP project area which is passing through six districts.

5.1 Physical Environment

The physical environment of project area consists of topography, climate & hydrology, geology, seismology, land use & landscape, and Environmental quality of the project area. These physical features of project area are described in following sections.

5.1.1 Topography and Land use

The proposed alignment passes through flat topography of Terai region. The road alignment starts from Kamala River at an elevation of 105 msl, gently rises to elevation 227 msl at 266+300 (Bardibas), again gradually decreases to elevation 122 msl at 322+800 (forest area) and gradually increases to elevation of 166 msl at end (Pathalaiya). Proposed road alignment in topographic map is shown in **Annex 5**.

The land use for various category of land use was analysed for land within RoW that is 50 meters and Land within Direct Impact Area that is 300-meter corridor of the road (**Annex 5**). The land use that the proposed intervention is going to impact shown in **Table 5-1** and this indicates that predominant land use is Forest land which is followed by agricultural land.

Table 5-1: Land Use Category of Project Area

Land Use Category	Impact Zone					
	RoW (50 m)		DIA (300 m)		IIA (2 km)	
	ha	%	ha	%	ha	%
Agricultural	97.14	14.92	949.76	24.28	8218.24	31.23
Residential	56.93	8.75	311.09	7.95	1109.79	4.22
Commercial	29.89	4.59	141.52	3.62	199.78	0.76
Industrial	1.6	0.25	12.42	0.32	112.47	0.43
Forest	317.09	48.71	1989.01	50.85	13890.8	52.78
Mining & Minerals	0.67	0.10	2.94	0.08	3.35	0.01
Public Use (Roads/Railways/School etc.)	124.51	19.13	296.19	7.57	771.47	2.93
Cultural & Archaeological	1.35	0.21	5.96	0.15	8.04	0.03
Riverine & Lake Area (Rivers/Water Body/Wet Land)	19.83	3.05	184.34	4.71	1802.02	6.85
Others	1.9	0.29	18.03	0.46	203.11	0.77
Total (ha/%)	650.91	100.00	3911.26	100.00	26319.07	100.00

Source: Field Survey 2022, Google Earth and Arc GIS

Though RoW falls under the jurisdiction of the road, as it is not fully occupied by the road, it is used as per adjoining land use like agriculture, forest, settlement etc.

Major forest patches along the road alignment can be noticed from chainage 249+100 to 250+500, 268+400 to 289+900, 291+900 to 293+700, 296+300 to 298+700, 315+900 to 324+600, 327+700 to 343+500 and 347+500 to 365+700. Major market settlements with high commercial activities along the road are Godar Bazar, Birendra Bazar, Dharapani, Puspapur,

Dhalkebar, Badahari, Lalgadh, Bardibas, Phuljor, Raniganj, Lalbandi, Nawalpur, Harion, Bagmati, Chandranigahpur, Nijagadh and Pathalaiya. These settlements are susceptible to pollution, noise and vibrations during both construction and operation phases of the project. Beside this, industries are found to be expanding within Puspapur and Dhalkebar area.

The project area laying within flat topography, has no issues regarding slope instability and landslides. However, bank cutting near rivers is general issue observed in most of the locations, major issue within Charnath, Baluwa, Jalad, Aurahi, Basai, Barahari, Ratu, Gadhanta, Maraha, Bankeh, Phuljor, Lakhandei, Chapani, Gairi, Paurahi, Chandi, Lamaha, Dhansar, Pasaha and Balganga. This may be further deteriorated due to project implementation, especially due to bridge and culvert construction. Further, some locations (especially in Mithila, Lalbandhi and Nijgadh area) is found to be under water logging mainly during heavy rain.

5.1.2 Climate, Meteorology and Air Quality

i) Climate

The climate of the study belongs to the tropical climate zone characterized by a distinct monsoon period from June to September, a mild winter period from November to March and a hot summer from April to September. The region has a hot and humid climate during summer and has foggy climate during winter. Nearest aeronautical/climatological station of Department of Hydrology and Meteorology (DHM) from the project are at Simara Airport (index no. 909) and Karmaiya (index no. 1121). Temperature and precipitation data of above-mentioned stations are given in table below. As per these stations, the annual average temperature of the project area is 25.03°C with annual average minimum temperature of 19.1°C and annual average maximum temperature of 31.01°C. Similarly, annual average precipitation of the project area is 1669.03 mm.

Table 5-2: Annual Temperature and Precipitation of Nearest Stations (Simara Airport and Karmaiya)

Station	Climatic Parameters	Average from 1985 to 2021
Simara	Annual Minimum Temperature	18.22°C
	Annual Maximum Temperature	30.49°C
	Annual Rainfall	1871.45 mm
	Annual Average Humidity	74.20 %
	*Annual Average Wind Speed and Direction	2.57m/s, 134.07°
Karmaiya	Annual Minimum Temperature	20.52°C
	Annual Maximum Temperature	31°C
	Annual Rainfall	1803 mm
	Annual Average Humidity	81.60 %
	*Annual Average Wind Speed and Direction	1.31m/s, 104.05°

* Data available only from 2019 to 2021

Source: DHM 2022

Beside this, the road design has considered 11 stations for rainfall analysis. As per this analysis, 24 hours annual maximum rainfall (R100 yr) over the catchment was 565.41 mm. The linear trend analysis of both rainfall series historical and RCP4.5-upscaled has been undertaken in the road design of KDP. Both series show a positive trend. The trend for the RCP4.5 rainfall is an increase of 0.651 mm/year, and the trend in the historical data is 0.380 mm/year for Lakhandehi basin (KDP alignment crosses Lakhandehi River, Sarlahi district).

For Bakraha river basin (catchment area = 450 km², originating from Churia hill, Morang district). The trend for the RCP4.5 rainfall is an increase of 0.023 mm/year, and the trend in the historical data is 0.352 mm/year. The result shows that the percentage change in projected rainfall due to climate change at Pattharkot Rain fall station (Lakhandehi river basin) varies between 1.4%-21.5% for different return periods. All this information has been incorporated into the road design mainly for designing side drain and cross drainage structures.

ii) Air Quality

Baseline Air Quality of the project area was monitored in the month of October 2022 to establish the air quality of the project area. The five air quality stations were identified to represent the entire project area. These stations were Dhalkebar, Lalbandi, Paurahi, Nijgad and Dudhaura. Sampling location at Dhalkebar represents highly commercial area (including industries), Lalbandhi represents commercial area, Paurahi and Dudhaura represents forest areas and Nijgadh represents mix residential area. Summary of results of air quality monitoring along with lab analysis report is given in **Annex 17**. The results indicate that Air quality of the project area is within the National Air Quality Standard of Nepal. However, as per Status of Air Quality in Nepal- Annual Report 2021, air quality of Simara and Janakpur (Air quality stations near KDP road alignment) were found in higher range for some months. In the case of Simara station, PM_{2.5} ranged from 1 to 1475.8 µg m⁻³ with mean 47.43 µg m⁻³. Similarly, PM₁₀ ranged from 1 to 2945.2 µg m⁻³ with mean 78.36 µg m⁻³. For both parameters, higher concentration can be seen during January and April whereas lower concentration was observed during monsoon and post-monsoon season. Total suspended particles (TSP) in Simara Station was observed to range from 1 to 4997.2 µg m⁻³. The mean of the TSP point data was observed to be 159.15 µg m⁻³. Higher concentration can be seen during April whereas lower concentration was observed during monsoon and post monsoon season. In the case of Janakpur station, PM_{2.5} ranged from 1 to 579.4 µg m⁻³ with mean 29.67 µg m⁻³. Higher concentration can be seen during winter, pre-monsoon and post-monsoon season.

The main source of air pollution within project area is vehicular emissions, construction activities, industrial pollution, loading and unloading of sand from riverbeds. During construction phase, dust level is expected to be high due to construction activities, transportation of construction material, loading and unloading of construction material, excavation of soil and movement of vehicles & equipment.

There are more than 47 educational institutions and 23 health institutions are adjoining to the road alignment. Settlement wise list of these institutions are given in **Annex 32**. All together 25 air and noise sensitive locations were identified along the road alignment where special attention is to be given for controlling air and noise pollution during construction. These locations are along chainages: 243+250, 243+500, 246+580, 247+600, 251+800, 257+150, 264+750, 294+050, 294+500, 295+400, 296+200, 299+300, 299+800, 299+900, 299+950, 300+800, 301+000, 303+200, 305+250, 306+370, 311+700, 311+800, 313+780, 326+100 and 366+650.

iii) Noise Levels

Baseline noise levels of the project area was also monitored in the month of October 2022 to establish the baseline noise levels of the project area. The five noise monitoring stations were

identified to represent the entire project area. These stations were Dhalkebar, Lalbandi, Paurahi, Nijgad and Dudhaura. Sampling location at Dhalkebar represents highly commercial area (including industries), Lalbandhi represents commercial area, Paurahi and Dudhaura represents forest areas and Nijgad represents mix residential area. The summary of results of noise levels are given in **Annex 18**.

The day and nighttime noise levels were calculated separately for all monitoring stations. It is noticed from the results of noise that equivalent noise level at Dhalkebar and Lalbandhi exceeded National Standard for Noise Level 2069 for urban residential area for night time only and day time the noise levels are within the limit for Lalbandi and slightly exceeding for Dhalkebar station. The Day and nighttime Leq for other stations are within limit of residential area.

Like for air pollution, vehicular movement, some industries adjoining to road alignment and construction activities are major source of noise pollution in the project area along. In addition to these sources of pollution traffic movement and quarrying operation in riverbed areas are source of noise pollution. There is some issue of noise in built-up areas, during traffic jams and congestion near bridges where sand and boulders quarrying is going on. Noise sensitive locations along the road alignment is already mentioned above in air quality section. Beside these, elephant crossing locations identified at Amu1, Lamaha, Dhansar, 13 kilo, Pasaha, Balganga and Dudahura are also considered as noise sensitive locations. As predicted noise level exceeds noise level standard at all sections (**Annex 18**) and in order to protect wildlife from any adverse noise impact due to traffic flow noise barrier is recommended and prior site-specific due diligence study is also suggested.

5.1.3 Hydrology

i) River System

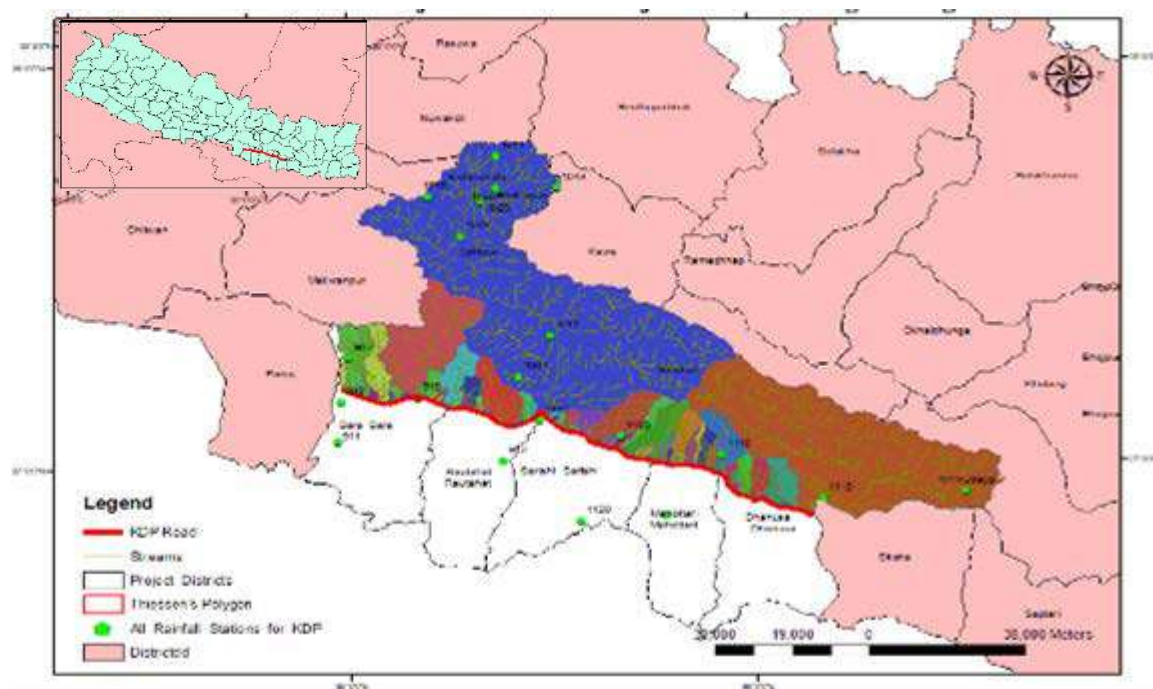
The KDP road is in foothills towards south side of Nepal. There are many rivers and rivulets along the KDP alignment. The alignment crosses major rivers like the Kamala, Bagmati, Bakaiya, Pashaha Khola, Dudhaura Khola etc. These rivers are originated from the Mahabharat Range and Lesser Himalaya and perennial in nature. But small rivers along the road alignment are originated from the Siwalik Range and are ephemeral. Those ephemeral rivers carry heavy sediment loads and debris during the heavy rainfall event. Most of the streams and rivers within project area are of aggrading nature with siltation/sedimentation problem while only few rivers are either stable or degrading. Major siltation problems observed are in Charnath, Baluwa, Jalad, Basai, Ratu, Bhapsi, Gaushala, Bankhe, Betini, Lakhandei, Lamaha, Dhansar, Pasaha, Dudhaura etc. Table 5-3 below shows the distribution of numbers of rivers and corresponding catchment area class at crossing.

Table 5-3: Distribution of Numbers of Rivers Crossing the Road Alignment

Catchment area at crossing (km ²)	Numbers of rivers
>1000	2
1000 to 100	3
100 - 25	17
< 25	51

Source: Detailed Design Report 2023

Beside these, the road alignment also passes through few irrigation canals (Kamala canal at chainage 237+812, Bagmati east canal at chainage 312+070 and Bagmati west canal at chainage 313+615).



Source: Detailed Design Report 2023

Figure 5-1: Catchment Area for major Rivers and Cross Drainages along KDP Alignment

Detail list of major crossings along the road alignment with lowest bed level, high flood level, type of river and nature is given in **Annex 4**. Type of environmental impacts associated with these crossings is also given in **Annex 4**. All these including further impact due to climate change has been addressed while designing drainage and cross drainage structures along with road's longevity, durability, and resilience to extreme weather conditions. Considerations have been made to divert storm water to nearest river stream through roadside drain.

ii) Ponds

Also, there are some water ponds along the KDP alignment. The chainage wise list of these ponds is given **Table 5-4**. There may be impact on these ponds during road construction.

Table 5-4: The list of ponds along the KDP alignment

S.N.	Chainage		Length	Side	Pond Edge Distance from Center Line of Alignment (m)
	Start	End			
1	242+600	242+750	150	LHS	22.16
2	242+765	242+865	100	RHS	19.12
3	242+960	243+050	90	RHS	22
4	243+000	243+150	150	LHS	20.9
5	247+870	247+900	30	LHS	7.8
6	255+190	255+310	120	LHS	18.5
7	293+620	293+720	100	LHS	14.45
8	295+310	295+370	60	RHS	15

S.N.	Chainage		Length	Side	Pond Edge Distance from Center Line of Alignment (m)
	Start	End			
9	301+000	301+080	80	LHS	12
10	304+920	304+950	30	LHS	24.95
11	304+960	305+000	40	LHS	17.15

Source: Field Survey 2022 and Detailed Design Report 2023

Proper roadside drainage and cross drainage structures has been designed and will be constructed so that storm water from road will not accumulate in these water bodies.

iii) Flood

The proposed project area lies towards upper part of Terai region. During the monsoon months from June to September, all the rivers in Terai are in spate with bank-full discharges and cause flooding and inundation. Considering the high level of rainfall in the Terai Region, the water network is abundant in the project area and water may cause drainage problems along the highway, especially during wet monsoon seasons, associated with water-logging. As per the detail design report, FGDs and field observation, majority of the river banks and adjoining land within project area are subjected to bank cutting/ erosion hence requires river training works. Major risk is noticed in Charnath, Baluwa, Jalad, Aurahi, Basai, Barahari, Ratu, Gadhanta, Maraha, Bankeh, Phuljor, Lakhandei, Chapani, Gairi, Paurahi, Chandi, Lamaha, Dhansar, Pasaha and Balganga. Further, some locations (especially in Mithila, Lalbandhi and Nijgadh area) is found to be under water logging mainly during heavy rain.

iv) Climate Change and Hydrology

Climate change will increase monsoon rainfall and intensity, melting of glaciers and snowmelt, and increase flood risks nationwide. Climate change also can contribute to the severity of the floods; because it is predicted in climatic scenarios that rainfall amount might be increased in terai region, especially in the monsoon season. The impact of climate change reveals that there will substantially increase in the number of extreme rainfall events and in the frequency and magnitude of extreme river flows.

i) Water Quality

Drinking water and surface water quality of the project area was monitored and result of drinking water and surface water along with lab analysis result is given in **Annex 19**. In case of drinking water, it is noticed that beside E. coli contamination, all the other measured parameters are within Nepal Drinking Water Quality Standard (NDWQS) 2062. All the drinking water samples except that from Bagmati and Pathalaiya had E. coli contamination.

Similarly, in case of surface water, beside color, turbidity and total coliforms, all the other parameters were within NDWQS.

5.1.4 Soil and Geology

i) Soil

The soil is in general alluvial and fine to medium textured in the project area which is suitable for agriculture. The baseline soil quality was monitored at five locations along the project area. The result of soil quality testing along with lab analysis report is given in **Annex 20**.

The soil of project area is acidic in nature and suitable for agriculture purpose. However, traces of oil & grease are present in soil.

For the proposed project, different associated/ancillary facilities are required like contractor and labor camps, construction yards, stockpiling yards, quarry and burrow pit sites, crusher plant sites, hot mix plants, batching plants etc. Haphazard disposal of wastes (both solid and liquid), leakage of oil and grease from construction vehicles, machineries and equipment, inappropriate storage and handling of chemicals etc. can contaminate soil, surface water and ground water during construction phase.

i) Geology and Seismicity

The KDP road alignment lies at the Gangetic Zone just pass the Siwalik Zone. This zone is further subdivided into northern terai region, middle terai region and southern terai region. Mostly the road section lies in northern terai region pass the siwalik hills (**Annex 5**). This area is mostly composed of quaternary sediments (alluvium deposits) that consists of sandy gravel with boulder, bobble, pebble, silt and clay. Large alluvial fan deposits occur along the main streams. They are tens of meters thick and extend all over the project area. The fine sand and silt with clays are produced from the surrounding sloping catchment, washed away during recent floods and transported due to moderate to steep gradient of the rivers and deposited in the gentle slopes of the Terai plain due to decrease in the velocity of the flood flows. It is noticed that the road alignment is close to the Chure foot hills at two sections - Chainage 262+150 and 312+000.

For geotechnical analysis (mainly for bridges), boring and sampling, standard penetration test and dynamic cone penetration test were conducted during design. Further laboratory tests (including grain size distribution, saturated unit weight, natural moisture content etc.) were conducted with disturbed and undisturbed soil samples for identification and classification purposes and to obtain the strength and other properties of the formation. It is noticed that throughout the whole alignment, the plasticity index of the soil doesn't exist and are non-plastic. Further there is no or very low potential for the liquefaction. Major findings are given in **Annex 21**.

As per National Building Code (NBC 105:2020), the project area lies within seismic zoning factor (Z) equal to 0.3 (**Annex 5**). Further, Peak Ground Horizontal Acceleration of the Project area is around 100-200 gal. The risk of seismic hazard in the vicinity of the project area is of moderate nature, since one of the major regional thrust called the Higher frontal Thrust (HFT) is quite far away from the project site.

5.2 Biological Environment

5.2.1 Forest Resources

Around 54.49% of the road alignment adjoins forest area. The forests adjoining the project area are of tropical nature as per climatological condition. Because of usual adequate rainfall and sun, these forests mostly remain ever green. As per geographic condition, forests adjoining the project area lie within Terai Mixed Hardwood Forest zone that mainly consists of Sal trees with other associate trees. Riverine forest can be found along the banks of rivers and streams with dominant species of Khair and Simal. The road alignment also adjoins the boundary of Parsa National Park (forming the southern boundary of the National Park from

chainage 350+050 to 363+750), Forest area of Sagarnath Forest Development Project, 21 community forests, 9 collaborative forests and national forests as shown in **Table 5-5**.

Table 5-5: List of Forests adjoining the Road Alignment

Left Side				Right Side			
S.N	Name of Adjoining Forest	Chainage		S.N.	Name of Adjoining Forest	Chainage	
		From	To			From	To
Adjoining Forests within Division Forest Dhanusha							
				1	Kamala Community Forest	237+650	238+200
				2	Maltol Community Forest	250+000	250+800
Adjoining Forests within Division Forest Mahottari							
1	National Forest	268+650	283+000	3	Bardibas Garanta collaborative forest	268+650	277+450
					Tuteshwor Collaborative forest	277+600	283+000
Adjoining Forests within Division Forest Sarlahi							
2	Sagarnath Forest Development Project	283+100	290+250	4	Fuljorbaba Collaborative Forest	283+100	290+250
3	Everest Community Forest	292+150	292+950	5	Everest Community Forest	292+150	292+400
4	Kalika Community Forest	293+000	293+300	6	Kalika Community Forest	292+400	292+950
5	Radhakrishna Community Forest	293+300	294+000	7	Radhakrishna Community Forest	293+000	294+000
6	National Forest (Bagbani Center)	296+550	299+200	8	Janajyoti Community Forest	296+550	297+400
				9	Nandeshwor Community Forest	297+400	299+200
Adjoining Forests within Division Forest Rautahat							
7	Shreejana Community Forest	316+050	320+300	10	Gairigau Community Forest	314+430	314+850
8	National Forest	320+300	325+250	11	Bagmati Community Forest	314+850	317+150
9	Hatemalo Community Forest	327+900	329+900	12	Brahababa Community Forest	317+150	317+950
10	Rangapur Collaborative Forest	329+900	333+970	13	Deurali Community Forest	318+000	320+750
11	Jungle Saiya Collaborative Forest	334+000	339+500	14	Namuna Community Forest	320+750	322+700
				15	Judbela Community Forest	322+700	325+250
				16	Jana Ekata Community Forest	327+900	329+900
				17	National Forest	329+900	339+500
Adjoining Forests within Bara Forest Division							
12	Tamagadhi Collaborative Forest	339+700	342+400	18	National Forest	339+650	340+650
13	Adarsa Sadabahar Community Forest	342+400	343+810	19	Janjyoti Community Forest	340+650	343+810
14	National Forest	347+650	351+225	20	Nagmadi Community Forest	347+650	350+050

Left Side				Right Side			
S.N	Name of Adjoining Forest	Chainage		S.N.	Name of Adjoining Forest	Chainage	
		From	To			From	To
15	Sahajmath Collaborative Forest	351+225	357+400	21	Parsa National Park	350+050	363+750
16	Halkhoriya Collaborative Forest	357+550	363+750	22	Gadhimai Collaborative Forest	363+900	365+950
17	Pathalaiya community forest	363+900	365+950				

Source: Field Survey/Consultation 2022, www.iucnredlist.org, www.cites.org

5.2.2 Flora Commonly Found Along Road Alignment

Tree species, shrub, and herb species within project area with their threatened status as per IUCN and Government of Nepal are given in **Table 5-6** and **Table 5-7** respectively.

Table 5-6: List of Major Tree Species within Project Area

S.N.	Local Name	Scientific Name	Family	CITES	IUCN	GON
1.	Sal	<i>Shorea robusta</i>	Dipterocarpaceae		LC	National list of timber trees banned for felling, transport or export
2.	Sindure	<i>Mallotus philippensis</i>	Euphorbiaceae		LC	
3.	Banjhi	<i>Anogeissus latifolia</i>	Combretaceae			
4.	Masala	<i>Eucalyptus camaldulensis</i>	Myrtaceae		NT	
5.	Asna	<i>Terminalia elliptica</i>	Combretaceae			
6.	Kyamuna	<i>Cleistocalyx operculata</i>	Myrtaceae			
7.	Padke	<i>Albizia odoratissima</i>	Fabaceae		LC	
8.	Teak	<i>Tectona grandis</i>	Verbenaceae			
9.	Botdhairo	<i>Lagerstroemia parviflora</i>	Lythraceae		LC	
10.	Pithari	<i>Stereospermum suaveolens</i>	Bignoniaceae		LC	
11.	Bhalayo	<i>Semecarpus anacardium</i>	Anacardiaceae		LC	
12.	Ashare	<i>Lagerstroemia sp.</i>	Lythraceae			
13.	Peepal	<i>Ficus religiosa</i>	Moraceae		LC	
14.	Satal	<i>Dalbergia latifolia</i>	Fabaceae	II	VU	National list of timber trees banned for felling, transport or export
15.	Sisoo	<i>Dalbergia sissoo</i>	Fabaceae	II	LC	
16.	Simal	<i>Bombax ceiba</i>	Malvaceae		LC	
17.	Jamuno	<i>Syzygium cumini</i>	Myrtaceae		LC	
18.	Khair	<i>Senegalia catechu</i>	Fabaceae		LC	
19.	Khirro	<i>Sapium insigne</i>	Euphorbiaceae			
20.	Dudhe	<i>Euphorbia hirta</i>	Euphorbiaceae			
21.	Karma	<i>Haldina cordifolia</i>	Rubiaceae			
22.	Kadam	<i>Neolamarckia cadamba</i>	Rubiaceae			
23.	Kusum	<i>Schleichera oleosa</i>	Sapindaceae		LC	
24.	Barro	<i>Terminalia bellirica</i>	Combretaceae		LC	
25.	Harro	<i>Terminalia chebula</i>	Combretaceae		LC	
26.	Timilo	<i>Ficus auiculata</i>	Moraceae		LC	
27.	Palas	<i>Butea monosperma</i>	Fabaceae		LC	

Note: LC – Least Concern, NT – Near Threat, EN – Endangered, VU – Vulnerable, DD – Data Deficit

Source: Field Survey/ Consultation 2022, www.iucnredlist.org, www.cites.org

Table 5-7: List of Important Shrubs and Herbs Species within Project Area

S.N.	Local Name	Scientific Name	Family	CITES	IUCN	GON
1.	Kanikeghas	<i>Euphorbia prostrata</i>	Euphorbiaceae	II		
2.	Parajivi	<i>Aerides multiflora</i>	Orcidaceae	II	LC	
3.	Harjor	<i>Cymbidium aloifolium</i>	Orcidaceae	II		
4.	Grey Orchid	<i>Vanda tessellate</i>	Orcidaceae	II	LC	
5.	Ketuki	<i>Agave americana</i>	Agavaceae		LC	
6.	Bhedekuro	<i>Syzygium nervosum</i>	Acanthaceae			
7.	Datiwan	<i>Achyranthes aspera</i>	Amaranthaceae			
8.	Kuro	<i>Bidens pilosa</i>	Asteraceae			
9.	Dhaiyaro	<i>Woodfordia fruticosa</i>	Lythraceae		LC	
10.	Asuro	<i>Justicia adhatoda</i>	Acanthaceae		LC	
11.	Dhursul	<i>Colebrookea oppositifolia</i>	Lamiaceae		LC	
12.	Bhorla	<i>Phenera vahlii</i>	Fabaceae			
13.	Rudilo	<i>Pogostemon benghalensis</i>	Lamiaceae			
14.	Dudhejhar	<i>Oxalis acetosella</i>	Oxalidaceae			
15.	Ankuriphul	<i>Oxalis corniculata</i>	Oxalidaceae			
16.	Thakal	<i>Argemone mexicana</i>	Papavaraceae			
17.	Pire	<i>Persicaria barbata</i>	Polygonaceae		LC	
18.		<i>Aerides multiflora</i>	Orcidaceae	II		
19.	Taro	<i>Colocasia esculenta</i>	Araceae		LC	
20.	Aank	<i>Calotropis gigantean</i>	Apocynaceae		LC	

Source: Field Survey/Consultation 2022, www.iucnredlist.org, www.cites.org**5.2.3 Important Species within Project area as per Ethnobotany**

Ethnobotanical aspect within the project area was found to be significant. Different ethnic communities with their own distinct traditional healing practices were quite unique. The list of some ethnobotanical significant plants along with their uses are given in **Table 5-8**.

Table 5-8: List of Important Shrubs and Herbs Species within Project Area

SN.	Plants	Uses
1.	<i>Terminalia chebula</i>	Gastrointestinal disorders
2.	<i>Terminalia bellirica</i>	Tonic and gastrointestinal disorders
3.	<i>Cybidium aloifolium</i>	Fractures and sprain
4.	<i>Eclipta prostrata</i>	Skin allergy
5.	<i>Dalbergia sissoo</i>	Furniture and wood craft
6.	<i>Bambusa sp.</i>	Weaving
7.	<i>Colocasia esculenta</i>	Culinary (rich in minerals)
8.	<i>Calotropis gigantean</i>	Diarrhoea, skin disease, Jaundice

Source: Field Survey/ Consultation 2022

5.2.4 Tree within RoW

Tree inventory was prepared for all trees to be felled down. All together there are 28120 trees (including poles) are found to be affected due to road widening. List of trees to be affected due to proposed project within RoW and name of adjoining forest is given in **Table 5-9**.

Table 5-9: Forest wise Number of Trees within RoW

S.N.	Name of Adjoining Forest	Trees within RoW	S.N.	Name of Adjoining Forest	Trees within RoW
1	National Forest	4431	18	Tuteshwor Collaborative forest	432
2	Settlement	3433	19	Bardibas Garanta collaborative forest	354
3	Jungle saiya Collaborative Forest	2774	20	Adarsa Sadabaha Community Forest	180
4	Sahajnath Collaborative Forest	2338	21	Gadhimai Collaborative Forest	180
5	Sagarnath Forest Development Project	2071	22	Hatemalo Community Forest	179
6	Parsa National Park	1697	23	Brahababa Community Forest	173
7	Halkhoriya Collaborative Forest	1749	24	Nandeshwor Community Forest	159
8	Rangapur Collaborative Forest	1276	25	Kalika Community Forest	90
9	Tamagadhi Collaborative Forest	1009	26	Everest Community Forest	62
10	Janjyoti Community Forest	752	27	Janajyoti Community Forest	78
11	Fuljorbaba Collaborative Forest	864	28	Maltol Community Forest	109
12	Namuna Community Forest	740	29	Radhakrishna Community Forest	70
13	Shreejana Community Forest	650	30	Jana aakata Community Forest	73
14	Judbela Community Forest	639	31	Gairigau Community Forest	77
15	Bagmati Community Forest	504	32	Kamala Community Forest	28
16	Deurali Community Forest	462	33	Radhakrishna Community Forest	11
17	Pathalaiya community forest	466	34	Nagmadi Community Forest	10
Grand Total					28120

Source: Field Survey/Consultation 2022

Similarly, species wise number of trees to be affected due to proposed project is given in **Annex 22**. It is noticed that there are altogether 108 tree species with the greatest number of sal (7060) followed by Sindure (3894), Banjhi (3003), Eucalyptus (1950), Asna (1746) and so on. There are 55 religious trees within RoW.

5.2.5 Quadrat Analysis of Vegetation Along the Road Alignment

All together 30 species were recorded within 41 quadrat samples. Among them, Sal (*Shorea robusta*) had the highest number with density of 71.61/ha. It was also the most abundant species with occurrence of 41.46%. Quadrat samples of vegetation analysis is given in **Annex 23**.

5.2.6 Fauna within Project Area

IBAT data generated for 50 km buffer generate list of 1229 species of fauna. Among them, 38 species are considered critical as per Critical Habitat-Qualifying biodiversity Assessment. These lists are given in **Annex 24**. Further, as per field observation and consultations, major fauna found within the project area are listed in **Table 5-10**.

Table 5-10: Fauna within Project Area

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON
Mammals						
1.	Chital	<i>Axis axis</i>	Cervidae		LC	VU
2.	Nilgai	<i>Boselaphus tragocamelus</i>	Bovidae		LC	VU
3.	Rhesus monkey	<i>Macaca mulatta</i>	Cercopithecidae	II	LC	LC
4.	Terai Grey Langur	<i>Semnopithecus hector</i>	Cercopithecidae	I	NT	LC
5.	Northern Palm Squirrel	<i>Funambulus pennanti</i>	Sciuridae		LC	LC
6.	Indian Bush Rat	<i>Golunda ellioti</i>	Murinae		LC	LC
7.	Eurasian Wild Boar	<i>Sus scrofa</i>	Suidae		LC	LC
8.	Indian Crested Porcupine	<i>Hystrix indica</i>	Hystriidae		LC	DD
9.	Bengal Fox	<i>Vulpes bengalensis</i>	Canidae		LC	VU
10.	Common Leopard	<i>Panthera pardus</i>	Felidae	I	VU	VU
11.	Tiger	<i>Panthera tigris</i>	Felidae	I	EN	EN
12.	Elephant	<i>Elephas maximus</i>	Elephantidae	I	EN	EN
13.	Golden Jackal	<i>Canis aureus</i>	Canidae	III	LC	LC
14.	Barking Deer	<i>Muntiacus vaginalis</i>	Cervidae		LC	VU
Birds						
1.	Indian Peafowl	<i>Pavo cristatus</i>		III	LC	
2.	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	
3.	Rose-ring Parakeet	<i>Psittacula krameri</i>	Psittacidae		LC	
4.	Black drongo	<i>Dicrurus macrocercus</i>	Dicruridae		LC	
5.	House Crow	<i>Corvus splendens</i>	Corvidae		LC	
6.	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae		LC	
7.	House Sparrow	<i>Passer domesticus</i>	Passeridae		LC	
8.	Common Myna	<i>Acridotheres tristis</i>	Sturnidae		LC	
9.	Asian Koel	<i>Eudynamis scolopacea</i>	Cuculidae		LC	
10.	Large billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	
11.	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae		LC	
12.	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae		LC	
13.	Little Egret	<i>Egretta garzetta</i>	Ardeidae		LC	
14.	Black Kite	<i>Milvus migrans</i>	Accipitridae		LC	
15.	Red headed vulture	<i>Sarcogyps calvus</i>	Accipitridae	II	CR	EN
16.	Shikra	<i>Accipiter badius</i>	Accipitridae	II	LC	
17.	Steppe Eagle	<i>Aquila nipalensis</i>	Accipitridae	II	EN	VU
18.	Kalij Pheasant	<i>Lophura leucomelanos</i>	Phasianidae	III	LC	
19.	Red Jungle Fowl	<i>Gallus gallus</i>	Phasianidae		LC	
20.	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Columbidae		LC	
21.	Spotted Dove	<i>Spilopelia surattensis</i>	Columbidae		LC	
22.	Slaty headed Parakeet	<i>Psittacula himalayana</i>	Psittacidae	II	LC	
23.	Common Kingfisher	<i>Alcedo atthis</i>	Alcedinidae		LC	
24.	Indian Roller	<i>Coracias benghalensis</i>	Coraciidae		LC	
25.	Indian Grey Hornbill	<i>Ocyrceros birostris</i>	Bucerotidae		LC	
26.	Yellow wagtail	<i>Motacilla flava</i>	Motacillidae		LC	
27.	Grey wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	
28.	Eurasian Tree Sparrow	<i>Passer montanus</i>	Passeridae		LC	
29.	Scarlet Minivet	<i>Pericrocotus speciosus</i>	Campephagidae		LC	
30.	Grey Bushchat	<i>Saxicola ferreus</i>	Muscicapidae		LC	
31.	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae		LC	
32.	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Corvidae		LC	
33.	Coppersmith Barbet	<i>Megalaima haemacephala</i>	Megalaimidae		LC	
34.	Oriented Pied Hornbill	<i>Anthraceroceros albirostris</i>	Bucerotidae		LC	
35.	Pied Kingfisher	<i>Ceryle rudis</i>	Cerylidae		LC	
36.	Alexandrine Parakeet	<i>Psittacula eupatria</i>	Psittacidae		NT	
37.	Large -tailed Nightjar	<i>Caprimulgus macrurus</i>	Caprimulgidae		LC	

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON
38.	Yellow -footed Green Pigeon	<i>Treron phoenicoptera</i>	Columbidae		LC	
39.	Common Kestrel	<i>Falco tinnunculus</i>	Falconidae		LC	
40.	Asian Paradise - flycatcher	<i>Terpsiphone paradisi</i>	Corvidae		LC	
41.	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Corvidae		LC	
42.	Common Iora	<i>Aegithina tiphia</i>	Corvidae		LC	
43.	Plain Prinia	<i>Prinia inornata</i>	Cisticolidae		LC	
44.	Baya Weaver	<i>Ploceus philippinus</i>	Passeridae		LC	
Amphibians						
1.	Asian black-spined toad	<i>Duttaphrynus melanostictus</i>	Bufonidae		LC	
2.	Indian bull frog	<i>Hoplobatrachus tigerinus</i>	Dicroglossidae	II	LC	
3.	Common Indian tree frog	<i>Polypedates maculatus</i>	Rhacophoridae		LC	
4.	Indian softshell turtle	<i>Aspideretes gangeticus</i>	Anguillidae	I	EN	
Reptiles						
1.	Common garden lizard	<i>Calotes versicolor</i>	Agamidae		LC	
2.	Yellow-bellied house gecko	<i>Hemidactylus flaviviridis</i>	Gekkonidae		LC	
3.	Keeled indianmabuya	<i>Eutropis carinata</i>	Scincidae		LC	
4.	Bengal Monitor Lizard	<i>Varanus bengalensis</i>	Varanidae	I	NT	
5.	Indian gamma snake	<i>Boiga trigonata</i>	Colubridae		LC	
6.	Asiatic rat snake	<i>Ptyas mucosa</i>	Colubridae	II	LC	
7.	Buff-striped keelback	<i>Amphiesma stolatum</i>	Natricidae		LC	
8.	Spectacled cobra	<i>Naja naja</i>	Elapidae	II	LC	
Butterflies						
1.	Restricted Demon	<i>Notocrypta curvifascia</i>	Hesperiidae		LC	
2.	Rice Swift	<i>Borbo cinnara</i>	Hesperiidae		LC	
3.	Dark Palm Dart	<i>Telicota aneilla</i>	Hesperiidae		LC	
4.	Common Mormon	<i>Papilio polytes</i>	Papilionidae		LC	
5.	Lime Butterfly	<i>Papilio demoleus</i>	Papilionidae		LC	
6.	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae		LC	
7.	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae		LC	
8.	Long-banded Silverline	<i>Spindasis lohita</i>	Lycaenidae		LC	
9.	Common Cerulean	<i>Jamides celeno</i>	Lycaenidae		LC	
10.	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae		LC	
11.	Pale Grass Blue	<i>Pseudozizeeria maha</i>	Lycaenidae		LC	
12.	Striped Tiger	<i>Danaus genutia</i>	Nymphalidae		LC	
13.	Common Crow	<i>Euploea core</i>	Nymphalidae		LC	
14.	Common Evening Brown	<i>Melanitis leda</i>	Nymphalidae		LC	
15.	Common Sergeant	<i>Athyma perius</i>	Nymphalidae		LC	
16.	Painted Lady	<i>Vanessa cardui</i>	Nymphalidae		LC	
17.	Blue Pansy	<i>Junonia orithiya</i>	Nymphalidae		LC	
18.	Peacock Pansy	<i>Junonia almanac</i>	Nymphalidae		LC	
19.	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	
Fish (Recorded from Bagmati and Kamala River)						
1.	Indian Mottled Eel	<i>Anguilla bengalensis bengalensis</i>	Anguillidae		NT	
2.	Chaguni	<i>Chagunius chagunio</i>	Cyprinidae		LC	
3.	Catla	<i>Catla catla</i>	Cyprinidae		LC	
4.	Gurdi	<i>Labeo gonius</i>	Cyprinidae		LC	
5.	Rohu	<i>Labeo rohita</i>	Cyprinidae		LC	

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON
6.	Mungri	<i>Clarius batrachus</i>	Clariidae		LC	
7.	Indian spiny eel	<i>Macrognathus pancalus</i>	Mastacembelidae		LC	
8.	Tengra	<i>Mystus tengra</i>	Bagridae		LC	
9.	Pothi	<i>Puntius sophore</i>	Cyprinidae		LC	
10.	Olive barb	<i>Systomus sarana</i>	Cyprinidae		LC	
11.	Bhote/ Spotted snakehead	<i>Channa punctatus</i>	Channidae		LC	
12.	Guntea loach	<i>Lepidocephalus guntea</i>	Cobitidae		LC	
13.	Mrigal	<i>Cirrhinus cirrhosus</i>	Cyprinidae		LC	

Source: Field Survey/Consultation 2022, www.iucnredlist.org, www.cites.org

5.2.7 Status of Wildlife Habitat within Project Area

Elephant Distribution

Asian elephant (*Elephas maximus*) is a mega-herbivore. Nationally assessed as Endangered as per the Nepal Red list series¹ As per IUCN Red list, it is listed as Endangered under criteria A2c., It is CITES Appendix I species and Nepal's Protected species as per NPWC Act 1973.

Using the primary data collection by the project team, an attempt has been made to map the distribution of elephant movements along the project road (**Annex 25**). Elephant movement was noted between the road stretch of km 363+100 to km 334+500. By connecting the information gathered by all possible sources estimated population was between 6-7 individuals which are partial migrants within the Parsa National Park and associated community and collaborative forests. In monsoon season a group of 12-18 were noticed expected to be seasonal migration from the Chitwan National Park which is connected with west of Parsa National Park. Unprecedented travel movement of elephant was noticed near the village Piluwa Village which is 300 m distance from the km 357+800, Tangia Basti 2.5 km distance from the km 351+000 and other villages near the road alignment. Residential and migratory elephants move from Chitwan National Park towards the east in Bara and Rautahat and destroy crops massively. Connecting the information collected from different stakeholders, two peak seasons for road crossings were recorded during consultations which include one during maize or wheat maturing time (June – July) and other during paddy maturing time (Sep. – Nov.).

Tiger Distribution

Tiger (*Panthera tigris*) is a flagship species that inhabits a wide range of interconnected habitats, it has been listed as 'Endangered' in the IUCN's Red List and under Appendix I in Convention on International Trade in Endangered Species of Wild Fauna and Flora. Nepal has also listed the species under Schedule I in its National Parks and Wildlife Conservation Act, 1973.

As per the Status of Tigers² in Nepal, 41 tigers were estimated with minimum individuals identified was 31 tigers in Parsa National Park and adjoining forests. Tiger population Near Parsa National Park was increased from 18 to 41 individuals from the year 2018 to 2022.

¹ Jnawali, S.R., et al. (2011), The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.

² DNPWC and DFSC. (2022). Status of Tigers and Prey in Nepal 2022. Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation. Ministry of Forests and Environment, Kathmandu, Nepal.

With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. Beside Parsa National Park, tiger movement were identified between the chainage 333+100 to 327+700.

During field survey, considerable number of signs of tiger pugmarks, prey signs including dung/pellets, footprints, sightings and consultation was recorded. The evidence of presence of tiger given in **Annex 25**.

Prey Animals and Ungulates Distribution

Major prey species were recorded, which include spotted deer (*Axis axis*), Sambar (*Rusa unicolor*), Barking deer (*Muntiacus vaginalis*), Blue bull (*Boselaphus tragocamelus*), Wild boar (*Sus scrofa*), and Gaur (*Bos grunniens*). Rhesus macaque (*Macaca mulatta*) and Grey langur (*Semnopithecus entellus*) were commonly sighted along the project road. **Direct evidence of Barking deer & Gaur was noticed along the project road.**

Major ungulates between the km 364+00 to 347+500 includes spotted deer, Sambar deer, Barking deer, Wild boar and Gaur. Ungulates reported in rest of the project road includes Blue bull, Wild boar & spotted deer. However spotted deer was not noticed from the km 268+500 to 236+698, blue bull was more predominant in these section due the influence of agricultural crops.

Vultures

Himalayan griffon vulture (*Gyps himalayensis*), it is listed as Near Threatened as per the IUCN Red List. A pair of individuals has been noticed near the dumping site at the bank of Puljor River near at Chainage 292+700, roosting site was noticed 350 m from the project road.

5.2.8 Status of Aquatic Life Habitat within Project Area

Many seasonal streams and perennial rivers flow within the project area. Seasonal streams like Pasaha, Lamaha Khola and important river like Bagmati provide regulatory ecosystem services to the project area. Additionally, there are few natural and man-made fish ponds that are important in creating wildlife-valuable waterholes. There are a few waterholes that are fed by water from Churia. All these waterholes and fish ponds help wildlife to get fresh drinking water during dry season. All these aquatic habitats support diverse fish fauna including globally threatened Indian Mottle Eel (*Anguilla bengalensis bengalensis*), CITES indexed amphibian species like Indian Bull Frog (*Hoplobatrachus tigerinus*) and Indian Soft-shell Turtle (*Aspideretes gangeticus*) are also found within project area.

5.3 Baseline Information on Socio-Economic and Cultural Environment

Proposed KDP road section (130 km) is a part of Mahendra Highway. The road stretch lies within Madhesh Province and covers 6 Districts and 16 Municipalities. The socio-economic and cultural information of the project area collected through desk study and field studies is presented in following sub-chapters.

5.3.1 Socio-economic Profile of the Project Area (DIA)

The socio-economic profile of the project area, which consist of settlement pattern, demography, age, occupation, literacy, religion, caste & ethnicity, Indigenous population, language and infrastructure is described in following sections.

Settlement Pattern

The project area lies within 16 municipalities (including 1 sub-metropolitan city and 15 municipalities) from 6 districts in Madhesh Province. Survey settlement within the project area include the major settlements adjoining to the KDP section of Mahendra Highway from Kamala River Bridge to Pathalaiya. Settlement pattern of market centers within the project area are compact whereas the settlement pattern of the remaining settlements is scattered. Major market settlements along the road are Godar Bazar, Birendra Bazar, Dharapani, Puspapur, Dhalkebar, Badahari, Lalgadh, Bardibas, Phuljor, Raniganj, Lalbandi, Nawalpur, Harion, Bagmati, Chandranigahpur, Nijagadh and Pathalaiya. The major settlements along the KDP road section are presented in **Annex 26, Table 1**.

Demography

As per Population Census (2021), the households of project affected municipalities are 963,829 with population 475,474. Out of these 475,474 populations are male and 488,355 females. Percent of male population is 49.3 and female population is 50.7. Average household size is 4.8. The municipality wise information is given in **Annex 26, Table 2**.

Out of 16 municipalities that KDP road alignment passes, only 11 project affected municipalities and their 40 wards have settlements within the direct impact area (DIA) and rest have forest area. In total 858 households with 4929 population were surveyed, out of these 2563 population are male (52%) and 2366 females (48%).

Age Groups

Age category within surveyed households have been classified under 0-4 years (infant), 5-14 years (child), 15-59 years (adult/economically active population) and 60 years and above (old). It is found that among the total surveyed population (4,929) in the project area, 316 population that is 6.4 percent is within the age group of 0-4 years, 770 that is 15.6 percent is within the age group of 5-14 years, and 3296 that is 66.9 percent is within the age group of 15-59 years. The population of above 60 years is 547 that is 11.1 percent. Population by age group within surveyed household is given in **Annex 26, Table 3**.

Occupation

It was observed during study that out of 4929 surveyed population in the project area, there are 3,296 population who are economically active. However, it is found that only 2,450 population are economically engaged in different occupation such as trade and business (24.4%), household chores (20.2%), job/service (11.0%), agriculture and livestock (10.2%), foreign employment (5.3%) and wage labour (3.3%). Remaining 846 population are economically inactive population in surveyed households, which include students (22.4%) and unemployed (3.3%). Detailed information is shown in **Annex 26, Table 4**.

Literacy

Out of total population aged 5 years and above (4613) within the surveyed households, 4582 population are found literate and 31 illiterate. Household survey within the project area showed that the literacy rate in the project area is 92.2 percent, which is higher than the province (63.5%) literacy rate and national literacy rate (76.3%) as per CBS 2021. The male and female literacy rate in the project area is as shown in **Annex 26, Table 5**. It is found that literacy rate of female (93.7%) is slightly higher than male (92.2%) within the surveyed households. As per CBS 2021, female literacy rate of Madhesh Province is only 54.7 percent and male literacy rate is 72.5 percent. Similarly, male literacy rate of Nepal is 83.6 percent while female literacy rate is 69.4 percent.

Religion

The major religions in the project area are Hinduism and Buddhism; however, there are some populations of Islam and Christianity. The religion of household respondents includes Hindu (88.6%) Buddhist (9.8%), Muslim (1.2%) and Christians (0.5%) by faith as shown in **Annex 26, Table 6**. As per Population Census (2021), national average of Hindu population is 81.19 percent, Buddhist is 8.21 percent, Muslim is 5.09 percent, Kirat is 3.17 and Christian is 1.76 percent. Similarly, within Madhesh Province, percent of Hindu population is 84.24 percent, Muslim is 13.28 percent, Buddhist is 2.21 percent and Christian is 0.18 percent.

Caste and ethnicity

The project area has multi-ethnic/caste groups which include Brahman, Chettri, Janjati, Dalit, Tarai Caste and Muslim. Among the surveyed households, Brahmins are 19.7 percent, Chhetris are 13.5 percent, Jananjatis are 24.4 percent, Dalits are 16.5 percent, Madheshi /Terai Castes are 24.5 percent and Muslims are 1.3 percent respectively. Detail of caste / ethnic groups in the area is provided in **Annex 26, Table 7**.

Indigenous Population

According to the sampled household survey, endangered categories of indigenous peoples are not found in the KDP road corridor. However, the Indigenous People found in project area are mainly of marginalized category. Detail number of surveyed IPs households and population is given in **Annex 26, Table 8**.

Among the surveyed households, 222 households and 1205 population belonged to IPs category. Out of these, only one household with 6 population was reported from the highly marginalized category (Danuwar) IP. Likewise, 177 households of marginalized IP with 651 population was reported among the surveyed households. Similarly, 45 households and 235 population are belonged to disadvantaged category of IP. The disadvantaged IPs in the project area include Gurung, Magar, Rai and Limbu.

Language

Nepali, Maithili, Tamang, Magar, Nepal Bhasha, Bhojpuri, Tharu, Hindi and Rai are major languages spoken in the project area. About 57.8 per cent of the respondents in the project area speak Nepali language as mother tongue. It is found that some ethnic groups like Gurung and Limbu are also using Nepali language. The second most spoken language of the respondents is Maithili (34.4%) followed by Tamang (1.9%), Magar (1.6%), Nepal Bhasha

(1.5%), Urdu (1.2%), Bhojpuri (0.7%), Tharu (0.5%), Hindi (0.3%) and Rai (0.1%). The details of mother tongue/language spoken by household respondents are presented in the **Annex 26, Table 9**.

5.3.2 Economic Profile

Land Holding

It is found that none of the surveyed households are landless. Out of 858 surveyed households, 705 households have extra land beside land with structure and rest 153 HHs have land with structures (built up area) only as shown in the **Annex 26, Table 10**.

Type of Land

Extra land among 705 HHs is being used mostly for agriculture/farming (76.98%) followed by commercial land/ghaderi (21.7%). Around 1.31 percent of land is found to be river flood plain/barren land. Within agricultural land, 71 percent of land is khet (irrigated) and 5.98 percent of land is bari (non-irrigated). Type of extra land of surveyed households is presented in **Annex 26, Table 11**.

Landholding Size

It is found that about 67 percent of the surveyed households have less than 0.5 ha land, 17.3 percent households have 0.5-1.0 ha land, 9.5 per cent households have more than 1.0 to 2.0 ha land, 4.8 per cent household have more than 2.0 to 5.0 ha land and 1.4 per cent households have more than 5.0 ha land for agriculture as shown in **Annex 26, Table 12**.

5.3.3 Agriculture and Livestock Activities

Agriculture

As per FGD participants, agricultural practice in the survey area is mostly traditional and agriculture production system is conventional. Farmers are producing mainly rice, wheat and maize as cereals crops, and mustard, wheat, sugarcane, banana, mango and leechi as cash crops at subsistence level. Banana farming for commercial production is being started by some enthusiast farmers in the survey area. However, the farmers have encountered with some risk of wind/ storm and diseases. Hence, they are in doubt to invest further in banana farming. Sugarcane is another cash crop but the farmers have not been paid by the sugar mills for long time. Mango and *Leechi* are seasonal fruits the farmers grow and sale in few quantities. Lack of irrigation and fertilizer is the main problem of farmers in the project area according to FGD participants. Other agricultural related problems prevailing in the project area are uncertain rainfall, flooding and riverbank cutting.

Livestock

It is found that among 858 surveyed household, 364 households are involved in livestock rearing. Most of the households (156) are rearing goat followed by buffalo (93 households), cow/ox (84 households), poultry (24 households) and pig (7 households). It is found that there are 4 animals per HHs on an average. Average number of poultries per household is 11. Average number of goats and pig per HHs is 4 each whereas average number of cow/oxen and buffalo per HHs is only 2. Number of households having domestic animals is presented in **Annex 26, Table 13**.

5.3.4 Household Income and expenditure

Household Income: When asked about the monthly household income, Rs. 67,829 per month was reported on average. The per capita income of the surveyed population is Rs. 142,412 (lower than the national average) according to the HH survey 2022. per capita income of Nepal is Rs. 164,598 in 2022 (Source: CBS).

Household Expenditure: When asked about the monthly household expenses, Rs. 35,525 per month was reported on average. The average annual household expenditure of the surveyed household is Rs. 426,305.

5.3.5 Migration Status

Migration from hill to Terai and rural area to urban areas is common phenomenon in Nepal, which is similar in the project area. People from hilly area have migrated in the project area since generations, and the trend is continued. The main cause of migration reported by the survey respondents include for better economic opportunities and better living conditions. The employment, service and education are major causes of out- migration in project area.

5.3.6 Sanitation and Water Supply

Most of the population is having toilet facilities in the project area at their home compound. Nepal Government has declared an “Open Defecation Free (ODF) Nation” in 2019. Approximately 75 percent population are using Piped/tap water followed by underground water 18 percent, and river/khola/spring 6 percent as sources of water for domestic use.

5.3.7 Energy Sources

Electricity is the main source of lighting energy in the project area. LPG gas is the main source of cooking energy in the project area. Firewood, keroscene, solar, biogas and cow dung are being less used as energy sources in the project area. In contrary, use of electricity for cooking has been increased in the project area as per the survey respondents.

5.3.8 Market Centers and Service Providers

Major market centers within the project area are Dhalkebar, Bardibas, Lalbandi, Harion and Nijgadh. Every settlement has their typical chain of market system in which small shops, hotels, lodges, restaurants and so on are involved. Weekly Hat bazars in all above-mentioned major settlements play the vital role in transaction of goods and product such as clothing, home appliances, agriculture products (grain, meat, fish, fruits and vegetables), food and beverages of this area which is given in **Annex 26, Table 14**.

5.3.9 Industries within the Project Area

As per FGD participants, 29 different types of industries were reported within the project area, which include carpet, grill, crusher, rice mill, oil mill, noodle, vehicle repair, furniture, garment, bakery, soap, cement and brick block, dalthoth, spice, incense stick and candle, hume pipe, oxygen gas, bag, dairy, poultry, plywood, bamboo product, banana product, toothpick, water processing, paper, pickle, and saw mill etc.

5.3.10 Municipality Offices and Police Stations

Municipality offices and Police Stations for the people of KDP corridor are easily accessible. Among 11 project affected municipalities (within the survey area), 4 municipality offices are adjoining to the KDP road, 4 municipality offices are within a kilometer from KDP alignment and remaining 3 municipalities offices are within 5 to 8 kilometer away from the KDP alignment. Similarly, among 40 ward offices (within the survey area), 20 ward offices are adjoining to the KDP road, 15 ward offices are within 1 km and 5 ward offices are within 3 km from KDP road. Fourteen (14) police stations within the survey area are adjoining to the KDP road.

5.3.11 Other Public Services

Other public services available in the project area include schools, college, hospital/health posts/centers, local hat bazars, market and ward/municipality offices and district headquarters.

Physical infrastructure facilities like electricity, drinking water, school buildings, health institutions, financial institutions, linking roads are good in condition. Regular maintenance for inner roads is essential. There are some on-going and future projects/programs being implemented/to be implemented in and around project area, which may bring cumulative impact to the KDP road and bridges upgrading sub-project. Following are the on-going projects around the project area as in **Annex 26, Table 15**.

5.3.12 Gender Status

According to focus group discussion (FGD) findings, early marriages, poor socio-economic status, dependency and low level of literacy rates are the common characteristics seen in the project area. Gender status in the project area has also been assessed through the household survey. About 71.44 percent surveyed households opined that the status of both man and women is equal, and in very few cases it is unequal (8.51%). In 11.89 percent surveyed households, women are engaged in household activities only whereas in 4.08 percent households, women are also involved in social activities.

5.3.13 Poverty Situation in project area

The Central Bureau of Statistics (CBS) produces the poverty estimates based on the Nepal Living Standard Survey (NLSS). Similarly, in 2022, below poverty line income of Nepal is estimated at NRs. 103,257* per person per year (source: CBS). Out of 858 surveyed households, 377 (43.94%) are under poverty line. Likewise, of 4,929 survey population, 2,266 population (45.97%) have per capita income (Rs 68,621) less than national poverty line. Regarding the ethnicity of the surveyed households under poverty, 27.6 percent HHs belong to Brahmin/Chhetri, 25.2 percent HHs belong to Dalit, 19.9 percent belong to Janajati and 25.7 percent belong to other Terai caste groups and 1.6 percent Muslims households. Regarding the literacy status, 77.9 percent surveyed population under poverty are literate. The literacy rate of male (83.3%) is higher than female (72.2%). Major occupation of surveyed population under poverty includes household works (14.1%) followed by trade and business (11.6%), wage labor (3.6%), agriculture/livestock (9.0%), service/ jobs (5.3%), pension (1.8%) and foreign employment (3.1%). A large number of populations is economically

inactive (students 31.2% and child and senior citizen 20.3%) as per the Baseline survey report of KDP road.

5.3.14 Cultural Environment

The project area is rich in cultural sites, situated within the alignment area. The National Park, Forest areas, temples and architecture are all representatives of the rich historical and cultural sites of the project area. Although the project does not consist of any important area of the world heritage sites; there are still other pilgrimage sites holding great historical and cultural importance.

In the project area, there are numerous historical and cultural site and places of importance that add value to the area. Some of them are given in **Annex 26**.

5.3.15 Festivals and Other Practices

Festivals in project area are unique in their own way and they are much similar to the festivals of India. Major festivals and ceremonies include Jurshital, Chaurchan, Jitiya /Jivitputrika, Sama Chakeva, Fagu Purnima/Holi, **Chhat**, Shivaratri, etc. besides other national festivals like Dashain, Tihar/Deepawali, Teej, Lhosar, festival of Muslim community (Ramadan, Eid-ul-Fitar, Eid-ul-Adaha, Eid-Milad-un-Nabi, Moharram, Shab-i-Qadar and Shab-i-Barat), etc. as multicultural communities reside along the KDP road.

5.3.16 Socio-economic Profile of the Project Affected Households

Population and Household

Within the project area, a total of 64 households consisting of 330 project-affected population have been identified. Among these affected persons, males represent 53.6%, while females make up 46.4%, a figure slightly under the national average of 51%. The average family size in these project-affected households stands at 5.1 which is higher than the national average of 4.8. Details are presented in **Annex 27, Table 1**.

Caste and Ethnic Composition of Project Affected Households

Altogether, 64 households within the RoW are impacted by the KDP road project. Terai Castes makes up the largest ethnic/ caste group at 37.5%, followed by Hill Janajati at 21.8%. Chhetri represents 10.9% of the affected households, while Terai Janajati accounts for 3.1%. The Hill Dalit make up 4.7%, and the Terai Dalit and Muslim populations each constitute 1.6% of the households within the RoW. The composition of affected households by caste group is presented in **Annex 27, Figure 1**.

Aged Group

The age group distribution has its implication to find the dependent population, economic active population and working aged group. 26.4% of the surveyed project affected populations are minors aged between 0- 14 yrs. The working-class population (15-59yrs) constitute 64.5% while 9.1% are 60 yrs. and above. Distribution of the project affected persons by age group is shown in **Annex 27, Figure 2**.

Religion

The major religions in the project area are Hindu, Buddhist, Islam and Christian. In the project area, 84.4% of the surveyed households are Hindu, 12.5% are Buddhist, 1.6% are Muslim and 1.6% are Christians by religion. The proportion of the religion in the project affected household is presented in **Annex 27, Figure 3**.

Education and Literacy

The literacy percent of the surveyed HHs is 88 and the educational status of 1-10 class is 51.3%, educational status of S.L.C. passed 10%, 12 or Intermediate passed 9.1%, the graduate and above are 2.4% while illiterate populations are (15.8%) that indicating varying degree of educational status of the project affected surveyed population along the KDP road alignment. Educational status of school going age and above population of project affected surveyed households are given in **Annex 27, Figure 4**.

Land Use and Ownership

The survey revealed that 62.5% of the households' own land for both agriculture and housing purposes, while 37.5% own only residences. 37.5 percent do not own any land. From the surveys, 52.9% of small landholders are male, while 47.1% are female as their response. Also, the survey revealed a trend where households, especially those running residential businesses, buy small parcels near the RoW.

Livelihood, Income & Expenditure

It is noticed that 37 percent of project affected HHs are engaged in business. The main purpose of residing into the RoW seems as business. Similarly, 14 percent household's populations are engaged in household works, 10 percent engaged into wage labor, 6.2 percent foreign employment, 4.5 percent agriculture, 3.3 percent services and 1.2 percent by pension while remaining are students. The 15.6 percent are them found school going population and the 7.8% as economically inactive population. Details is given in **Annex 27, Table 2**.

The socio-economic survey of the households shows that there are 7 households falls below poverty level. Detail of the household's income level of the project area is given in **Annex 27, Table 3**.

Vulnerability and Vulnerable Groups

Out of the 64 impacted HHs, 15 HHs representing 23.43% as vulnerable households. These vulnerable groups have been considered as women headed households, household having disabled member, household having senior citizen, below poverty level, Indigenous groups, Dalit and ethnic minorities group.

Food Security

About 49 HHs (76.57%) have only food sufficiency less than 3 months by their own agricultural production due to not have adequate land for farming. Among the 64 HHs surveyed households, only 15 HHs (23.43%) have entertained up to 6 months of food sufficiency by their own product. The larger number of HHs have food insufficiency by their own agriculture production. However, business, wage labor, remittance from the foreign employment are other major income sources to cope their food insufficiency.

CHAPTER 6: ALTERNATIVE ANALYSIS

6.1 Introduction

The Project Road Kamala – Dhalkebar - Pathalaiya is a part of Mahendra Highway. This Road has a total length of 130 Km. There are 76 bridges and 127 other cross drainage structures, and 25 Causeways provided on the Project Road. The Road Carriageway width in Project Road section in average is about 7 m ~8 m and shoulder width is about 1 to 2m on both sides. In selected settlement/urban areas, width more than 7m has been provided for the pavement.

The design for the up-gradation project mainly consists of widening the existing 2-lane highway into 4-lane highway and design of bridges accordingly. In urban areas, the design includes the provision for service roads either on the one side or on both sides depending up on nature of the settlement.

The alternatives analysis for the proposed widening/upgradations of this corridor based on the mitigation hierarchy for management of environmental and social risks and impact have been considered. The aspects considered for the analysis of alternatives include Road safety, Hydrology, Impact on forest and trees, bridges, causeway, impact on built up area, wildlife habitat, wildlife & wildlife movement, indigenous people, cultural & community resources, land acquisition, marketplaces and urban area, and public acceptance for social & cultural aspects etc.

6.2 Basis of Selection of Road alignment

The environmental and social screening and initial analysis of alternatives sections of the design report was reviewed for independent assessment of the adequacy of consideration of environmental & social aspects in the selection of preferred road alignment, bridges, causeway improvement alternatives were done. Public consultations were carried out at different locations along the alignment to understand the improving the road sections with due considerations to all alternatives. The data of existing physical structures and infrastructures, existing ecological features, social aspects, and other environmental aspects were collected and studied. The alternative studied for various sections of existing alignment, bridges, and causeways.

6.3 Design

The design of the proposed road section will adopt Asian Highway Design Standards (AHDS) to meet Class I standards and NRS 2070 to meet Class II standards. The road will be 4-lane (6 lane in urban sections with service lane roads). **Accordingly, adequate drainage and cross drainage system have been designed for addressing water logging issues.** All the causeways will be modified as box culverts. Bridges, within the forest, where wildlife movement is found to be high, will be modified as underpasses to meet Wildlife Friendly Infrastructure Construction Guidelines 2078. The design also complies for providing universal access.

6.4 Alternative Alignment

The proposal is for upgrading existing highway which is already under operation. Hence no much alternatives were considered for different alignment. Five different critical sections due to curve geometry were considered for the study: Dhalkaber section, Badahari section, Bankhe Bridge section, Hariyon section and Bagmati Bridge section. However, for Dhalkaber, Badahari and Hariyon sections significant amount of land and property acquisition is required and in case of Bankhe and Bagmati sections significant amount of forest land and trees needs to be acquired. Hence, this option was dropped and design speed will be limited to these sections with adequate safety measures.

Part plans of alignment at above mentioned 5 locations are given from **Figure 6-1 to Figure 6-5**.



Figure 6-1: Proposed Realignment at Dhalkebar



Figure 6-2: Realignment at Hariyon



Figure 6-3: Alignment along Bhagmati River Bridge and Approaches



Figure 6-4: Alignment at Badahari Bazar



Figure 6-5: Alignment at Approaches of Bankhe Bridge

6.5 Alternatives for Construction Technology

Cold Mix Technology involves cold asphalt which is a high-quality, polymer-modified cold mix asphalt available in batch orders. Hot Mix Technology involves Hot Mix Asphalt (HMA) which is a combination of approximately 95% stone, sand, or gravel bound together by asphalt cement, a product of crude oil. Asphalt cement is heated aggregate, combined, and mixed with the aggregate at an HMA facility. The comparison between the two is given in **Table 3-3**.

Table 6-1: Analysis of Cold & Hot Mix Technology

S. No.	Parameter	Cold Mix	Hot Mix
1	Description	Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity and material design, of the various components of an asphalt mix - Street Cold Asphalt is soft and sticky out of the bag, but it quickly hardens after application and the end result is a pavement patch with better strength but similar properties to hot asphalt.	Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities. Hot mix asphalt facilities can be broadly classified as either drum mix plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate is dried first, then transferred to a mixer where it is mixed with the liquid asphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement.
2	Requirements	Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shovelled or poured into a pothole or utility cut and tamped down with a hand tool.	Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C) for virgin asphalt and 330 °F (166 °C) for polymer modified asphalt, and the asphalt cement at 302 °F (150 °C). Paving and compaction must be performed while the asphalt is sufficiently hot
3	Use	Cold mix asphalt concrete is produced by emulsifying the asphalt in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact The emulsion will break after enough water evaporates and the cold mix will, ideally, take on the properties of cold HMAC Cold mix is commonly used as a patching material and on lesser trafficked service roads	HMAC is the form of asphalt concrete most commonly used on high traffic pavements such as those on major highways, racetracks and airfields Asphalt concrete has different performance characteristics in terms of surface durability, tire wear, braking efficiency and roadway noise.

S. No.	Parameter	Cold Mix	Hot Mix
4	Merits	Actually, less expensive to use over the life of a road repair. Completely seals and patches potholes, utility cuts, edge repairs, and even overlays.	Less expensive for new road construction
5	Demerits	Less resilient and more vulnerable to cracking	Expensive

Cold Mix technology is more suitable for repair of potholes and cracks on roads, bridges, overlays, parking lots and other asphalt and concrete surfaces. Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However, for constructing of new roads hot mix technology is better suited so the contractor shall utilize the same wherever suitable.

Further, hot mix asphalt, while effective in producing durable roads, requires heating thus has higher climate footprint and result in pollution. On the other hand, cold mix is relatively friendlier to environment, however, are less durable.

6.6 Alternatives for Wildlife Movement

Based on the experience and site visits and the mitigation hierarchy as per ESS, two alternatives for wildlife movement facilitation were identified.

1st Alternative: The best option as per the ESIA Consultant's view taking into the present & proposed traffic figures, animal movement and road kills as reported and noticed during the site visits is

- Elevated corridor / flyovers in two areas for approximately 15 km:
 - In between Dhansar bridge to Lamaha bridge for approximately 5.5 km &
 - In between Bakaiya & Pasaha rivers for approximately 10 km
 - The areas are reported to have the most WL crossings and habitats
- Other engineering option like underpasses & / or overpasses (land bridges or ecoducts) as per site suitability at the remaining wildlife crossing locations besides keeping the guiding principle of Wildlife Institute of India (WII), which the consultants have been guided to apply besides other Good International Industry Practices (GIIP).
 - WII (2016) Eco Friendly Measures to Mitigate Impacts of Linear Infrastructures on Wildlife, funded by GoI & WB suggests that 300m underpass at every 1 Km for connectivity across 3km corridors divided due to upgradation of the road. Thus, there shall be approximately 28 underpasses in the project corridor – vertical curves shall be more and may lead to traffic snarls and speed reductions
 - Provision of minimum 6-8 feet height mesh fences along with guiding channels to prevent WL crossings other than at designated areas for approximately 56.6 km (28.3 km on both sides) – regular maintenance shall be required and cost to be budgeted

- Provision of the canopy bridges for primates – these are reported to be most impacted in road kills
- Provision of traffic calming measures like table top speed breakers at regular intervals, traffic awareness signages, traffic camera and other paraphernalia
- Design speed to be restricted to no more than 60 km per hour in the WL crossing areas to reduce chances of road kills

2nd Alternative: As the above option is not accepted due to design, cost and other constraints the second option has been explored:

- Engineering option like underpasses & / or overpasses (land bridges or ecoducts) as per site suitability. Here bridges to be modified as underpasses is proposed.
- Provision of minimum 6-8 feet height mesh fences along with guiding channels to prevent WL crossings other than at designated areas along the entire forest sections on both side for approximately 86.6 km (43.3 km on both sides) – fencing has been suggested as an option by locals & forest officials & shall regular maintenance shall be required and cost to be budgeted
- Provision of the canopy bridges for primates
- Provision of traffic calming measures like table top speed breakers at regular intervals, traffic awareness signages, traffic camera and other paraphernalia

Design speed to be restricted to no more than 60 km per hour in the WL crossing areas to reduce chances of road kills.

CHAPTER 7: IDENTIFICATION OF ENVIRONMENTAL IMPACTS

The identification and prediction of environmental impacts have been made for the proposed actions/activities of the project during the construction and operation stages of the project. Both beneficial and adverse impacts were analyzed based on-site observation, field survey & information obtained from the stakeholders and few were identified from value judgment.

Potential environmental impacts on Physical, Biological and Socio-economic and Cultural aspects are identified and predicted based on the existing environmental condition with respect to the proposed project interventions in terms of type of impact (direct/indirect), their magnitude (low/moderate/high), duration (short term/ medium term/long term), and extent (site specific/local/regional).

7.1 Beneficial Impact

Beneficial impacts are related to improvement of road infrastructure and its technical efficiency, economic development and livelihoods of the local people. Upgrading of KDP road will facilitate economic development and transport efficiency, providing multiple services to local communities and industries, contributing to safety issues and allow solving the environmental problems, associated with road inefficiency and traffic congestions.

7.1.1 Construction Phase

7.1.1.1 Socio-Economic and Cultural Environment

1. Employment Generation

The road improvement activities will provide opportunities for local employment along the settlements in the project area. It will be direct employment for construction-related work for the inhabitants all along the existing alignments for construction-related work prioritizing the inhabitants along the existing alignments, or indirect employment on project-support activities such as construction activities, food supply and transport.

Direct employment generation from the proposed project activities will be 1000 labour per day. It is estimated that, out of 1000 workers, about 600 migrant workers will work in this project. The skilled and unskilled labours will primarily be promoted and prioritized from among the local communities. People will be required for embankment and river protection, graveling works, concrete works, scaffolding, gabion box weaving, transportation, supervision and management etc. During construction of this project and local people based on their qualification and skill will have additional income opportunities. This will uplift the economic status of the ZoI.

The impact will be direct in nature, high in magnitude, site specific in extent, long-term in duration and significant.

2. Skill Development

The proposed construction is likely to enhance the skills of local people in the construction sector to some extent. They will have practical training and there will be transfer of skills and technical know-how during construction period in different activities like construction of masonry structures, gabion boxes, bio-engineering works, road side plantation, and river

protection works, etc. These skills will support the local in getting long-term employment opportunity in similar other construction projects in future.

The impact will be direct in nature, moderate in magnitude, site specific in extent, long-term in duration and significant.

3. Increase in Income of Local People

During the construction period, different types of commercial activities will be emerged in order to meet the demand of labor groups, construction crew and project team. For meeting these needs, enterprises like food and tea shops, groceries and restaurants will be developed for serving large numbers of people. Demand on the local production like pulses, milk, meat, vegetables, fruits etc. will increase which may provide added impetus for local production and marketing. This will increase local trade and business in the area and provides opportunities for new income generating activities as well.

The impact will be indirect in nature, high in magnitude, site specific in extent, short-term in duration and significant.

4. Income from Rented Land and Houses

During the construction period there is a need to use private land/structures temporarily in order to set up campsite, stockpile the construction materials, etc. Thus, the local people whose land/structures have been used for such purposes will be provided with the rent for the land or structures. This will ultimately enhance their income and serve positively to upgrade the economic status of his family.

The impact will be direct in nature, moderate in magnitude, site specific in extent, short-term in duration and insignificant.

5. Outside Exposure and Women Empowerment

Women are empowered during the construction of road as they can participate in activities of the sub project. Generally, women in Nepal only work within houses as house wife they do not have chance to work outside the houses. During construction of road women will find chances to work within project directly. Also, the women involved in agricultural activities can sell their farm product to the workers and involved in economic activities and they will develop their small business. Women will get awareness on business know how and about the development.

The impact will be direct in nature, moderate in magnitude, site specific in extent, long-term in duration and significant.

7.1.2 Operation Phase

7.1.2.1 Socio-Economic Environment

1. Improved Road Infrastructure

The most significant benefit of road rehabilitation/upgrading is improved road infrastructure responding to Nepal road standards, including increased width of the road, pedestrian walks, bus stops, transportation public and gas stations, proper traffic lights (especially in urban

sections), underpasses and other crossing structures for pedestrians, improvement of sidebars for safety issues, mirrors where road bends, etc., responding to safety issues.

Details of proposed road improvement infrastructure is given in **Table 7-1** and **Annex 28**.

Table 7-1: Proposed Road Improvement Infrastructures

S. No.	Proposed Road Improvement Infrastructures	Details
1	VUP/PUP	5 nos.
2	Major Junctions	27 nos.
3	Bus shelter	49 nos.
4	Truck lay bye	5 nos.
5	Service roads	19 nos. in total length of 34,704 m
6	Elephant Underpasses	Total 8 nos. (existing bridges), 4 of them to be dismantle and rebuild
7	Medium size animal crossings	10 nos.
8	Tractor and Cart Crossings	18 nos.

Source: Detailed Design Report 2023

Health and safety of road users will be enhanced with the implementation of the good road conditions and other additional roadside facilities. The upgraded road will provide better access to services and transportation, including easy access to the social services such as health posts, hospitals, schools and other education institutions, offices of local authorities, municipalities, district coordination committees, etc. Freight transportation between project towns and major cities of Nepal will be substantially increased reducing travelling time and cost as well as accidents due to freight transportation and freight related vehicles, such as large trucks. *This impact will be direct, high significance, and long term.*

2. Improvement of Trade

Along with improved road infrastructure, the proposed road upgrading works will also improve the connectivity on the East-West Highway and the trade with the neighboring countries (India, Bangladesh, Bhutan) as the road is part of Asian Highway. After 4 lanes, the transportation of goods and services from India to the project region and to other parts of the country will be cheaper, easier and faster. More economic activities such as industries, shops, hotels will be developed along the highway. This impact will be high, regional/transboundary and long term.

3. Tourism Development

The road assists in connecting with some pilgrimage sites (such as Janakpur, Gadimai, banks of Kamala river and Bagmati river etc.), holding great historical and cultural importance and tourist destination places such as Bharat Tal, Nunthar etc. The improved road will enhance tourism due to increased influx of domestic and international tourist to these places, including improved access to well-known tourist destination places.

This impact will be indirect, medium in magnitude, local and long-term in nature.

4. Appreciation of Land Value

Road construction often leads to rise in land values along the road corridor. The agricultural land along the road alignment will turn into commercial land of higher value. **It is assumed that the land value may be increased by 15 to 25 percent.** Increased land values will enhance farmer's capability for borrowing loans on collaterals. Besides farming, this will provide them the opportunity to get involved in various enterprising activities that will enhance their livelihood. High value lands are easily acceptable to banks and micro-finance institutions to provide loans.

The impact will be indirect in nature, moderate in magnitude, site specific in extent, long-term in duration and significant.

7.1.2.2 Physical Environment

1. Carbon Emission Savings/Reduction in GHG emissions in Transportation

Though during project construction there will be emission of Green House Gases (GHSs), during operation, the upgraded road will enhance efficiency of transportation and will eventually result in net carbon emission savings and ultimately will have a positive impact in terms of reduced Green House Gas (GHG) emissions as shown in **Table 7-2** below. **Beside this, the carbon sequestration achieved through the tree to be planted as compensation by the project has the potential to offset a portion of the carbon emission.**

Table 7-2: Estimate of Carbon Emission (2022 – 2046)

	W'out Project	With Project	W'out Project	With Project	W'out Project	With Project	W'out Project	With Project
Vehicular GHG Emission (TPY)	Jan, 2022		Jan, 2031		Jan, 2041		Jan, 2046	
Total GHG Emission	115,292	115,292	181,670	136,263	302,355	229,678	395,401	303,435
% Carbon Saving		0.00		33.32		31.64		30.31

Source: USDA³

The impact will be indirect in nature, moderate in magnitude, regional in extent, long-term in duration and significant.

7.2 Adverse Impact

7.2.1 Pre-Construction Phase

7.2.2 Construction Phase

7.2.2.1 Physical Environment

1. Change in Land Use

General land use pattern of the project area is given in table 5-1. However, it is observed that the proposed road upgrading works is going to impact 303.44 ha (54.01%) of forest/vegetative area, 159.3 ha (28.35%) of agricultural land with houses, 73.90 ha (13.15%) of settlement area, 22.97 ha (4.09%) of river and flood plain and 2.20 ha (0.39%) of other vegetation. As

³ Source: U.S. Department of Agriculture (USDA) referred from website <https://www.usda.gov/media/blog/2015/03/17/power-one-tree-very-air-we-breathe>

the widening/construction works will be confined only within RoW, the impact will be direct in nature, low in magnitude, site specific in extent, long-term in duration and insignificant.

2. Loss of Productive Top Soil

It is estimated that during site clearance, around 2,485,380 m³ of top soil will be generated. Improper storage and use of top soil can disturb the community, water bodies, vegetation etc. It can affect more badly, if done during rainy season. *The impact will be direct in nature, low in magnitude, site specific in extent, long-term in duration and insignificant.*

3. Air Pollution

Sensitive locations for air pollution are already given in section 5.1.1. Dust particles and air pollutants will be released from various activities related to construction works, operation of quarry site and movements of construction vehicles and others vehicles. Dust particles will be also released from excavation works during construction works. Dust and gaseous emissions are also likely to increase during the construction works, spoil disposal sites and earthwork excavation. Generation of exhaust gases is likely during the construction stage due to movement of heavy machinery for construction. High levels of PM, SO₂, HC, CO and NO₂ are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. This may affect the workers and local people. Moreover, the construction work will be carried out during dry season and the dust emission will be likely to be significant. Such activities will affect the human health especially on school children and old aged people and labor force engaged in road construction and people living in the nearby alignment. *The impact will be direct in nature, high in magnitude, local in extent, short-term in duration and significant.*

4. Noise Pollution

Sensitive locations and receptors for noise pollution are already given in section 5.1.1. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface. During construction period, the movement of heavy vehicles, construction machinery and equipment will add up additional noise to the existing sound level. The unnecessary pressure horns from the construction vehicles, unpleasant sound produced from the damaged parts of the construction vehicles and heavy machineries, vibrations from vibrating roller etc. may add up the noise level in the local surrounding. The unwanted vibrations from the roller may damage the private and public structures along the road alignment. The unwanted noise will create the nuisance, irritate the local people, disturb the pleasant sleep of the local people and create the hearing impairment to the construction workers if exposed for the long time. Persistent exposure to the higher noise level will affects wildlife too. *The anticipated impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.*

5. Vibrations

Large machinery and equipment including construction vehicles, generators, compressor and pumps will be used during construction. Such equipment generate vibration, will be experience by the nearby settlement. Also, soil compaction work with bulldozers will generate vibration within RoW only. The vibration induced by the construction equipment

can have a detrimental effect on structures standing near the road. This is of particular concern in the case of cultural heritage sites, which may have been standing for many centuries, but which were not designed to withstand such vibration. Makeshift or lightly constructed buildings may be the first to succumb to vibration damage. In proposed KDP project, these vibrations will be localized and temporary and will unlikely result in structural damage to buildings or walls of the adjacent private properties.

6. Water Pollution

It is noticed that almost all the rivers and streams will be receiving storm water during both construction and operation phase. Degradation of water quality of existing Rivers (Kamala, Bagmati etc.) is likely, especially during the time of construction due to disposal of soil and chemical wastes from construction works and from camps. Excavation for bridge foundation works can lead to sedimentation of Rivers and streams. Existing Rivers and streams are getting sedimentary, due to local activity like extraction of sand, operation of crusher plants and sand cleaning plants. Impact on water sources due to vehicle washing, fuel leakage, poor sanitation practices, increased human activities/settlement/market center expansions/hotel operations to the nearby water sources is also likely. There are total 7 nos. of Ponds which can be affected due to project upgradation work. *The anticipated impacts will be direct, medium in magnitude, local and short-term.*

7. Impact due to Solid Waste Generation

The construction wastes particularly cement bags, plastic wrappings; metallic and non-metallic mesh wires, papers, empty plastic drums and container, etc. will create the pressure on local solid waste management. Unplanned disposal of these non-biodegradable wastes not only degrades the aesthetic beauty of the project area but also pollutes the land. Construction camps are other areas of excessive solid and liquid waste generation.

There will be approximately 1000 workers employed for this road upgradation work. About 600 workers will live in the construction camps and the average solid waste generation per worker will be 0.250 kg per day (including at camp & construction site). Approximately 150 kg solid waste will be generated from these 600 workers. The average solid waste generation on construction site per worker will be 0.150 kg per day. Approximately 400 local workers which will not be living in labour camps will generate about 60 kg solid waste per day on construction site only. Hence, in construction phase, total 210 kg solid waste will be generated per day by total 1000 workers.

The implication of land pollution is not only of aesthetic consideration but also of land quality and community health. Improper dumping and management of these wastes can result in unpleasant odors, deterioration of water quality in the river water and groundwater, visual impacts that can cause health related hazards to the local inhabitants and the workers.

The impact will be direct in nature, high in magnitude, site specific in extent, short term in duration and significant.

8. River Bank Instability

Excavation for the foundation of the bridge can cause landscape disturbance, disturbance in natural water flow, water pollution, soil erosion may occur along the banks and approach road. Disturbance to land and instability of banks are likely in proposed new bridges along

the existing road. *The impact will be direct, of medium magnitude, site specific and short-term and reversible in nature.*

9. Operation of Quarries and Borrow Pits

Quantity of construction material required for the project is given in **Table 2.7**. Quarrying from river bed can lead to change in river morphology, disbalance in river bed slope and can generate high sediment load impacting the water quality.

Sand and gravel extraction from Rivers and streams may change River regime and affecting aquatic ecology, exposing River side embankment without natural protection causing embankment instability and bank cutting.

The quarries used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect adverse impacts on the environment. It is likely that material from quarries could be needed depending on the appropriateness of the material quality. Quarrying and crushing can have a critical impact especially on the air quality of the area especially in the area downwind to the quarry.

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being an eyesore, reduces visibility thereby increasing safety concern. Dust is generated due to procurement and transport of raw materials from quarries to the road construction area. These impacts will persist till the activity ceases.

Quarry material for the project will be sourced from existing licensed quarries. The dredging and use of dredged material, if involved, may have its impact in terms of localized sedimentation level increase and dispersion of pollutants present in the dredged material in the River water. Probable sources for construction materials are located near the road alignment and detailed in the **Table 2.8**.

The impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.

10. Generation of Spoils

Excavations for earth works for road widening and drainage structures and removal of road material from the damaged sections of existing roads will generate about 221,591 cubic meters of cut material. Most of the cut material can be used as fill material for embankment construction backfilling for retaining structures and road material can be used as the base or sub base. For this project, about 5,018,645 cubic meters of filling volume is required. Disposal of spoils is not anticipated due to potential reuse of all cut material. The anticipated impacts will be low in magnitude, site specific, short-term and insignificant.

11. Impacts from stockpiling and transportation of construction materials

Stockpiling of construction materials and aggregates as well as excavated material if piled haphazardly along the existing alignment as well as at the River side will be washed out affecting River/streams and cultivated lands. Stockpiling along the existing road and near settlement and urban areas will provide discomfort to the local inhabitants with the dust pollution as well. Further, haphazard storage along the urban settlements may also lead to

accidents. Such impact is likely all along the highway alignment and especially along the existing urban settlements such as at Dhalkebar, Bardibas, Lalbandi, Nijgarh, Chandrapur and Pathalaiya etc. These materials may be washed away by monsoon rain, causing water pollution to existing natural drainages and along the kamala, Baghmati, Bakaya Rivers and streams as Ratu, Lakhandehi etc. The unnecessary piling of construction materials would disturb the scenic beauty and topography of the local environment. Similarly, surrounding crops and ground vegetation may be damaged due to haphazard disposal of these materials.

The impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.

12. Impact from Stone Crushing Plants, Batching Plants and Asphalt Plants

The project needs to establish Crushing Plant, Hot mix Plant and Batching Plants if not sourced from nearby authorized suppliers. The establishment of Crushing Plant/Hot mix Plant/Batching Plants creates enormous quantity of dust particles and gaseous pollutants into the atmosphere, surface water pollution. These plants will impact on public health and well-being emits air, noise pollution to the local people, labor force.

Further, the wastewater discharges from the crusher plant and batching plants contain high sediments including cement slurry contamination. These discharges will pollute the soil (mainly agricultural land and crops) and surface water quality and aquatic environment if they are discharged into rivers and streams without any prior treatment. Locations of these sites are given in section 2.3.7.

The impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.

13. Impact of Climate Change

Climate change can contribute to the severity of the floods; because it is predicted in climatic scenarios that rainfall amount might be increased within the Terai region, especially in the monsoon season. Meteorological stations in the Terai region show an increasing level of precipitation in July from 1970 to 2009. The frequency and intensity of rainfall are also increased, as well as rainfall causing a rise in flash floods and debris flows. Predicted increase in precipitation may cause the water level higher than usual in Rivers and various streams crossing the project road. Bridge span capacity should be designed considering 10-15% increase of the storm water.

Also, the prevailing river networks may cause drainage problems related to water-logging along the KDP, especially during monsoon season.

7.2.2.2 Chemical Environment

1. Hazardous Waste

During construction, different types of hazardous materials like epoxy, additives, admixtures, cements, bitumen, paints, anti-stripping agents, etc. will be used. Waste containing such chemicals can be hazardous and needs special attention for disposal. Further, hazardous waste would also arise from the maintenance of equipment which may include used engine oils, hydraulic fluids, waste fuel, spent mineral oil/cleaning fluids from

mechanical machinery, scrap batteries or spent acid/alkali, spent solvents etc. *The impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.*

2. Potential Hazards Caused by Bitumen and other Toxic Chemicals

Bitumen is used for Asphalt/black topping the road surface. Approximately 30,000 metric ton bitumen will be required during asphalt works. Spillage of bitumen could harm soil and water pollution. Furthermore, during operation of bitumen, it also causes adverse impact to human health including skin burning.

Large number of vehicles, crusher/asphalt/batching plants and heavy equipment will operate during construction of road and bridges. There is possibility of accidental leakage of fossil fuel, lubricants, oils, acids and chemicals from such operations, if all these are not maintained properly. Exposure to acids and chemicals might bring carcinogenic effect to the laborers and land. Directly mixing of chemicals and lubricants in the water sources can disrupt aquatic species. *The impact will be direct in nature, high in magnitude, site specific in extent, short-term in duration and significant.*

7.2.2.3 Biological Environment

1. Loss of Vegetation/Trees

Due to road widening, it is noticed that in **total 4914 saplings (diameter 4.0425 cm to 14.56 cm)** and **28,120 trees and poles** including 8,954 poles (with dbh 14.56 to 24.26 cm) and 19,166 trees (with dbh >24.26 cm) may need to be felled down. Among these, 8,523 poles and 16,164 trees lie adjoining to forest area and rest lie adjoining to settlement area. **It is noticed that in total 1408.869 m³ of pole volume and 5868.305 m³ of tree volume is going to be affected due to road widening.** Detail list of saplings, poles and trees to be felled are given in **Annex 22**. Dominant of the tree species to be felled include Sal, Sindure, Banjhi, Eucalyptus, Asna, Padke, Kyamuna, Datrung, Pithari, Pyari, Sapota, Teak, Botdhairo, Sisoo, Hade, Aule and so on. *The impact will be direct in nature, high in magnitude, site specific in extent, long-term in duration and significant.*

2. Use of Forest Products by Construction Workers

Forest resources adjoining to the road alignment are mentioned in **section 5.2.1, Table 5-5 and Table 5-9**. Construction workers may involve in unauthorized collection of forest for fuel wood and NTFPs from adjoining forest area during their leisure time. NTFPs has been important for the income generation and improving local economics. The harvesting and collection of NTFPs leads to conflict with local community. The case will be severe if the workforce's energy needs for their meal cooking is met from firewood and it may exert pressure on the local forests of the surrounding areas. However, the workers will be followed the code of conduct during construction at forest section. *So, impact will be site specific, short term and of low in magnitude.*

3. Forest Fires

The activity of construction labors (smoking/ throwing cigarettes without putting off/ leaving the fire unattended) 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 will be indirect, high magnitude, site specific in extent, long term in duration and significant.*

4. Loss of Protected Species of Flora

Some of the tree species to be felled are protected species like Satal (Dalbergia latifolia) and Sissoo (Dalbergia sissoo) are listed in annex II of CITES, and further, Satal also lies within vulnerable category of IUCN. *The anticipated impact will be site specific, long term and of high in magnitude.*

5. Wildlife and Wildlife Movement

From the field survey, it is noticed that project area is subjected to wildlife movements mainly Elephant, Tigers, Deer, Sambar, Barking Deer, Blue Bull, Wild Boar, Gaur, Monkey, Langur etc. Wildlife movement is found to be of major concern in chainages 236+698 to 268+500, 327+700 to 333+100, and 334+500 to 363+100. Road kills are reported in Parsa National Park section. Road kills could be increased along with the widening of the road. Further, increase in traffic flow and speeds may cause wildlife population disturbance and decline due to vehicle-wildlife collisions in these sections when fast driving (especially during nighttime). *Proposed road upgrading works may pose more risks to the animals, and these impacts area assessed as high in magnitude.*

6. Hunting and Poaching of Wildlife

Illegal hunting and poaching can take place in natural forests by road workers. Where the road stretch is adjoining to forests (Parsa National Park and other Forests) concealing wildlife including game value, it may become a good ground for the locals for hunting and poaching of wildlife of game value due to open public transportation. *The anticipated impact will be site specific, long term and of high in magnitude.*

7. Impact in Aquatic Habitat

Construction works mainly for bridges can affect flows affecting aquatic wildlife too. Disposal of excavated materials in water bodies may increase turbidity of water and result in reduction in dissolved oxygen content. Inappropriate practices connected with vehicle washing in streams and Rivers can cause local water pollution by leakage of fuel that may put hazards on people and animals using these as household sources. Continual water pollution will also affect the aquatic biota, with subsequent negative consequences for fisheries and the economic return. The impact will be high in perennial rivers like Kamala, Janga Pul-1, Kalinjor – 2, Dumdume, Chapani, Rai Bridge, Bagmati, Lamaha, Kali Khola, Bakeya and Pasaha. *The anticipated impact will be site specific, short term and of high in magnitude*

7.2.2.4 Socio-economic and Cultural Environment

1. Private Structure Acquisition

The proposed road widening works will affect 66 private structures of 64 households. Among 64 projects affected HHs, 25 are losing residence, 35 losing business huts, 4HHs will lose both residential cum business. Further, 204 other extended housing structures (shed like) and dispensers of 4 petrol pumps needs to be removed. Details of structures to be damaged is

given in **Annex 29**. *The anticipated impacts will be of direct, site specific, of high in magnitude and long term in nature.*

2. Impact on Community and Public Structures

Due to road widening, it is noticed that all together 216 Community/Public structures need to be relocated beyond the proposed formation width. These include 35 small temples, 8 wells, 55 Bar/Peepal chautara, 69 waiting sheds, 5 gates, 12 boundary walls, 4 police posts, 3 public toilets, extended structures of 2 schools (Mahendra Adharsha Secondary School and Nepal Rastriya Secondary School), 3 roofs of haatbazar, 1 army checkpost, 2 police checkpost, 1 police waiting shed and 16 structures within army barrack. Besides these, it is noticed that due to road widening, 2221 electric poles and 33160 m of water pipe lines can be disturbed. Details of structures to be damaged is given in **Annex 30**. *The anticipated impacts will be of direct, local, of high in magnitude and long term in nature.*

3. Impacts from Labour Influx

The project requires approximately 1000 labours per day. Among these labours, around 600 are expected to be migrant workers. Labor influx may impact on the host community. The potential risks associated with labor influx are social tension arise between the local community and the construction workers, increase the rate of crimes and/or a perception of insecurity and influx of people may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), COVID-19, and **vector borne diseases like Dengue, Malaria** etc. The presence of workers in local communities can also result in intimate relations as well as sexual exploitation and harassment. *The anticipated impacts will be medium in magnitude, site specific and short-term in nature.*

4. Impacts from Labour Camps

Siting of camp will cause encroachment of agriculture land and alteration of drainage, solid waste and waste water problems. Impacts anticipated from construction camp establishment and operation include disposal of solid waste (organic waste, plastic and metal scrap, domestic effluent, etc.), competition on public facilities (drinking water sources, health facilities, schools, etc.), impairment of aesthetic value of the landscape (loss of vegetation, compaction and contamination of soil and land), poor sanitation (unhygienic latrine, poor drainage facility), transmission of communicable diseases (sexually transmitted diseases, vector borne diseases, etc.), poor water supply, use of alcohols, gambling and conflict with local communities. Further, toilet waste and waste water from Labor camps can pollute the nearby surface water source or soil, if not handled properly. Basic requirements of the worker in the project are given below:

Water Requirement for workers:

- Water requirement for worker living in Labor camps (600 nos.) will be about 30,000 Liters/day.
- Water requirement for worker not living in Labor camps (400 nos.) will be about 10,000 Liters/day.
- Total water requirement for the workers in the project: 40,000 Liters/day.

Wastewater Generation by workers:

- Wastewater generation by workers in labor camps (600 nos.) will be about 24,000 Liters/day.
- Wastewater generation by workers not living in Labor camps (400 nos.) will be about 8,000 Liters/day.
- Total Wastewater generation by workers in the project: 32,000 Liters/day.

Solid Waste Generation by workers:

- Solid waste generation by workers in labor camps (600 nos.) will be about 150 Kg/day
- Solid waste generation by workers not living in Labor camps (400 nos.) will be about 60 Kg/day
- Total Solid waste generation by workers in the project: 210 Kg/day

5. Child Labour, Forced Labour, and Trafficking in Persons (TIP)

Child labour refers to any work that deprives children of their childhood, their right to education, health, safety and mental development based on the ILO standards on child labour are defined by the ILO Minimum Age Convention, 1973 (No. 138) and the Worst Form of Child Labour Convention, 1999, (No. 182). Similarly, World Bank ESF, DOR OHS Policy and Guidelines, National Occupational Health and Safety Policy, Labour Act 2074, Child Labor (Prohibition and Regulation) Act 2056 etc. have provisions to prohibit use of child labours. If not monitored properly, there may be some chances of child labour in this project too.

Forced labor occurs when individuals are compelled against their will to provide work or service through the use of force, fraud, or coercion. Though the project aims in full avoidance of forced labours, however, in practice in some sector of works, there might be the risk of the non-compliance.

Trafficking in persons is defined as the recruitment, transportation, transfer, harbouring or receipt of persons by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purposes of exploitation. Women and children are particularly vulnerable to trafficking practices. The project is easily assessable to the Nepal-India boarder area, where there is human trafficking, hence the project should tackle the issue of trafficking in persons seriously.

6. Gender Discrimination/Sexual Harassment

During construction works, there may be discrimination between male and female workers in opportunity and wage. Contractor may favor male workers. There can be the issues regarding gender violence like sexual harassment in work place too.

The impact will be direct in nature, moderate in magnitude, local in extent, short term in duration and significant.

7. Occupational health and Safety

During construction period, workers could be exposed to various health risks and hazards. Occupational Health and Safety risks likely to arise during the construction phase include: exposure to physical hazards from use of heavy equipment; working at height and electrical

equipment; working on water, trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Workers may be encountered with health hazard during earthwork cutting, handling of hazardous materials, machinery movement, bitumen works, bridge construction and embankment stabilization etc. If the personnel protective equipment (PPE) (helmet, gloves, boots, goggles, ear guard with sponge muffler etc.) are not used or if there is lack of adequate safety measures, workers may suffer from accident, respiration issues and eye irritation due to exposure to dust and emissions. *The impact will be direct in nature, high in magnitude, site specific in extent, long term in duration and significant.*

8. Impacts on Community Health and Hygiene

There are settlements, schools and others on both side of the road alignment. The deterioration in ambient air quality due to increase in dust particles from the construction activities and vehicular emission will cause respiratory problems, eyes disease among all ages especially children and old age people. The movement of heavy vehicles, use of heavy equipment and construction activities will add up in the existing noise level in the subproject area disturbing people living. Further, environmental pollution from haphazard disposal of waste, construction spoil, leakage/ spillage of chemicals, fuel affect the health of locals. Accidents involving spillage of fuel and chemicals may pollute water source and contaminate water supply. The spread of communicable diseases like COVID 19, **Dengue** etc. from the construction workers to the community may cause serious impact on community health.

The impact will be indirect, high in magnitude, site specific in extent, short-term in duration and significant.

9. Traffic Management

Efficient traffic management is very important during the time of construction, when some sections of the road can be blocked for the upgrading work. Blockage of the road can also affect traffic and road safety, especially in highly populated sections of the highway. Pedestrians including disable people along the bridge and approach roads will be vulnerable to accidents. *The impact is considered as direct, high in magnitude, site specific and short term in nature.*

7.2.3 Operation Phase

7.2.3.1 Physical Environment

1. Air and Noise Pollution

The improved road surface is expected less dust and noise pollution due to traffic plying on the asphalt paved road. However, the increased number of heavy vehicles plying in the highway and the increased commercial and industrial activities will increase air and noise pollution. The air and noise quality will further deteriorate due to increment in vehicular traffic in future years. *The anticipated impacts will be medium in magnitude, local to regional and long-term in nature.*

2. Water Pollution

Leakage of fuel, oil and grease from vehicles can contaminate water sources and pollute them. The practices connected with car/truck washing in rivers and near wells has the potential to cause local water pollution by leakage of fuel, lubricants and hydrocarbons that may not only

affect the aesthetic value of water bodies but also have detrimental effects on the health of people and animals relying on these sources.

The impact will be direct in nature, low in magnitude, site specific in extent, mid term in duration and insignificant.

3. Increase in Road Accidents

The road will be upgraded to meet the design speed of 100 km per hour. Hence, the smoother road with curve improvements will result in increase of traffic speeds hence creating more risks for accidents amongst traffic users as well as the local communities in the project area.

The anticipated impacts will be direct, medium in magnitude, site specific and long-term in nature.

4. Road Embankment Instability and Blockage of Cross Drainage causing Inundation and Flooding

During the operational phase, high road embankment sections could be destabilized due to monsoon rain; the stability of road embankments may also be affected by human activities by opening access road etc. Cross drainage problems such as water blockage, chocking of natural drainage due to erosion, sediments deposition (mainly from chure section) and disposal of debris by the public. It will create overflow of surface water, change paths causing soil erosion, bank cutting, inundation and flooding. Sometimes it might cause complete failure of drainage structure. The inundation and floods cause severe bank erosion, threatening the destruction of settlements and agricultural land. The main flood and water logging prone area are noticed in Dhanusha, Lalbandhi and Nijgadh area. The main reason of flooding/inundation/water logging is due to encroachment of waterway (buildings and settlements) and deposition of sediment. *The impact will be direct, medium in magnitude, local and long term in nature.*

5. Climate Change

Climate change can contribute to the severity of the floods; because it is predicted in climatic scenarios that rainfall amount might be increased within the Terai region, especially in the monsoon season. Meteorological stations in the Terai region show an increasing level of precipitation in July from 1970 to 2009. The frequency and intensity of rainfall are also increased, as well as rainfall causing a rise in flash floods and debris flows. Predicted increase in precipitation may cause the water level higher than usual in Rivers and various streams crossing the project road.

Beside this, other than traffic load, climate factors such as temperature, precipitation, sunshine, humidity, etc. are also the cause for degradation of road surface. The change in temperature and precipitation deteriorate the pavement surface earlier than expected. Change in temperature (high temperature) result in cracking of the pavement and bitumen bleeding. Increase in precipitation causes moisture imbalance in the subgrade resulting in the reduction of subgrade stiffness properties and ultimately increased permanent deformation.

The impact will be indirect in nature, high in magnitude, site specific in extent, short term in duration and significant.

7.2.3.2 Biological Environment

1. Pressure on Forest Resource

A road that passes through forest may convert forest area into built up area. Development of ribbon settlement, often in the form of undesirable ribbon development of squatters, commonly results in increased pressure on forest resources for collection of firewood. 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 demand of both locals and tourists.

The impact will be indirect in nature, moderate in magnitude, site specific in extent and long term in duration and significant.

2. Disturbance to Wildlife Movement

Fast vehicular movement (especially during night), excessive use of horn in forest area will disturb wildlife. The lighting of vehicles during night time restricts the movement of wildlife and also possibility of collision with vehicles. However, after construction of all mitigation measures the impact will be expected minimal. *The impact is indirect in nature, low in magnitude, local in extent and long term in duration.*

7.2.3.3 Socio-economic and Cultural Environment

1. Ribbon Settlement along the Road and RoW Encroachment

Due to improved transportation and services, people will be attracted to project area (present scenario too) and more houses will be built to accommodate increased population. This increases ribbon settlement along road corridor of major settlements and market centers. The permanent and temporary structures built by encroachers along the road alignment can cause impacts on the pavements and road side drains. They also obstruct maintenance activities of the roads, view range of travelers and impact to the movement of pedestrian. This will lead to haphazard urbanization with problem of traffic congestion, drainage, waste etc.

The impact will be indirect in nature, moderate magnitude, local in extent and long-term in duration and significant.

CHAPTER 8: ENVIRONMENTAL ENHANCEMENT AND MITIGATION MEASURES

Numerical Scale mentioned in EPR 2077 and National EIA Guidelines (1993) is used to analyze the impact of the proposed subproject. Abbreviations uses are as: *Nature: *Direct (D)/Indirect (I)*; Magnitude: *M (High-60, Moderate-20, Low-10)*; Extent: *E (Regional-60, Local-20, Site Specific-10)* Duration: *D (Long term-20, Mid term-10, Short term-05)*, Significance: Σ (*Highly Significant (HS), Very Significant (VS), Significant (S)/Insignificant (IS)*). The combine score below 40 shall be termed as insignificant impact (IS); scores ranging between 40 and 79 shall be termed as significant impact (S), scores ranging between 80 and 99 shall be termed as very significant (VS) and the scores above 100 shall be termed as highly significant impact (HS). The numerical scale is presented in Tables 8.1 and 8.2 below. Further Environmental Management Plan (EMP) as per EPR 2020 schedule 12 is given in **Annex 31** (General EMP and Bridge specific EMP).

Adverse and beneficial impacts that are not identified or anticipated at this stage, if latter discovered during the construction and operation stage of the project shall be duly taken care of by the proponent.

8.1 Beneficial Impacts Augmentation Measures

The Augmentation measures for beneficial impacts are given in Table 8-1.

Table 8-1: Augmentation Measures for Beneficial Impacts

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Augmentation Measures
		D/I	M	E	D	Σ	
Beneficial Impacts							
Construction Phase							
Socio-economic and Cultural Environment							
Overall Project Activities	Employment Generation	D	H (60)	SS (10)	LT (20)	VS (90)	The contractor will be encouraged to give priority to local and marginalized people including women in construction works as per their skills.
On the job learning	Skill Development	D	M (20)	SS (10)	LT (20)	S (50)	The local labor will receive on job training in construction techniques (gabion weaving, bar binding for bridges, embankment filling, bio-engineering, drain lining, masonry training), small engineering structures and bio-engineering works.
Overall Project Activities	Increase in Income of Local People	I	H (60)	SS (10)	ST (05)	S (75)	Construction activities will not only increase the income sources of the local people, but will open opportunities for additional businesses such as the establishment of additional food and tea shops, groceries for serving large numbers of people.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Augmentation Measures
		D/I	M	E	D	Σ	
Camp and Office establishment	Income from Rented Land and Houses	D	M (20)	SS (10)	ST (05)	IS (35)	Local people will be benefited from renting their houses and spaces for different project facilities like labor camp, project office etc.
Construction Activities, Involvement of Women	Outside Exposure and Women Empowerment	D	M (20)	SS (10)	LT (20)	S (50)	The employment emphasis will be given to the women as a part of benefit augmentation measure imparted by the road project. While selecting participants for different training special consideration will be given to women and at least 33% of the total participants will be women. Further as a part of awareness programme the beneficiaries will get different types of awareness on HIV/AIDS and other skill based training. A separate GESI plan will address the gender-based activation of the project.
Operation Phase							
Socio-economic and Cultural Environment							
Construction of Road Improvement Structures	Improved Road Infrastructure	D	H (60)	SS (10)	LT (20)	VS (90)	The upgraded road provides the easy, comfortable and improved access to the people. The benefit augmentation measures will be proper maintenance of the road during operation period and after operation period. Contractor will undertake responsibility of maintenance through Defect Liability Period (DLP) phase of 12 months and Performance Based Maintenance (PBM) period for 24 months after the construction.
Smooth operation of road	Improvement of Trade	I	H (60)	SS (10)	LT (20)	VS (90)	The road has connecting other country via India. After 4 lanes, the transportation of goods and services from India to the project region and to other parts of the country will be cheaper, easier and faster. This beneficial impact could be augmented by increasing production of local products such as cereals and cash crops like vegetables and fruits.
Smooth operation of road	Tourism Development	I	M (20)	SS (10)	LT (20)	S (50)	The improved road will enhance tourism due to better and smooth road to well-known tourist destination places. As stated above, periodic and routine maintenance of the road should be properly streamlined.
Smooth operation of road	Appreciation of Land Value	I	M (20)	SS (10)	LT (20)	S (50)	The local people can be benefitted by the appreciation of land value. The locals with farm-based enterprise will gain benefits by borrowing loans on collaterals based on the increase in land value.
Physical Environment							
Smooth operation of road	Carbon Emission Savings/Reduction in GHG emission in Transportation	I	M (20)	R (60)	LT (20)	VS (100)	Enhancement measures for this include: Periodic maintenance of Pavement and structures, Recommendations for fuel efficient machinery, Carbon offset by planting trees and Prevent activities that increase GHG emissions.

8.2 Adverse Impact Mitigation Measures

Mitigation hierarchy as defined by EPR 2077 BS and also in the Guidance Note of the World Bank has been adopted. As per this, first priority is given for avoiding impact, second priority for minimizing impact, third priority for rectifying impact, forth priority for reducing impact and finally for offsetting the impacts. Practical measures (or actions) have been proposed to address the possible environmental and social impacts that may result due to project implementation (construction and operation). Mitigation Measures for Adverse Impacts are given in Table 8.2.

Table 8-2: Mitigation Measures for Adverse Impacts

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Adverse Impacts							
Construction Phase							
Physical Environment							
Upgrading the road (widening and blacktop)	Change in Land use	D	L (10)	SS (10)	LT (20)	IS (40)	The impact in land use is residual impact but can be reduced through confining vegetation clearance only within formation width or only where necessary. Road width has been reduced in forest areas and rural areas from 50 m to 26 m only. Further, compensatory plantation and maintenance of greenery along road embankment (road side) and median will be done. The project will plan and implement greenery enhancement along the road alignment. Unnecessary access roads/diversions will not be constructed.
Road widening in agricultural and forest areas	Loss of Productive Top Soil	D	L (10)	SS (10)	LT (20)	IS (40)	Impact on topsoil cannot be avoided but can be reduced by collecting and preserving the topsoil that is to be disturbed during site clearance for construction and later reuse it during turfing/bioengineering along road embankment and maintaining greenery along median and site restoration (camps, quarry and borrow pit). Loss of top soil can be reduced if vegetation clearance is not done during rainy season.
Excavation and use of vehicle/equipment	Air pollution	D	H (60)	Lo (20)	ST (05)	S (80)	So as to minimize air pollution due to project activities, Construction materials will be transported in well covered vehicles, Sprinkling water on working areas, at-least two times a day during dry season; Avoiding operation of drill machines, excavators, loading and unloading of materials during wind or will be wetted before loading (specially during windy condition); Regular check, maintenance of vehicles, machinery and equipment operating on site; Use emission test passed vehicles for construction works and Providing dust masks to labour workers

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Construction work and movement of vehicles/equipment	Noise pollution and vibration	D	H (60)	SS (10)	ST (05)	S (75)	The mitigation measures adopted will be: Discourage the use of horns in schools, hospitals and forest areas, Strict adherence to day working hours if nearby is sensitive receptors, switch off vehicle engines while offloading and on loading the construction materials, Routine maintenance of construction machinery and vehicles, Proper barricade of construction area, Scheduling construction works (mainly near schools and hospital areas) so that noise generating construction works will be done during off office time), Use of ear muffler by worker in high noise exposure areas;
Use of chemical substances, quarrying operation, stockpiling of excavated soil	Water pollution	D	M (20)	Lo (20)	ST (05)	IS (45)	An instruction will be given to all equipment operators, drivers and warehouse personnel on immediate response for spill contamination and eventual clean up, Prohibition on mixing of soil, solid waste and other waste directly into the river, Sanitary facility will be provided with provision of portable chemical toilets with a connection to a sewer if possible or separate septic tank to prohibit open defecation and disposal of waste, sludge and other waste directly into water bodies;
Construction activity, Operation of Camp sites	Solid waste generation	D	H (60)	SS (10)	ST (05)	S (75)	Operationalization of the Reduce, Reuse and Recycle (RRR) principles in waste management will be adopted. Garbage generated from construction of labour camps will be segregated at the source and the degradable waste will be managed in its own pit and non-biodegradable waste and construction waste will be collected and stored in a separate garbage collection center. For segregation of wastes at source itself, clearly labeled separate bins with language understood by workers will be placed at all the possible locations. Generated wastes will be collected daily. Recyclable and reusable portion of solid waste will be stored in a separate storage area and sold to scrap vendors, non-biodegradable waste will be transported to the nearest landfill site in coordination with the local government ; Burning of the garbage will be strictly prohibited.
Excavation near river and at river banks	River Bank Instability	D	M (20)	SS (10)	ST (05)	IS (35)	Excavation works will be halted during rainy season. During road improvement, only required vegetation will be cleared and all high embankment near Bridges will be re-vegetated 2640 Sqm and river side slope protection will be done by applying bio-engineering technique (Grass plantation, Brush layering, and Tree/Shrub plantation) with combination of civil structures. Further, soil erosion will be stabilized by applying engineering as well as bioengineering techniques. Excess spoil material during excavation of bridges will stockpile in designated location for filling purposes, River water flow will not be disturbed during construction, retaining structures and vegetation cover for bare slope is proposed 2640 Sqm

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
							slope covers with bioengineering measures and 17563 cum retaining structures is proposed for river bank protection.
Operation of Quarries and Borrow Pits	Air, water and noise pollution, Change in River morphology, downstream sedimentation	D	H (60)	SS (10)	ST (05)	S (75)	The project will obtain approval from concern authorities of government and private land owners. In the case of extracting materials from national forests area, prevailing mines and mineral act and regulation of GON will be followed. For this specified amount will be paid to Department of Mines and Geology and extra 10% amount will be deposited in Forest Development Fund through Department of Mines and Geology. Contractor will prepare borrow pits and quarry sites operation and restoration plan and submit for approval from Engineer before beginning the quarry activity, The contractor will be responsible for maintenance of any damage to haul roads to their original state and does not disturb river water course during the operation of quarry, Water spray system will be developed to check the flying of dust from quarrying and crushing activities, Sediments will be covered while transporting, Proper storage space at the extraction sites will be established, Storing or piling the sediments nearby the road or paths or any agricultural lands will not be done, Reclamation and management of quarry sites after its operation. The project activities will not increase sediment load to any of the water bodies. For this, excavation will not be done from river water area and will further be halted during rainy season.
Excavation activities	Spoil Generation	D	L (10)	SS (10)	ST (05)	IS (25)	Most of the cut material will be used as fill material for embankment construction backfilling for retaining structures and road material will be used as the base or subbase. Disposal of spoils is not anticipated due to potential use of all cut material. If spoil disposal is needed, the spoils will be used for the restoration of the borrow sites.
Stockpiling and transportation of construction materials	Air, water and soil pollution	D	H (60)	SS (10)	ST (05)	S (75)	Possible locations of construction camp and material stockpiling site are given in section 2.2.7. The contractor will obtain written permission from landowners and local bodies for stockpiling on their land. Stockpiling will be covered by a tarpaulin sheet specially during the rainy and windy season; Proper drainage will be arranged around the stockpile area; Floodways, natural drainage paths, water bodies will be avoided for stockpiling the construction materials, stockpiling of the cement and other materials in shaded structures above the ground on wooden plank to avoid the moisture contact within the construction camp will be made; agricultural land and other land will be restored/rehabilitated after use.
Operation of Crushing Plants,	Air, water and soil pollution	D	H (60)	SS (10)	ST (05)	S (75)	Suitable locations for establishing such construction camps are given in section 2.2.7. Permission will be obtained from local stakeholder for operation of construction camps.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Batching Plants and Asphalt Plants							Impacts from operation of crusher plant, hot mix plant and batching plant will be minimized through: Locate plant site away from population centers, drinking water sources, cultivated lands and water bodies, The equipment for crushing, screening, washing, handling and stockpiling of aggregates will be designed in such a way that the concreting schedule can be kept at any time, Stone crushing equipment / cement batching plants will be fitted with dust control devices and operated as per Manufacturer's Specification, Water sprinkle will be done to crusher running materials during operation to minimize dust, make siltation pond to manage waste water, For controlling noise, regular lubrication of moving parts will be done, The plant will be operated during day time only, agricultural land and other land will be restored/rehabilitated after use. All the crushing plant, batching plant and asphalt plant sites will be assisted with sedimentation pond with sufficient retention capacity to settle the sediment (reduce sediment load) and treating facilities to neutralize chemicals before discharge.
Chemical Environment							
Use of Chemicals in Construction	Generation of Hazardous Waste, Worker's and community's health hazard, soil and water contamination	D	H (60)	SS (10)	ST (05)	S (75)	Use of toxic and hazardous chemicals cannot be avoided but impacts can be avoided or reduced through proper implementation of Standard Operating Procedures for Pollution Spills and Management of Fuels and Hazardous Substances. Construction workers will be oriented on safety rules for proper handling, storage and disposal of hazardous substances like fuel and bitumen; Hazardous or toxic substances will be in leak- proof containers labelled with details of composition, properties and handling information; Chemicals and oil will be stored in a well-ventilated room away from water bodies. The storage area will be paved covered, paved with interceptor drains, and oil/ water separator; Collected fuels and contaminated materials will be re- use, stored and disposed safely; Fire extinguisher will be installed in such chemical storage area and training will be provided to related staff for its use.
Use of Bitumen and other Toxic Chemical	Worker's and community's health hazard, air, soil and water contamination	D	H (60)	SS (10)	ST (05)	S (75)	Fuel wood and tyres shall be strictly prohibited for heating bitumen; Heating of bitumen near water bodies and disposal of bitumen in water bodies will be avoided; Automated asphalt plants will be used; Bitumen drums will be stored in a secure place within the construction and camp site and at least 500m from any water bodies; Bitumen mixing plant should have inbuilt mechanisms for the absorption of gases; Compulsory use of PPEs by the operator while operating bitumen distributor.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Biological Environment							
Widening of Road	Loss of Vegetation/Trees	D	H (60)	SS (10)	LT (20)	VS (90)	The design has comprised curve improvement in forest sections (chainage 281+500 to 284+000 and 314+500 to 316+500) to avoid forest land acquisition. For minimizing the impact, vegetation only within formation width will be cleared. Further, compensation of cut down poles and trees by planting new trees in the ration 1:10 and caring for 5 years will be done considering survival rate and other factors including climate change and No Net Gain-No Net Loss approach. For this, around 281,200 trees will be planted as compensatory plantation and will be cared for 5 years. The required amount for compensatory plantation and care for 5 years will be deposited in Forest Development Fund. Some of the identified locations for compensatory plantation are: degraded forest at Lalgadh CF, near Banke Subdivision Forest Office, plantation area near Jaitapur post, Kakadi, post, Bodhwan post etc. Similarly, compensatory plantation can be done along river banks through adoption of appropriate flood control measures. Contractor will prevent illegal felling of trees by labor force and who's ever found guilty will also be liable for penalties; The Project will closely coordinate with division forest office, community forest group and its outlet to control illegal trade of forest resources;
Influx of workers	Use of Forest Products by Construction Workers	D	L (10)	SS (10)	ST (05)	IS (25)	Contractor will provide alternative fuel like LPG and no use of firewood; Contractor will prevent illegal cutting of forest wood by labor force and who's ever found guilty will also be liable for penalties; The Project will closely coordinate with forest office, community/collaborative forest and its outlet to control illegal trade of forest resources; No workers will be allowed to enter the forest area and will be confined only within RoW of KDP road that too during construction time only; Project officials, labor force, contractors, consultants and other stakeholders will abide the forest act and its regulation.
Fire related works, smoking by workers	Forest Fires	ID	H (60)	SS (10)	LT (20)	VS (90)	Smoking will be restricted in the construction site near forest area; Labor camp will not be established near or within the forest premises; Firefighting equipment (fire extinguishers) will be provided at the camps site and construction sites to control if fire break out and spread of fire; Awareness on forest fire management will be provided to the construction crews in coordination with CFUG, DFO.
Widening of Road	Loss of Protected Species of Flora	D	H (60)	SS (10)	LT (20)	VS (90)	Compensatory plantation will be given priority as per conservation (Such as Sal, Satal and other indigenous species).

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Road Improvement Works	Disturbance to wildlife and wildlife movement	D	H (60)	SS (10)	LT (20)	VS (90)	For reducing the impact in wildlife movement across KDP road alignment, 8 bridges at chainages 329+752, 333+733, 339+342, 347+209, 353+628, 357+227, 358+477 and 363+585 will be modified as underpasses for elephants and 9 bridges at chainages 271+514, 274+925, 275+630, 277+266, 278+913, 282+758, 285+721, 292+703, and 317+698 and one culvert (causeway to be upgraded to culvert) at chainage 322+553 will be modified as underpass for medium size animals to meet the Wildlife Friendly Infrastructure Construction Directives, 2022 (2078 BS) and as per BMP. All these underpasses will be assisted with guiding fences and annual maintenance of river/stream bed level and banks for facilitating animal movement. Span and height of the bridges proposed for underpass are sufficient enough for addressing animal movement as well as water flow. The understructure of the bridge will be modified to improve access of the wildlife to the river course for drinking water, Mobility of the wildlife, flat passage (more than 15 m wide) on both sides of the river, above the normal flood level, underneath the bridge and Baseline vegetation under and around the underpass will be maintained, rather improved with added native fodder species, preferred bamboo and grasses, horticultural species, etc. will be grown not obstructing the visibility in and around the underpass. As far as possible, the basement of the underpass will be maintained naturally with the main focus on mammals using the underpass being tigers, elephants and other ungulates largely.); Beside these other measures like speed breakers/rumble strips, roadside reflectors and mirrors, signage, variable message sign, installation of arboreal mammal canopy bridges at six locations (Ch: 364+200, Ch: 357+500, Ch: 349+200, Ch: 340+900, Ch: 336+400 and Ch: 330+700), sound and light barriers etc. will be adopted. Ponds in different locations in coordination with DFOs and Parsa National Park will be constructed for addressing water requirement to wildlife as well as recharge. A Rapid Response Unit is proposed constituted with a staff of Parsa National Park, Wildlife Biologist and Environment expert to respond in the event of an emergency situations and take appropriate steps till the situations comes to normal. Regular patrolling will be done to monitor the wildlife movement, frequency and to note change in routes by elephants and other mammals. Beside this, wildlife monitoring will be done as suggested by BMP mainly in proposed underpass sections. Monitoring of wildlife movement and vehicle-animal interaction through camera traps has been suggested.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Influx of workers	Hunting and poaching of wildlife	D	H (60)	SS (10)	LT (20)	VS (90)	Preparation of code of conduct and proper implementation among the construction crew about these issues, instructions and orientation to workers; Awareness programs about the importance of conservation as well as legal punishment to the construction crew and locals in coordination with CFUG, DFO; None of the workers will be allowed to enter inside the forest.
Construction activities within and near rivers	Impact in Aquatic Habitat	D	H (60)	SS (10)	ST (05)	S (75)	Excavation work, construction of bridges and culverts will be carried out in dry season; Construction waste or material will not be disposed in the water bodies or in valley; The construction camps will be located sufficiently away (at least 100 m distance) from the water bodies; Open field defecation will be avoided; Activities like washing clothes, washing vehicles near water bodies will be avoided.
Socio-Economic and Cultural Environment							
Widening of road	Acquisition of Private Structures	D	H (60)	SS (10)	LT (20)	VS (90)	The affected households will receive cash compensation against loss of structures and will provide additional cost of assistance for relocation and livelihood restoration. Skill training will be provided to people of affected households, mainly vulnerable households. A Resettlement Action Plan (RAP) has been prepared to address on the affected households.
Widening of road	Impact on Community and Private Structures	D	H (60)	SS (10)	LT (20)	VS (90)	Prior inform to public before shifting of the respective structures, utility. Take advanced actions and process necessary clearance, transfer of funds etc. to the respective utility service provider so that not cause any disturbance for uses by local community; and delays to the road construction schedule. Community structures- Rebuilt/shift with consultation of the local community, local authorities, and the cost is allocated in project cost. Water supply lines – contractor will relocate/reinstate the water pipelines – provision in the engineering costs; Electric poles and power lines – coordination with Nepal Electricity Authority for relocation; Telephone lines – Communication Department; Public toilet– Coordination with local government for relocation/reinstate Access roads – reinstate; Wells - new well will be constructed before demolishing the existing on; Separate utility duct will be installed with consultation of concern stakeholders.
Influx of Labours from outside	Conflicts and social stress, spread of communicable diseases	D	M (20)	SS (10)	ST (05)	IS (35)	Awareness campaign will be implemented at the beginning of the construction phase to provide awareness to workers about social behaviors of local peoples, raising awareness and implementing a Code of Conduct for the workers; Construction camps will be built in the designated areas, located away from the local settlements; Community awareness programs on construction-related hazards, including awareness programs in schools, construction activities such as excavation, bridge foundation particularly and the areas, may pose safety

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
							risks to the nearby people; The awareness campaign with local people and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS; COVID-19 and other communicable diseases protocol measures will be adopted; Regular monitoring of camp sites and construction sites will be done by the contractor and proponent; Adopt a Grievance Mechanism to allow local residents to file complaints.
Operation of Labour Camps	Generation of Solid and Liquid Wastes, Impacts on Health and Sanitation	D	H (60)	SS (10)	ST (05)	S (75)	Suitable sites for establishment of labour camps are provided in section 2.2.7. Contractor will follow site selection criteria for establishment of camp sites (away from settlement, school, health posts, hospital); To the extent possible, existing houses which are in good living conditions and not affected by the earthquakes will be used for lodging; Orientation on waste management to the construction staff and labors. Separate waste bins (for waste segregation) will be provided at labor camps, construction camps, bio-degradable wastes will be converted into compost manure, recyclable wastes will be sold to scrap vendors and remaining wastes will be disposed to the landfill site of local government with coordination to the municipality; Sanitation and hygiene of the labor camp will be maintained; Separate toilets will be made for male and female workers. Bathrooms will also be established in the campsite; Bed and bedding will be provided to the workers. Separate lodging arrangements will be made for the husband and wife among the labors. Net will be provided within the campsite for the protection against mosquitoes and insects; Safe drinking water, gas for cooking, proper ventilation, communication and lighting will be managed by the contractor. For the means of recreation contractor will provide means of entertainment like carom boards, ludo etc.; First aid facilities will be made available at camp sites. In addition to this, collaboration with health/sub-health posts for major injury cases including a contingency plan for emergency cases will be prepared; Fire extinguisher will be installed and training for using fire extinguisher will be provided to the staffs;
Construction Works	Child Labour, Forced Labour and Trafficking in Persons	D	H (60)	SS (10)	ST (05)	S (75)	For avoiding cases of child labour, forced labour and trafficking; Community awareness and sensitization with emphasis to women and young girls will be arranged, Training and awareness regarding trafficking; Coordination with organizations working on anti-trafficking within project area; Vigilance from law enforcement authority and compliance with the labour laws; Display of hoarding boards about anti trafficking; Strictly avoid use of child labors below 16 years old as the construction works is categorized as risky jobs; Discourage the use of forced and bonded labors.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Overall Project Implementation	Gender discrimination and sexual harassment	D	M (20)	L (20)	ST (05)	IS (45)	The project will make provision in the contract document to provide equal wages despite of gender for same nature of work; The contractor and proponent will provide awareness on gender discrimination, sexual harassment, gender-based violence, sexual exploitation in labor camp; Contractor will monitor the camp area and activity of the labor; Establishing the well-functioning Grievance Hearing Mechanism to address the issues of Gender Based Violence (GBV), Sexual Exploitation and Sexual Harassment.
Construction works	Occupational health and safety	D	H (60)	SS (10)	LT (20)	VS (80)	Compliance of Compliance of World Bank ESF, DOR OHS Policy and Guidelines, National Occupational Health and Safety Policy, Labour Act 2074, Child Labor (Prohibition and Regulation) Act 2056; Life and accidental insurance of labors and staffs; Orientation and awareness about the OSH to the construction crew; Preparation and approval of Emergency Preparedness and Response Plan (EPRP) by the contractor; Provision of well-equipped first aid boxes at the construction site; Provision of first aid training to the staffs; Compulsory uses of PPEs in the construction area by construction crews and staffs; Provision of proper safety signs at construction site to avoid fatal accidents with moving and stationary equipment
Construction works	Impacts on community health and hygiene	I	H (60)	SS (10)	ST (05)	S (75)	Sprinkle water to control dust at least two times a day during dry season; Schedule and inform the construction activities timely to the sensitive receptor (health posts, schools, temples); Campsite with provision of sanitation facilities, waste disposal sites, washing areas, etc.; Awareness program on the spread of diseases due to haphazard waste disposal by the proponent.
Construction works, Movement/operation of construction vehicles and equipment	Traffic Management	D	H (60)	SS (10)	ST (05)	7S (45)	Traffic management plan is given in Annex 33. This will be further elaborated by the contractor prior to the construction works; Safety signs like Men at Work, Construction works in Progress etc. and use of caution tape in risky areas to avoid the traffic accidents; Well-maintained Traffic diversions will be provided in necessary places; Speed limit will be defined in sensitive receptors area (like school, health post); Awareness to the drivers of construction vehicles and equipment about the speed limits and traffic rules by the contractor. For worker's safety: Establishment of work zones to separate workers from traffic; Closure of lanes and diversion of traffic to the remaining lanes if the road is wide enough (e.g.re-routing of all traffic to one side of a multi-lane highway); Where worker exposure to traffic cannot be completely eliminated, use of protective barriers to shield worker from traffic barrels) to delineate the work zone; Regulation of traffic flow by warning lights, use of flaggers if possible; Install warning sign such as reduction of maximum vehicle speeds in

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
							work zones; Training of workers in safety issues related to their activities, safe practices for work at night and in other low-visibility conditions, including use of high-visibility safety apparel and proper illumination for the workspace.
Operation Phase							
Physical Environment							
Movement of Vehicles	Air and Noise pollution	D	M (20)	L (20)	LT (20)	S (60)	Air pollution by dust will be controlled with provision of paved shoulders and regular maintenance especially in the sensitive/built up areas; Periodic and routine monitoring and maintenance of road, bridges and culverts will be done by the contractor during DLP and PBM period; Awareness to the local communities will be given on maintaining greenery along the road corridor by planting fodder, fuel wood and fruit trees including flowering plants in coordination with DFO.
Leakage of chemicals from vehicles, washing vehicles in rivers	Water pollution	D	M (20)	SS (10)	LT (20)	S (50)	Soil, sludge, and other wastes will generate from maintenance of road, drain and cross drainage. Directly disposal into water bodies will be avoided by using designated spoil disposal locations; Prohibition of activities likes washings - near water bodies.
Vehicular movement	Increase in Road Accidents	D	M (20)	SS (10)	LT (20)	S (50)	Provision of road safety and pedestrian- friendly design features in the road design like, bus bays, traffic signs, speed limits signboards, especially at school and settlements; Provision of reflecting paint on level surface, reflectorizing glass beads on bituminous surface, road marker; Provision of road maintenance sign at construction site to avoid fatal accidents with moving and stationary construction equipment and construction material during the road maintenance period; Provision of road safety awareness campaigns to communities by proponent along road corridor targeting pedestrians, drivers, parents, school children, professional drivers by the proponent
Rain, Human activities-opening/upgrading access roads	Embankment Instability, Blockage of Drainage leading to Inundation and Flooding	D	M (20)	L (20)	LT (20)	S (60)	Routine and recurrent maintenance of roads like cleaning of cross drainage, drains and additional embankment protection structures will be done along with road maintenance. Soil conservation activities through plantation will be promoted in the right of way and embankment slopes. The size of the drainage structures is designed to accommodate increasing volumes of water. All pipe culverts will be replaced by box culvert to minimize flooding, inundation, and maintain natural flow. Deposition of sediment will be regularly removed and river channelization will be done in case of heavy sedimentation.

Proposed Activity	Environmental Impacts	Determining the level of Impact*					Mitigation Measures
		D/I	M	E	D	Σ	
Climate Change	Increased flow in rivers, Pavement cracking and bitumen bleeding	I	H (60)	SS (10)	ST (05)	S (75)	All the drainage and cross drainage structures have been designed considering increased precipitation due to climate change (10% incremental); Further, during road design phase sustainable pavement design and management has been adopted to prevent early cracks and bleeding; Local people will be encouraged to maintain the road side greenery to reduce the climate change impacts. Existing petrol pumps will be encouraged to add vehicle charging stations too.
Biological Environment							
Access adjoining to forest	Pressure in Forest Resources	I	M (20)	SS (10)	LT (20)	S (50)	Make the local people aware of the existing laws and policies related to road rights and forest and biodiversity; Encourage and support local community for controlling illegal harvesting of forest resources; Traffic signs and board with a message on "Importance of forest" will be placed near the forest boundaries; Awareness will be provided to locals for plantation and maintenance of the forest resources and that intensive cattle grazing will destroy the forest in coordination with DFO;
High speed of vehicles within forest reserve	Disturbance to Wildlife Movement, Loss of Wildlife	I	M (20)	SS (10)	LT (20)	S (50)	Regular cleaning and maintenance of all wildlife crossing structures (modified bridges and culverts for animal crossings) to reduce the chances of blocking and facilitate animal movement; Workshops for awareness-raising on forest fire, wildlife protection such as prevention of waste dumping from vehicles, speed limit, and potential collision with animals; Regular inspection and maintenance of water sources/pond, fencing installed in the forest areas; Install cameras for regular monitoring of wildlife crossing.
Socio-economic and Cultural Environment							
Development due to Road Upgradation	Ribbon Settlement along Road and RoW encroachment	I	M (20)	L (20)	LT (20)	S (50)	Project/DRO will conduct awareness to local about RoW encroachment. With coordination of local government, enforcement of law to discourages settlements adjacent to road, plantation of trees. Awareness and land use plans will be in placed that can carefully tackle the problem of removing encroachers while taking into full account.
High speed of vehicles	Road Safety	D	M (20)	SS (10)	LT (20)	S (50)	So as to avoid accidents and mishaps, proper road safety has been considered in design and road will be constructed accordingly. For this, establishment of traffic signals, speed control mechanisms such as zebra cross, speed breakers, speed limits etc. at crowded places have been proposed. Beyond designing and constructing road safety measures, following will be addressed: GPS tracking and CC cameras for speed control for public buses plying the highway; Vehicle maintenance and inspection; Road safety awareness trainings to general public; Capacity enhancement for traffic police and locals.

8.3 Cost for Mitigation Measures

Cost required for implementation of mitigation measures along with location, time and responsible agency is given in Table 8.3 below. Detailed EMP is given in **Annex 31**.

Table 8-3: Environmental and Social Management Cost

S.N.	Environment Protection Measures	Location for Implementation	Time of Implementation	Estimated Cost (NRs.)	Implementation Responsibility	Remarks
Physical Environment						
1	Stockpiling and re-using of topsoil	Agricultural and forest sections of Road Alignment	During Site Clearance	1,000,000	Contractor	LS
2	Stockpiling and re-using of muck/spoil	Excavated areas	Cutting/Excavation for embankment and bridges	1,000,000	Contractor	LS
3	Waste Management (solid and liquid)	Labour Camps and Construction Camps	During construction	Imbedded in BOQ, to be managed by contractor	Contractor	It will be finalized by the contractor before construction and it goes under contractor responsibility
4	Management of Quarry and Borrow Sites, Construction Camps (crusher plant, batching plant, asphalt plant, workshops, stockpiling yards etc.)	Quarry and Borrow Sites, Construction Camps	During construction	Imbedded in BOQ, to be managed by contractor	Contractor	It will be finalized by the contractor before construction and it goes under contractor responsibility
Biological Environment						
5	Recruit BMP Advisor	Project Office/ Supervision Consultant	Just before construction	5,400,000	Project/CSC	Expert cost for 3 years@ 1,800,000 per year
6	Cutting of Trees (beside site clearance)	Road side within RoW	Just before construction	183,751,596.98	Project/ Contractor	Included in BOQ Rate analysis done for cutting of 28,120 trees
7	Compensatory Plantation and care for 5 years	Location to be finalized in	During construction and 5 years from Plantation	389,510,482.76	Project/ Forest Development Fund	Rate analysis done for plantation of 281,200 trees and care for 5 years

S.N.	Environment Protection Measures	Location for Implementation	Time of Implementation	Estimated Cost (NRs.)	Implementation Responsibility	Remarks
		coordination with DFOs				
8	Underpasses for wildlife including guiding fences	Forest sections	During construction	2,987,865,368.38	Project/ Contractor	Included in BOQ Cost for 18 bridges modified for large and medium sized animal crossing has been estimated and included in design and BOQ
9	Noise barrier in location of Elephant crossing	Sections of Elephant Crossing Locations	During construction	85737600.00	Project/ Contractor	Included in BOQ Noise barrier to be installed within proposed elephant underpasses
10	Installation of Canopy Bridges	Forest Sections	During Construction	900,000	Project/ Contractor	For canopy bridges at 6 places. It is estimated that for installation of one canopy bridge it cost 150,000
11	Avenue Plantation, maintaining greenery along the road (favor to flowering plants as per thematic concept consultation with local people)	Throughout the road alignment (median and road side)	During Construction	18,205,646.55	Project	Cost of maintain greenery in median throughout the section (excluding the junction, bridge and approach areas)
12	Setup a rapid response wildlife management unit (coordination with Parsa National Park, Division and subdivision forest offices and community and collaborative forests)	Site Office	Just before construction	8,541,000	Project including CSC and Contractor, Parsa National Park	For regular patrolling in road adjoining to forest areas
13	Implement effective anti-fire strategies	Forest sections	During Construction	390,000	Project including CSC and Contractor	Cleaning road side by removing leaves and twigs during dry season

S.N.	Environment Protection Measures	Location for Implementation	Time of Implementation	Estimated Cost (NRs.)	Implementation Responsibility	Remarks
14	Wildlife monitoring	Forest sections	During Construction	4,158,000	Project including CSC and Contractor	Installation of camera traps and monitoring in forest section focusing in proposed 8 elephant underpass areas
15	Training and Capacity Building (For wildlife management and monitoring)	Respective DFOs Parsa NP	During Construction	300,000	Project	LS
Socio-economic and Cultural Environment						
16	Compensation to Project Affected Private Structures, Displacement and Shifting Assistance, Livelihood Support Trainings	Along Road Alignment	Just before construction	31,952,628	Project	Included in RAP
17	Rehabilitation of Community Structures	Along Road Alignment	Just before construction	100,056,054.400	Project/ Contractor	As per RAP of Project
18	Shifting of Electric Poles	Along Road Alignment	Just before construction	Included in BOQ	Project/ Contractor	In coordination with NEA
19	Shifting of water supply Pipelines	Along Road Alignment	Just before construction	80,000,000	Project/ Contractor	In coordination with DWSS and water user's groups
20	Implementation of IPDP (organizing eye camps, orientations for the marketing of local products through radio, hoarding boards and managing local souvenir shop and orientation program to control school dropout children of the Majhi communities)	IP Communities along road alignment	During Construction	2,185,000	Project including CSC and Contractor	As per IPDP of Project
Awareness and Orientations						
21	Awareness to Labours on communicable diseases (including HIV/AIDs), SEA, SH etc.	Labour Camp Sites	During Construction	500,000	Project/ Contractor	LS
22	Awareness to workers on material handling, waste management	Construction Camp Sites	During Construction	500,000	Project/ Contractor	LS
23	Awareness/ capacity building to workers, local communities on road safety	Project Office	During Construction	500,000	Project/ Contractor	LS

S.N.	Environment Protection Measures	Location for Implementation	Time of Implementation	Estimated Cost (NRs.)	Implementation Responsibility	Remarks
24	Awareness to local communities on project, communicable diseases, grievance mechanisms etc.	Project Office/ Municipal/ward office	During Construction	500,000	Project/ Contractor	LS
25	Awareness to local communities on trafficking, coordination with anti-trafficking organizations	Project Office/ Municipal/ward office	During Construction	500,000	Project/ Contractor	LS
26	Community sensitization and orientation on GBV	Project Office/ Municipal/ward office	During Construction	500,000	Project/ Contractor	LS
Environmental Monitoring and Auditing						
27	Environmental Monitoring	As per environmental monitoring plan chapter 9	Just before construction, during construction and just after construction	3,650,000	Project including CSC and Contractor	
28	Environmental Auditing	Along Road Alignment	After two years of Project Completion	1,210,000	MoFE and DOR	
	Total (without VAT)			3,908,813,377.07	Including RAP, BMP, IPDP and 18 underpasses for large and size medium animals	
	Total in words (without VAT)			Three billion nine hundred eight million eight hundred thirteen thousand three hundred seventy-seven rupees and seven paisa		

CHAPTER-9: ENVIRONMENTAL MONITORING OF THE IMPACTS ON THE ENVIRONMENT DUE TO IMPLEMENTATION OF THE PROPOSAL

In accordance to provision included in Section 33, Subsection (1) 8 (2) EPA 2076 and Rule 45 of EPR 2077, the proponent shall conduct self-monitoring every six months regarding the impact on the environment during the construction and operation of the proposal. The report will be submitted to the relevant agency or department. Monitoring Plan for Baseline Monitoring, Compliance Monitoring and Impact Monitoring is given in **Table 9-1** below. It is noticed that for environmental monitoring around NRs. 3,650,000 is estimated. Similarly, CSC and Contractor have to include Environment and Safety expert for monitoring as mentioned above and preparing monitoring report in continuous basis.

Table 9-1: Environmental Monitoring

Parameters	Indicators	Method	Monitoring Location	Monitoring Time	Cost	Monitoring Agency
Baseline Monitoring						
Water Quality	Appearance, Color, pH, turbidity, Electrical Conductivity, Iron, Nitrate, Alkalinity, Hardness, Calcium, Magnesium, Sulphate, E.coli etc..	Sample collection and lab analysis	Locations as per baseline and as per site condition to be decided by SC	Just before construction works	100,000	DCID/ SC/ Contractor
Air Quality	PM _{2.5} , PM ₁₀ , SO _x , NO _x , CO	Measurement through portable devices or High-volume air samplers	Locations as per baseline and as per site condition to be decided by SC	Just before construction works	250,000	DCID/ SC/ Contractor
Noise Level	Day time and Night time noise level (max, min and Leq levels)	Measurement through Noise level meter	Locations as per baseline and as per site condition to be decided by SC	Just before construction works	100,000	DCID/ SC/ Contractor
Waste Management	Waste Management scenario within project locality	Observation/Consultation with local people	Near proposed labour camps and construction camps	Just before construction works	No extra cost required	DCID/ SC/ Contractor
Rain/stormwater outflow and Water Logging	Outflow of rain water/storm water and water logging scenario	Observation during heavy rain /Consultation with local people	Within existing causeway and culverts and Dhalkebar, Lalbandhi, Nijgadh and other water logging areas	Just before construction works	No extra cost required	DCID/ SC/ Contractor
River Cutting and Erosion Prone areas	Risk of river cutting, erosion	Observation /Consultation with local people	River banks	Just before construction works	No extra cost required	DCID/ SC/ Contractor
Structures within RoW and Formation Width	Structures and utilities to be damaged due to road upgradation	Observation /Consultation with local people	Within RoW	Just before construction works	No extra cost required	DCID/ SC/ Contractor

Parameters	Indicators	Method	Monitoring Location	Monitoring Time	Cost	Monitoring Agency
Vegetation within ROW and Formation Width	Vegetation status, Number of Trees to be felled	Observation, counting and measuring	Within RoW	Just before construction works	500,000	DCID/DFO/ SC/Contractor
Socio-economic activities along the road alignment	Number of tea stalls, shops, business activities	Observation /Consultation with local people	Along the Road alignment, mainly near proposed labour camps	Just before construction works	No extra cost required	DCID/ SC/ Contractor
Compliance Monitoring						
EIA proposed measures in project document	Contract documents/BOQs	Review/cross checking of tender and design documents	Project Office	During/after the project design stage completion of tender documents	No extra cost required	DCID/ SC/ Contractor
Contractor's commitment in Environment and Social Safeguarding	Revised Plans by Contractor (e.g. ESMP, LMP, Quarry and Borrow Pit Management Plan, Camp Management Plan, Traffic Management Plan, GESI Plan, OHS Plan, Site Restoration Plan etc.	Review of Document	Project Office	Within 1 month of awarding contract	No extra cost required	DCID/ SC/ Contractor
Employment opportunity to local people	Number of laborers from road affected municipality employed as skilled/ unskilled Labour in the road construction,	Employment records / observation of labor camp and construction sites/ Consultation with Local Government/Local people	Labour camps, construction sites	Periodically during construction phase	No extra cost required	DCID/Local Government/ SC/ Contractor
	Percent/ number of socially and economically vulnerable people (Janajati, Dalit, Women etc.)					
Awareness and Trainings as proposed in EIA	Number of trainings provided and awareness program conducted	Training and awareness records,.	Project Office, Camps sites, Construction sites, ward and municipal offices etc.	Beginning of construction and during construction	No extra cost required	DCID/ Local Government/ SC/ Contractor
Compensation to loss of Private Structures	Price fixation for loss structure by CDC/ Compensation amount/ acquired properties,	Records of CDC and FGD with families which have lost properties	As decided by CDC	After settlement of the prices by CDC	Included in Resettlement Plan	DCID/ SC/ Contractor
	Allowances and support provided to affected HHs					
Relocation of damaged community structures	Timely relocation of community/ pubic structures	Observation, consultation with affected communities	Relocated areas	During construction	Included in Resettlement Plan	DCID/ SC/ Contractor

Parameters	Indicators	Method	Monitoring Location	Monitoring Time	Cost	Monitoring Agency
Relocation of utilities: water supply pipelines and electric poles	Timely relocation of utilities	Observation, consultation with affected households	Relocated areas	During construction	Included in Resettlement Plan	DCID/ SC/ Contractor
Health and Sanitation at Labour Camps	Health and Sanitation Facilities at Labour camps, Health and sanitation condition of workers,	Observation, Consultation with workers	Labour camps	Periodically during construction phase	No extra cost required	DCID/Local Government/ SC/ Contractor
Occupational Health and Safety	Mandatory use of safety features during construction by the laborers,	Observation of construction sites and Camps	Construction sites and camps	Periodically during construction phase	To be done of OHS Expert, no extra cost required	DCID/DFO/ SC/Contractor
	Availability first aid material at the site for primary treatment/ Medical facility in the camps,					
	Fire extinguisher at the camp site,					
	Cases of withholding of payment to the contractor for non-compliance on occupational Health and safety	Records of Supervision consultant reports				
Ensure Life Insurance of the Labours	Insurance paper of the Labours	Review of contractor’s document and insurance paper	Labour camps and Construction Camps	Before commencement of construction work or recruiting new worker	No extra cost required	DCID/SC/ Contractor
Monthly wage paid to labours	Wage Paid to Labours not less than wage fixed by concerned district to both male and female	Consultation with labours	Project site	Monthly during construction	No extra cost required	DCID/SC/ Contractor
Application of road safety measure	Number of road safety signs in accident prone segments of the alignment,	Observation, Consultation with local people and Local Government	Construction Sites	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
	Implementation of traffic management plan					
Vegetation Clearance	Felling of trees in accordance with Forest Rules	Observation	Forest areas along Road Alignment	Just before construction	No extra cost required	DCID/DFO/ CFUGs/ SC/ Contractor
Plantation	Status of planted trees (compensatory as well as avenue), Greenery in Median, Care for planted vegetation	Observation	Plantation areas	Periodically during construction and operation phase	No extra cost required	DCID/DFO/ SC/ Contractor

Parameters	Indicators	Method	Monitoring Location	Monitoring Time	Cost	Monitoring Agency
Wildlife Movement	Construction of animal underpasses as proposed	Observation	Proposed underpass area	Near project completion	No extra cost required	DCID/DFO/ CFUGs/ SC/ Contractor
Grievances	Grievances Redress Mechanism in place as proposed	Observing Grievance recording register	Project Office and Site Office	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Spoil Generation	Storage and use of Spoil in embankment filling	Observation	Road Embankment	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Stockpiling of Construction materials	Proper storage and transportation of construction materials including hazardous and toxic materials	Observation	Stockpiling yards	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Rehabilitation of Labour camps and construction camps	Rehabilitation of sites as per restoration plan	Observing, consultation with land owners	Labour camp and Construction camps	Just after completion of construction works	No extra cost required	DCID/ SC/ Contractor
River Protection	Adoption of River Protection Works with bioengineering	Observation	River banks	Just after completion of construction works	No extra cost required	DCID/ SC/ Contractor
Stability of Road Embankment	Bioengineering/Turfing along Road Embankment	Observation	Road Embankments	Just after completion of construction works	No extra cost required	DCID/ SC/ Contractor
Impact Monitoring						
Impact on Air Quality	Emission of dust and smoke (PM _{2.5} , PM ₁₀ , SO _x , NO _x , CO)	Measurement through portable air monitoring device or high-volume air sampler	5 locations, as per baseline and additional 5 to be determined by SC as per site condition	Monthly during construction	900,000	DCID/ SC/ Contractor
Impact on Surface Water Quality, Downstream Sedimentation	pH, DO, TDS, TSS, Turbidity, Ammonia, BOD, Chloride, Iron, Nitrate, Alkalinity, Hardness, Calcium, Phosphate, Manganese, Chromium, Fluoride, Total coliform etc.	Water sampling and lab analysis	10 locations, 6 as per baseline and additional 4 to be determined by SC as per site condition	Quarterly during construction	600,000	DCID/ SC/ Contractor
Impact on Ground Water Quality	pH, TDS, TSS, Turbidity, Ammonia, Arsenic, Chloride, Iron, Nitrate, Alkalinity, Hardness, Calcium, Magnesium, Sulphate, Manganese, Chromium, Fluoride, E.coli etc.	Water sampling and lab analysis	10 locations, 7 as per baseline and additional 3 to be determined by SC as per site condition	Quarterly during construction	600,000	DCID/ SC/ Contractor

Parameters	Indicators	Method	Monitoring Location	Monitoring Time	Cost	Monitoring Agency
Impact on Soil Quality	Soil parameters viz. pH, moisture, organic matter, total nitrogen, total phosphorus, total potassium, sodium, oil and grease etc.	Soil sampling and lab analysis	5 locations, as per baseline and additional 5 to be determined by SC as per site condition	Quarterly during construction	600,000	DCID/ SC/ Contractor
Skill Enhancement	Number of trained graduates from project affected area working as a skilled laborer	Observation, Consultation	Construction Sites	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Occupational Health and Safety	Number of accident/incidents during construction	Observation, Accident Records	Construction Sites	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Impact due to utility shifting	Disruption in water supply and electricity	Observation, Consultation with Local Community	Construction Sites	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Impact in Traffic flow	Traffic Disturbance	Observation, Consultation with Local Community	Construction Sites	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Drainage outflow	Adequate drainage outflow or not, Water Logging issues	Observation, Consultation with Local Community	Construction Sites	Periodically during construction Phase and operation phase	No extra cost required	DCID/ SC/ Contractor
Solid waste Management	Cleanliness within labour camp and construction camps	Observation	Labour Camps and Construction Camps	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Waste Water Management	Cleanliness within labour camp and construction camps	Observation	Labour Camps and Construction Camps	Periodically during construction phase	No extra cost required	DCID/ SC/ Contractor
Status of Forest	Cases of hunting and poaching, use of forest resources, forest land encroachment	Observation, Consultation with Local Community	Forest and nearby areas along road alignment	Periodically during construction phase	No extra cost required	DCID/DFO SC/ Contractor
Economic Activities	Development of new business	Observation, consultation	Settlement areas along road alignment	Periodically during construction phase	No extra cost required	DCID/Local Government SC/ Contractor
Cultural Activities	Inflow of migrant workers in project area, affect cultural activities, conflicts and quarrels	Observation, consultation	Settlement areas along road alignment	Periodically during construction phase	No extra cost required	DCID/Local Government SC/ Contractor
GBV, SH, Child Labour, Forced Labour	Cases of GBV, SH, Child Labour, Forced Labour within project	Observation, consultation with workers and local people	Along road alignment, labour and construction camps, construction sites	Periodically during construction phase	No extra cost required	DCID/Local Government SC/ Contractor
Health Condition of workers	Occurrence of communicable diseases	Observation, consultation with workers and local people	Along road alignment, labour and construction camps, construction sites	Periodically during construction phase	No extra cost required	DCID/Local Government SC/ Contractor

CHAPTER 10: ENVIRONMENTAL AUDITING

Environmental Auditing will be carried out to examine and assess performances of the road project related to environment and its conservation and protection. According to sub-rule 1 of rule 13 of the Environmental Protection Regulation, 2077, Environmental Auditing will be carried out to examine and assess performances of the road project related to environment and its conservation and protection. Audit will be undertaken after two years from the project completion. Audit will be carried out by MoFE together with proponent team. The proponent can conduct separate audit too.

10.1 Auditing Parameters, Methods and Indicators

The Ministry of Forests and Environment (MoFE) may consider the environmental protection measures and monitoring parameters as the basis of EIA/EMP for auditing. MoFE, as a responsible agency for auditing, may hire a team of experts to prepare the audit report. In general, the parameters, methods, and indicators for auditing will be following.

Table 10-1: Auditing Parameters, Methods and Indicators

Parameters	Indicators	Location	Method
Physical Environment			
Land Use	Change in land use and land use pattern	Entire road alignment (mainly forest sections)	Observation, GIS/Satellite maps
Surface Water Quality	Different water quality parameters as studied in EIA and monitoring during construction	Sites as per EIA and monitoring during construction	Sampling and lab analysis, observation, consultation with local people
Ground Water Quality	Different water quality parameters as studied in EIA and monitoring during construction	Sites as per EIA and monitoring during construction	Sampling and lab analysis, observation, consultation with local people
Air Quality	Different air quality parameters as studied in EIA and monitoring during construction	Sites as per EIA and monitoring during construction	Measurement through portable air monitoring device or high-volume air sampler, observation, consultation with local people
Noise Level	Leq (Day and Night)	Sites as per EIA and monitoring during construction	Measurement through portable Noise Level Meter, observation, consultation with local people
Solid Waste	Status of waste management scenario around labour camps, construction camps and waste disposal sites	Labour camps, construction camps and waste disposal sites	Observation, consultation with local people

Parameters	Indicators	Location	Method
Drainage/Storm Water Outlet	Any water logged area due to proposed road, obstruction in natural flow of drainages	Road side drain and drainage crossings throughout road alignment	Observation (mainly during heavy rain), consultation with local people
Road Embankment and River bank Cutting, Soil Erosion	Proper function of proposed structures, status of bioengineering/turfing	Road embankments and constructed river protection structures	Observation
Road Safety	Proper functioning of constructed road safety measures, Accidents	Throughout road alignment	Observation, consultation with local people and traffic police, accident records
Pollution Control	Proper functioning of proposed pollution control measures	Throughout road alignment where such measures are adopted	Observation and measurements, consultation with local people
Biological Environment			
Forest and Vegetation	Status of forest and vegetation along the road alignment, forest resource use pattern	Forest and vegetation along the road alignment	Observation, consultation with DFO/CFUGs, local people
Compensatory and Avenue Plantation	Status of plant in the plantation area	Plantation area	Observation
Wildlife	Cases of hunting and poaching, wildlife accidents/collision with vehicles, functioning of constructed underpasses	Road alignment passing through forest section and animal underpass areas	Observation, consultation with DFO/CFUGs and local people, camera trapping
Socioeconomic and Cultural Environment			
Relocation and rehabilitation of affected structures	Existing status of relocated infrastructures such as temples, wells, public toilets, water supply pipelines, electric poles etc.	Along the road alignment	Observation, consultation with local people
Compensation to affected households	Living standard of affected households, educational status and availability of service facility with each family	Along the road alignment	Observation, consultation with local people
Employment	Employment scenario of local people	Along the road alignment	Observation, consultation with local people

Parameters	Indicators	Location	Method
	(including women and disadvantaged groups) during construction phase and post construction phase		
Health	Spread of diseases and community health condition due to project	Along the road alignment	Observation, consultation with local people
Road Use	Frequency of pedestrian crossing from proposed crossing structures, ease in using upgraded road, accidents, any grievances from upgraded road	Along the road alignment (mainly settlement sections)	Observation, consultation with local people
Livelihood and Income generation of local people	Economic activity of the local people and opportunities available to local people	Along the road alignment (mainly settlement sections)	Observation and consultation
Socio-economic change	Change in local economy (change in living standard)	Along the road alignment (mainly settlement sections)	Observation and consultation
Trade, Commerce and Industry	Increase/Decrease in Trade, Commerce and Industrial activities (local, national as well as international level), number of freight transportation ply per day, the price of commodity transported through this section of highway from India and Bangladesh	Along the road alignment (mainly market and industrial sections)	Observation and consultation
Tourism Development	Number of people (national as well as international) visiting touristic places within the project vicinity	Touristic places within the project vicinity	Observation and consultation

10.2 Format of Environmental Audit Report

The structure of the environmental audit report of the proposed project will be as follow as given in EPR 2077.

Table 10-2: Format for Environmental Audit

Chapter	Description							
Chapter 1	In this chapter, the executive summary of the report should be written including the main points of the environmental audit report.							
Chapter 2	In this chapter, details of audit administration and audit work, interviews conducted at the venue, auditing parties and audit areas and methods should be included. Also, the facts and details related to environmental monitoring and auditing should also be included.							
Chapter 3	This chapter should contain complete details of the environmental auditing							
Chapter 4	In this chapter, suggestions and corrective actions to be followed in relation to the project should be included.							
Annexes	Facts and details should be included in the Annexes.							
Human Resources to be included	Environment Expert, Highway Engineer, Soico-economic and Cultural Expert, Ecologist, and other experts depending upon the nature and severity of the project should be included							
Checklist for Environmental Auditing:								
S.N.	Description	Project Activities	Expected Impacts	Major Impacts	Mitigation Measures	Significance	Information	Source of Data
Physical Environment								
1.	Air Quality							
2.	Water Quality							
3.	Noise Level							
4.	Land Use							
5.	Water Resource							
Biological Environment								
1.	Forest							
2.	Vegetation							
3.	Wildlife							
4.	NTFPs							
5.	Fish							
6.	Protected Species							
7.	Protected Area							
Socio-economic and Cultural Environment								
1.	Education							
2.	Agriculture							
3.	Employment							
4.	Migration							

5.	Health and Sanitation							
6.	Environmental Beauty							
7.	Gender Inclusion							
8.	Religious and Cultural Status							
9.	Social Status							

10.3 Estimated Cost for Environmental Auditing

The estimated cost of environmental auditing is 1210000. The breakdown of the estimated cost is summarized in the **Table 10-3**.

Table 10-3: Estimated Cost for Environmental Auditing

Description	Unit/Month	Unit Cost (NRs.)	Amount (NRs.)	Remarks
Environmental Expert	2	180,000	360,000	
Highway Engineer	1	150,000	150,000	
Socio-economist	1	150,000	150,000	
Ecologist	1	150,000	150,000	
Field Sampling, Monitoring and Lab Tests	LS	200,000	200,000	
Reporting, Logistics etc.	LS	100,000	100,000	
Transport	LS	100,000	100,000	
Total Estimate			1,210,000	

CHAPTER 11: CONCLUSION AND COMMITMENTS

The upgrading works include widening of the existing two lanes to four lanes as fast lanes, with provision of new construction of bridges and culverts, sidewalks and junction improvements. The two lanes on either side of fast lanes are also proposed as a service road. The Right-of-Way (RoW) of the road is 50 m from the road's center line.

Kamala-Dhalkebar-Pathalaiya section of East-West Highway (Mahendra Highway) passes through major settlements like Dhalkebar, Bardibas, Lalbandhi, Harion, Bagmati, Chandrapur, Nijgadh and Pathalaiya. The road section also passes through some of the sensitive sections like Parsa National Park (forming southern boundary), Sagarnath Forest Development Project and other community and collaborative forests.

At present, travel time from start (Kamala) to end (Pathalaiya) of the road section is around 3 hours and after completion of the project, the travel time expected is to reduce to 1.6 hrs. Further, the travel will be smooth and comfortable, wear and tear of the vehicles will be less along with reduced fuel consumption and maintenance cost. Not only vehicles from Nepal but also from India and Bangladesh are expected to ply on the improved Asian Highway section.

Due to increased vehicular movement (both in quantity and speed) accidents can also be increased for which the design has considered safety measures to the extent possible and will be adopted according during construction. Major impacts in wildlife movement (mainly Elephants, Tigers, and Monkeys) is noticed for which special provisions like under passes, noise reduction measures, guiding fences, canopy bridges etc. have been proposed so as to address wildlife movement and reduce wildlife-vehicle collision.

It is noticed that due to widening of the road, approximately 28,120 nos. of poles and trees may need to be cut down. Compensatory plantation as well as avenue plantation and maintaining greenery in median section of the road has been proposed for minimizing impacts due to felling of trees and land use. Standalone document on Biodiversity Management Plan has been prepared for avoiding/minimizing/compensating impacts on biological environment.

As the road is going to be developed within existing RoW whose land ownership is within DOR, there is no permanent land acquisition required for the project. However, there are squatters and encroaches within the RoW. It is noticed that in total there are 66 private structures of 64 HHs within RoW and the project will directly affect these structures. Among 64 projects affected HHs, 25 are losing residence, 35 losing business huts, 4 HHs will lose both residential cum business. Further, 204 other extended housing structures (Sheds like) with having varied size that made of iron pillar with Zink roof and 4 extended part of petrol pump needs to be removed or shifting from the RoW. Likewise, 216 community/public structures including 35 small temples, 8 wells, 55 Bar/Peepal Chautara, 69 waiting sheds, 5 gates, 12 boundary walls, 4 police posts, 3 public toilets, 2 school extended structures (Mahendra Adarsha Secondary School and Nepal Rastriya Secondary School, 3 market/ hat Bazar sheds, 1 army checkpost, 2 police checkpost, 1 police waiting shed and 16 structures within army barrack may be affected due to road widening. Besides these, it is noticed that due to road widening, 2221 electric poles and 33160 m of water pipe lines can be disturbed.

All the affected private structures will be compensated and public/community structures will be relocated. For compensating/relocating these structures, separate Resettlement Plan has been prepared and will be implemented accordingly. Further, for enhancing indigenous peoples within the project area, Indigenous People's Development Plan (IPDP) has been prepared and will be implemented accordingly.

The Project will also consider Occupational Health and Safety issues and Community Health issues during construction phase. So as to reduce and mitigate pollution from labour camps, construction camps and construction sites, due consideration for preventing air, water, soil and noise pollution has been done.

Most of the identified impacts during construction and operation stage are of short term, low to moderate significance and most of them are local to site specific and reversible in nature with minimal residual impacts. The project has proposed mitigation measures to ameliorate all adverse impact. Further, to ensure proper implementation of mitigation measures, environmental monitoring and environmental auditing as per EPR 2077 has been provisioned. Total cost for environmental and social management of the proposed project is estimated to be 3,908,813,377.07. The Proponent is committed to implement the proposed mitigations measures mentioned in the EIA and monitored as proposed by this study.

REFERENCES

1. Annual report of Department of Health Services (DoHS) 2018/19
2. Baseline Report for Upgrading works of Kamala-Dhalkebar-Pathalaiya Section with Associated Bridges of the Mahendra Highway/ DoR/ SRCITP, 2023 (unpublished)
3. CBS (2011). National Population and Housing Census 2011, (National Report), Government of Nepal National Planning Commission Secretariat Central Bureau of Statistics
4. CBS (2021). Report of National Population Census 2021, Government of Nepal National Planning Commission Secretariat Central Bureau of Statistics
5. Conceptual Design Report of Highway and Bridges for Detailed Design of Upgradation of Kamala-Dhalkebar-Pathalaiya Section (130 km) of Mahendra Highway and Bridges/ DoR/ SRCITP, March 2022
6. Detailed Design Report for Upgrading works of Kamala-Dhalkebar-Pathalaiya Section with Associated Bridges of the Mahendra Highway/ DoR/ SRCITP, 2023 (unpublished)
7. DFRS (2014). "Terai Forests of Nepal, Forest Resource Assessment Nepal, Department of Forest Research and Survey".
8. Draft ESIA Report for Upgrading of Butwal-Gorusinghe Road Section of E-W Highway_BBIN Phase-1, Jan 2021(unpublished)
9. Environmental and Social Assessment (ESA) of Kakarbhitta-Pathalaiya Road Section, including Kamala-Dhalkebar-Pathalaiya of EWH-2020
10. Environmental and Social Assessment (ESIA) of Improvement of Naghdhunga-Naubise-Mugling (NNM) Road/ DoR/SRCTIP, April 2020.
11. Environmental and Social Framework (ESMF) of Strategic Road Connectivity and Trade Improvement Project (SRCTIP)-Trade Component/ MoICS/ MoALD), Sep 2020
12. Environmental and Social Framework, The World Bank, 2017
13. Feasibility Study Report of Kamala-Dhalkebar-Pathalaiya Section (130 km) of Mahendra Highway and Bridges/ DoR/ RSDP, Jan 2020
14. Feasibility Study Report of Kamala-Dhalkebar-Pathalaiya Section with Associated Bridges of the Mahendra Highway/ DoR/ SRCITP, Jan 2020
15. Ghimire, B., et al. (2019). "Nesting Characteristics and Habitat Preferences of Critically Endangered White-rumped Vulture *Gyps bengalensis* in Rampur IBA, Palpa, Nepal." Vulture Bulletin 8: 20-24.
16. Jayson, E. (1999). "Habitat preference of five herbivores in the Chimmony Wildlife Sanctuary." Indian Forester 125(10): 975-985.
17. Jha, K. K. (2015). "Distribution of vultures in Uttar Pradesh, India." Journal of Threatened Taxa 7(1): 6750-6763.
18. Koirala, R. K., et al. (2016). "Feeding preferences of the Asian elephant (*Elephas maximus*) in Nepal." BMC ecology 16(1): 1-9.
19. Paudel, P. K., et al. (2015). "Habitat suitability models of mountain ungulates: identifying potential areas for conservation." Zoological studies 54(1): 1-16.
20. Status of Air Quality in Nepal, Annual Report, 2022. Government of Nepal, Department of Environment. 2023.
21. Web link: <https://jeetpursimaramun.gov.np/>
22. Web link: <https://nijgadhmun.gov.np/>,

23. Web link: (https://inseconline.org/en/wp-content/uploads/2022/YB2022/Annex_1.2_Madhesh_Province_YB2022.pdf)
24. Web link: (<https://mohp.gov.np/attachments/article/706/Province%20%20Final%2010%20Jan%202021.pdf>).
25. Web link: (<https://old.risingnepaldaily.com/featured/madhesh-land-of-glory>)
26. Web link: <http://charnathmun.gov.np/>,
27. Web link: <https://bagmatimunsarlahi.gov.np/>,
28. Web link: <https://bardibasmun.gov.np/>,
29. Web link: <https://cbs.gov.np/social-statistics-2075/>
30. Web link: <https://chandrapurmun.gov.np/>,
31. Web link: <https://gaushalamun.gov.np/>,
32. Web link: <https://harionmun.gov.np/>,
33. Web link: <https://ishworpurmun.gov.np/>,
34. Web link: <https://lalbandimun.gov.np/en>,
35. Web link: <https://mithilamun.gov.np/>,
36. Web link: <https://offlinethinker.com/status-of-madheshi-province-no-2-women-and-girls-in-nepalese-society-shankuntala-nayak/>)
37. Weblink:(<https://mohp.gov.np/attachments/article/706/Province%20%20Final%2010%20Jan%202021.pdf><https://publichealthupdate.com/number-of-health-facilities-in-province-1-nepal/>)

Annex 1: Approved TOR

Terms of Reference (ToR) for
**Environmental Impact Assessment of the Upgrading of Kamala-
Dhalkebar-Pathlaiya Section (130 km) with associated Bridges of the
Mahendra Highway**

**Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat and Bara Districts
Madhesh Pradesh**

Submitted To
Government of Nepal
Ministry of Forests and Environment
Singhadurbar, Kathmandu

Submitted Through
Government of Nepal
Ministry of Physical Infrastructure and Transport
And
Department of Roads
Geo-Environment and Social Unit
Chakupat, Lalitpur

सम्माननीय प्रधानमन्त्री तथा वन तथा
वातावरण मन्त्रीजीको मिति २०२०/०१/११
को निर्णयानुसार स्वीकृत भएको ।

Proponent
Government of Nepal
Ministry of Physical Infrastructure and Transport
Department of Roads
Development Corporation Implementation Division (DCID)
Jwagal, Lalitpur, Nepal



March, 2023



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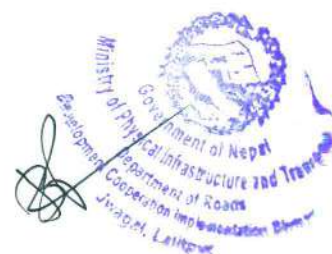
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Abbreviations

AADT	Annual Average Daily Traffic
AD	Anno Domini
ADB	Asian Development Bank
AH2	Asian Highway 2
AHDS	Asian Highway Design Standard
BBIN	Bangladesh, Bhutan, India and Nepal Initiatives
BIMSTEC	Bay of Bengal Initiatives for Multi-Sectoral Technical and Economic Cooperation
BS	Bikram Sambat
CBD	Convention on the Biological Diversity
CEG	Consulting Engineers Group Ltd.
CFC	Compensation Fixation Committee
CIAS	Civil Informatics and Solutions Pvt. Ltd.
CITES	Convention on International Trade in Endangered Species of wild Fauna and Flora
CRN	Core Road Network
DCID	Development Corporation Implementation Division
DFO	Divisional Forest Office
DLP	Defect Liability Period
DOR	Department of Roads
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPR	Environment Protection Rule
ESA	Environment and Social Assessment
ESIA	Environment and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESF	Environmental and Social Framework
ESS	Environmental and Social Standards
FGD	Focus Group Discussion
GESI	Gender Equality and Social Inclusion
GON	Government of Nepal
GRID	Green, Resilient, and Inclusive Development
ICIMOD	International Centre for Integrated Mountain Development
IDA	International Development Association
IFC	International Finance Corporation
IPPF	Indigenous Peoples Planning Framework
KDP	Kamala Dhalkebar Pathlaiya
KII	Key Informant Interview
Km	kilometer
LMP	Labor Management Procedures
m	meter
MoALD	Ministry of the Agriculture and Livestock Development


 Government of Nepal
 Ministry of Physical Infrastructure and Transport
 Department of Roads
 Development Cooperation Implementation Division
 Lalitpur

MoFE	Ministry of Forests and Environment
MoICS	Ministry of the Industry Commerce and Supply
MOPIT	Ministry of Physical Infrastructure and Transport
NBC	National Building Code
NRS	Nepal Road Standards
NTFP	Non-Timber Forest Products
PCU	Passenger Car Unit
RCC	Reinforced Cement Concrete
RoW	Right of Way
RPF	Resettlement Policy Framework
SCDP	Safe Corridor Demonstration Program
SEP	Stakeholder Engagement Plan
SRCTIP	Strategic Road Connectivity and Trade Improvement Project
TOR	Terms of References
TSP	Total Suspended Particulate
WB	World Bank
WWF	World Wildlife Fund



1. Background

1.1 Name and Address of the Person or Organization Preparing the Report

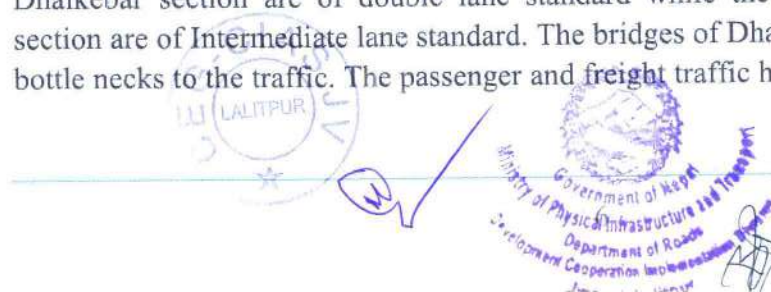
This report has been prepared by the Joint venture of Consulting Engineers Group Ltd., Jaipur, India and Civil Informatics and Solutions Pvt. Ltd., Lalitpur, Nepal (CEG-CIAS JV) on behalf of Development Corporation Implementation Division (DCID), Department of Roads (DOR).

1.2 Preface

The Strategic Road Connectivity and Trade Improvement Project (SRCTIP) is funded by the World Bank (WB under IDA credit no 6673-NP & 6674-NP to improve the efficiency and safety of selected transport infrastructure, improve the efficiency of cross-border trade, and strengthen capacity for strategic road network management in Nepal. This project has four components. 1) The first component, Trade Facilitation, has the following three sub-components: (i) Augmentation of physical infrastructure, equipment, inspection, and related border transit management systems that are required to absorb increasing traffic and trade volumes at key border crossing points including Birgunj, Bhairahawa, and Biratnagar; (ii) Augmentation of equipment and training, and construction and/or renovation of laboratory buildings at key border locations; and (iii) Knowledge and capacity building. 2) The second component, Regional Road Connectivity, comprises three sub-components: (i) Improvement of the existing Nagdhunga-Naubise-Mugling road to two lanes, with one-meter paved willers; (ii) Upgrading of the Kamala-Dhalkebar-Pathlaiya (KDP) road from two lanes to four lanes; (iii) A safe corridor demonstration program (SCDP), with support for road safety improvement initiatives including enforcement and post-crash response, covering a length of about 250 kilometers. 3) The third component, Institutional Strengthening, comprises three sub-components: (i) Support for the National Road Safety Council; (ii) Capacity enhancement of Department of Roads (DoR) for improved management of Strategic Road Network (SRN); and (iii) Support for periodic maintenance of the Core Road Network (CRN). 4) The fourth component, Contingency Emergency Response, aims to provide an immediate response to an eligible crisis or emergency, as needed.

Among the four components, the proposed proposal is related to these condone i.e. Regional Road Connectivity, Upgrading of the KDP road from two lanes to four lanes. The Development Corporation Implementation Division (DCID) under DOR, Ministry of Physical Infrastructure and Transport (MoPIT), Government of Nepal (GoN) is responsible for the procurement of component two which includes, "Detailed Design of Upgradation of KDP Road Section of Mahendra Highway and Bridges" in particular.

Mahendra Highway (Dhalkebar-Pathlaiya section, 109 Kms) was constructed in 1974 AD, however, Kamala Dhalkebar section of same highway was constructed in 1970's. Both of these sections were upgraded to double lane standard in late 1990's. The bridges at Kamala Dhalkebar section are of double lane standard while the bridges at Dhalkebar-Pathlaiya section are of Intermediate lane standard. The bridges of Dhalkebar-Pathlaiya section are now bottle necks to the traffic. The passenger and freight traffic have been increasing as a result of



trade enhancement. The recent regional trade agreements such as BIMSTEC, SAFTA, BBIN etc. for further enhancement of trade among the member countries, necessitates the standard of road needs to be upgraded to match with the Asian Highway Standards (Class I). In order to enhance road capacity and efficiency in the road transport, GON, DoR intends to upgrade the KDP section (130 Kms) of the Mahendra Highway under the proposed project from 2-lane to 4-lane road under SRCTIP Project. The Green, Resilient, and Inclusive Development (GRID) approach involving a fundamental shift in managing risk and development: from a reactive response to a deliberate and proactive recovery strategy for long-term green growth, climate action, and sustainable and inclusive development for all, will be adopted where applicable during design and construction of the proposed road project.

1.3 Name of the Proponent

Development Corporation Implementation Division (DCID) under Department of Roads (DOR), Ministry of Physical Infrastructures and Transport (MoPIT) is the proponent for Environmental Impact Assessment (EIA) of the Kamala-Dhalkebar-Pathlaiya Section with associated Bridges of the Mahendra Highway.

1.4 Full address for Correspondence

Full address of the Proponent is as follow:

Government of Nepal
Ministry of Physical Infrastructure and Transport
Department of Roads
Development Corporation Implementation Division (DCID)
Jwagal, Lalitpur, Nepal
Phone No.: 977 1 5541686
Email: dorfcid@dor.gov.np

1.5 Consultant

Joint venture of Consulting Engineers Group Ltd. and Civil Informatics and Solutions Pvt. Ltd. (CEG-CIAS JV) is the Consultant for preparation of Environment and Social Impact Assessment (ESIA) Study of Kamala-Dhalkebar-Pathlaiya Section with associated Bridges of the Mahendra Highway, including Environmental Impact Assessment (EIA).

Full address of the Consultant is as follows:

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1.6 Objectives of ToR

The main objective of ToR is to provide guidance to conduct EIA study. The specific objectives are:

- To identify data requirement for the EIA and Specify methods to collect the required data,



- To identify likely pertinent physical, biological, and socio-economic and cultural issues due to implementation of the project,
- Set out a time frame with required expert manpower and cost for carrying out the EIA study,
- Fit the EIA study into the context of existing policies, rules and administrative procedures and
- Clarification of the responsibilities of the institutions and stakeholders during EIA process

1.7 Objective of EIA Study

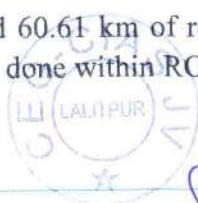
In general, the objective of EIA study is to establish environmental baseline information, identify both beneficial and adverse environmental impacts, analyze their significance, determine nature, magnitude, extent, and duration of impacts and mitigation measures, formulate appropriate enhancement and mitigation measures, propose environmental management and monitoring plan for effective implementation and make easier for decision makers to take decision on the project selection from environmental perspective. More specifically, the objectives of the EIA study are:

- to identify, study and document the existing physical, chemical, biological, economic and social and cultural environmental baseline conditions in the project area
- to identify, predict and evaluate both the beneficial and adverse impacts in terms of both direct and indirect, including definition of their magnitude, duration and extent in the context of areas affected and durability of impacts that are likely to arise from the implementation of the road project
- to formulate and propose suitable augmentation measures for enhancement of beneficial impacts and, appropriate and practical mitigation measures for adverse impacts incorporating provision of necessary environmental and social safeguards during project design, construction and operation plans
- to formulate an environmental management and action plan ensuring implementation of mitigation measures with proposed responsibilities including monitoring provisions

1.8 Rationale for EIA

As per Schedule 3 (E) 6, Transportation Sector pertaining to Rule 3 of EPR 2077, EIA is required for upgradation of National Highways or Feeder Roads of more than 50 Km. The proposal is to upgrade the existing 2 lane Kamala-Dhalkebar-Pathalaiya Road section of 130 Km to 4 lane standard that meets the Asian Highway (Class I) Standard. Similarly, Schedule 3 (A) 12 Forest Sector pertaining to Rule 3 of the same EPR mentions the requirement of EIA for the implementation of project in National Parks, Wildlife Reserve and Hunting Reserve. Chainage 350+050 to chainage 363+750 (about 14 Km) of this road section lies on southern border of Parsa National Park. Hence, EIA is the legal rational for the implementation of this project. The project is funded by the World Bank; hence, the report is prepared in English language.

Around 60.61 km of road alignment passes through forest area. However, upgrading works will be done within ROW of the road only and no extra forest land is required for the project.



2. Information about the Proposal

2.1 General Introduction of the Proposal

Nepal is a member to the Asian Highway Network which is a 141,000 km network of roads running across 32 countries. It is being built with an intention to improve transport facilities throughout these nations and provide road links to Europe. Nepal is connected by two Asian Highways. They are Asian Highway 2 (AH2) and Asian Highway 42 (AH42). AH2 originates from Dhaka in Bangladesh and ends in New Delhi in India. Mahendra Highway falls under AH2 and GON is upgrading this highway to Asian Highway Standard (Class I) under different sections. The recent regional trade agreements such as Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), South Asian Free Trade Area (SAFTA), Bangladesh, Bhutan, India and Nepal (BBIN) etc. for further enhancement of trade among the member countries, necessitates the standard of road needs to be upgraded to match with the Asian Highway Standards (Class I). KDP road section is one of these sections of Mahendra Highway (Chainage 236+698 to 366+667). The road will be upgraded from 2 lanes to 4 lanes (18 m width, 7 m on either side with 4 m center median). Service roads of width 6.5 m each will also be constructed in either side in urban areas. Upgradation works will also address bridges at 76 locations laying within the road section (Table 2-1 below).

Table 2-1: List of Bridges Associated with KDP

S.N.	Name of Bridge	Chainage (Km.m)	Length of Bridge (m)	Bed level below deck (m)	HFL below deck (m)	Type of River	Nature (Siltation)
1	Kamala	237.02	640	9	4	Perennial	Aggrading
2	Kamala Canal	237.81	70.4				
3	Charnath	241.19	322	4.5	2	Ephemeral	Aggrading
4	Baluwa	244.83	111	4.7	2	Ephemeral	Aggrading
5	Jagadav Branch	250.49	26.6			Ephemeral	Aggrading
6	Jagadav	250.82	96	6	4	Ephemeral	Aggrading
7	Jalad	252.47	266	6.2	2	Ephemeral	Aggrading
8	Aurahi	254.61	319	6.4	4	Ephemeral	Aggrading
9	Basai	256.14	96	5.8	2	Ephemeral	Aggrading
10	Sukhajor	258.63	44.2	6	4	Ephemeral	Aggrading
11	Barahari	260.96	75	6	3	Ephemeral	Aggrading
12	Ratu (New)	265.31	225.3	7	3.5	Ephemeral	Aggrading
13	Ratu Chahara	266.11	18.8			Ephemeral	Aggrading
14	Bhapsi (new)	268.13	50.46	Under Construction		Ephemeral	Aggrading
15	Atabbe	269.36	28.6	7.8	2	Ephemeral	Aggrading
16	Janga Pul-1	270.72	75		1	Perennial	Stable
17	Gaushala	270.99	37.5	4.4	2.2	Ephemeral	Aggrading
18	Gadhanta	271.36	62.5	3.5	1.5	Ephemeral	Aggrading
19	Belgachhi (Dhungre Khola)	274.80	38.1	2.3	0.5	Ephemeral	Aggrading



S.N.	Name of Bridge	Chainage (Km.m)	Length of Bridge (m)	Bed level below deck (m)	HFL below deck (m)	Type of River	Nature (Siltation)
20	Tuteshwor -1	275.49	19	3.8	2	Ephemeral	Degrading
21	Tuteshwor - 2	276.90	19	5.3	2.5	Ephemeral	Aggrading
22	Maraha Bridge	277.00	132	4.5	2	Ephemeral	Aggrading
23	Maraha KholsiPul/ Batuwa Khola	278.22	19	3.7	2	Ephemeral	Aggrading
24	Dholan	278.78	38	2.6	1.5	Ephemeral	Aggrading
25	Jarlahi (Kholsi Pul)	280.45	19	4	2.5	Ephemeral	Aggrading
26	Batuwa/ Budakhola	281.88	28.5	4	2	Ephemeral	Aggrading
27	Bankhe	282.73	102.5	4.8	2	Ephemeral	Aggrading
28	Amuwa	285.65	18.65	4.5	2	Ephemeral	Aggrading
29	Phuljor	290.22	87.4	4.8	2.5	Ephemeral	Aggrading
30	Kalinjor - 1	291.89	28.5	4.4	3	Ephemeral	Aggrading
31	Kalinjor - 2	292.76	63.4	6.4	3	Perennial	Stable
32	Betini	294.16	12	2.5	2	Ephemeral	Degrading
33	Dumdume	295.39	18.7	3.4	1.5	Perennial	Stable
34	Bastipur	296.33	18.8			Ephemeral	Aggrading
35	Lakhandei	300.67	204.55	6.2	2	Ephemeral	Aggrading
36	Chapani	301.71	66.4	5.8	2	Perennial	Aggrading
37	Bastol	302.55	20.8				
38	Sukhapokhari	305.62	20			Ephemeral	Aggrading
39	Rai Bridge/ Harion Khola	307.66	38	6	2.5	Perennial	Degrading
40	Dumajor	309.91	37.5	4	1.8	Ephemeral	Aggrading
41	Godari	311.44	19.4	2	1.5	Ephemeral	Aggrading
42	Bagmati	312.07	363.5	10.8		Perennial	Aggrading
43	Bagmati East	312.94	11.3				
44	Bagmati West	313.62	11.57				
45	Gairi	313.99	34.25	5	2.5	Ephemeral	Aggrading
46	Gairi Khola	314.83	11.5			Ephemeral	Partial Aggrading
47	Paurai	317.79	66.4	5.4	2.5	Ephemeral	Stable
48	Lachkan	319.13	22.67	2.6		Ephemeral	Aggrading
49	Katha KoPul/	323.57	46	2.4		Ephemeral	Aggrading
50	Chandi	325.26	165	7.7	3.5	Perennial	Aggrading
51	Dhou	327.33	22.5	1		Ephemeral	Aggrading
52	Jungle Tole	328.14	34.08	1.8		Ephemeral	Stable
53	Amu -1	329.67	34.08	2.5		Ephemeral	Stable
54	Amu - 2	330.90	22.73	3		Ephemeral	Stable
55	Kathi	332.72	56.8	2.3		Ephemeral	Aggrading
56	Lamaha	333.84	65.9	9.4	6	Perennial	Stable
57	Kali Khola	334.40	34	6.45	3.5	Perennial	Degrading



S.N.	Name of Bridge	Chainage (Km.m)	Length of Bridge (m)	Bed level below deck (m)	HFL below deck (m)	Type of River	Nature (Siltation)
58	Dhansasr	339.38	164.6	5.4	2	Ephemeral	Aggrading
59	Lamopul	342.17	45.4	3		Ephemeral	Stable
60	Bhamara	343.40	32.89	9.2	5	Ephemeral	Aggrading
61	Rampul	343.99	22.5	3.5		Ephemeral	Aggrading
62	Bakeya	347.27	355.59	8.6	4	Perennial	Aggrading
63	Unasi	348.93	89.6	2.8		Ephemeral	Aggrading/ Degrading
64	Terhakilo	353.61	45.6	2	0	Ephemeral	Aggrading
65	Barahakilo	354.66	34	4.8	2.5	Ephemeral	Stable
66	Pasaha	357.34	165	7.5	3.2	Perennial	Aggrading
67	Pasaha Branch	357.46	22.2			Ephemeral	Stable
68	Bangandi	358.58	113.6	4.2		Ephemeral	Aggrading
69	Balganga	361.00	67.1	8	4.5	Ephemeral	Aggrading
70	Baijura	362.95	46.1	5.5	3	Ephemeral	Aggrading
71	Dudhaura	363.69	89.3	Under Construction		Ephemeral	Aggrading
72	Dhungre- 1	364.55	22.8	3		Ephemeral	Aggrading
73	Dhungre - 2	364.78	23.3	5.5		Ephemeral	Stable
74	Tin Number	365.87	23.16	4.6	3	Ephemeral	Stable
75	Dui Number	366.39	34.74	4	2.5	Ephemeral	Stable
76	Ek Number	366.61	11.45	2.6		Ephemeral	Aggrading

Source: Draft Detail Design Report 2022

2.2 Relevancy of Proposal

It is noticed that different sections of Mahendra Highway were constructed in different time frames. Within proposed upgrading of 130 km long KDP road section of Mahendra Highway also, Dhalkebar-Pathlaiya section, (109 Kms) was constructed in 1974AD, however, Kamala-Dhalkebar section of same highway was constructed in 1970's. Both of these sections were upgraded to double lane standard in late 1990's. The existing bridges at Kamala-Dhalkebar section are of two-lane standard while the bridges at Dhalkebar-Pathlaiya section are of intermediate lane (5.5m width) standard. The bridges are the prime cause of the traffic congestion on that section of the highway. The bridges of Dhalkebar-Pathlaiya section are now bottle necks to the traffic. The passenger and freight traffic have been increasing as a result of trade enhancement.

KDP road section is one of the busy sections of Mahendra Highway and traffic flow in this section is increasing day by day (traffic data given in table 2.3). The road passes through some of the major settlements like Dhalkebar, Pathlaiya, Nawalpur, Chapur, Nijgadhi, Pathlaiya etc. and is also a part of access to all the district headquarters within Madesh Province along with province headquarter at Janakpur. Connection of Fast Track to this road section (at Chainage 348+850) will also lead in further traffic increment in this road section. The road section is also subjected to different forms of structural failures (like pavement cracking, pot holes, depressions, rutting, shoving, raveling, deterioration etc.) may be due to excessive loading and/or expiry of the operational period. In this regard, DOR-DCID intends



to upgrade the road section from two lane (existing 10 to 12 m formation width) to four lanes (24 m formation width) with adequate design standards. Upgrading works will also include extra service lane of 6.5 m in either side in dense settlement areas and bridges at 76 locations.

2.3 Location and Access

Proposed KDP road section is a part of Mahendra Highway. The proposed road section starts from Kamala 26°52'40.73"N latitude and 86° 8'24.20"E longitude and ends at Pathlaiya 27°11'57.66"N latitude and 84°58'50.76"E longitude. The road stretch lies within Madesh Province and covers 6 Districts, 16 Municipalities (including 1 sub-metropolitan city) and 78 wards as shown in Table 2.2 below.

Table 2-2: Districts, Municipalities and Wards covered by the Road Alignment

Districts	Municipalities	Wards
Siraha	Karjanha	2, 3
Dhanusha	Ganeshman Charnath Municipality	8, 7, 6, 4, 2, 1
	Dhanusadham Municipality	8, 9, 6
	Mithila Municipality	4, 3, 5, 6, 7, 8, 9, 10
Mahottari	Bardibas Municipality	1, 14, 4, 8, 5, 10, 11
	Gaushala Municipality	1, 8, 10, 11, 12
Sarlahi	Ishworpur Municipality	13, 4, 5, 12
	Lalbandi Municipality	17, 6, 7, 9, 10, 1
	Hariwan Municipality	4, 8, 9, 10, 11
	Bagmati Municipality	1, 2, 4, 11, 12
Rautahat	Brindaban Municipality	1
	Chandrapur Municipality	1, 2, 4, 5, 3, 6
	Gujara Municipality	2, 3
Bara	Nijgadh Municipality	2, 3, 7, 8, 9, 4
	Kolhabi Municipality	2, 3, 6, 5, 8
	Jitpur Simara Sub-Metropolitan City	17, 16, 15, 14, 4, 1, 2

The Project location along with proposed road alignment is shown in **Figure 2-1**, land use map with critical sections is shown in **Figure 2-2** and proposed road alignment in google earth is shown in **Figure 2-3**.

Start point of the road section, Kamala is 209 km far from Kathmandu via Kathmandu-Banepa-Dhulikhel-Bardibas (BP-Highway) road and end point of the road section, Pathlaiya, is 110 km far from Kathmandu via Kathmandu-Kulekhani-Hetauda Road. Nearest airport from the road section is at Simara, which is around 6 km far from Pathlaiya. Similarly, Janakpur airport is around 24 km far from Dhalkebar (Ch 257+200).



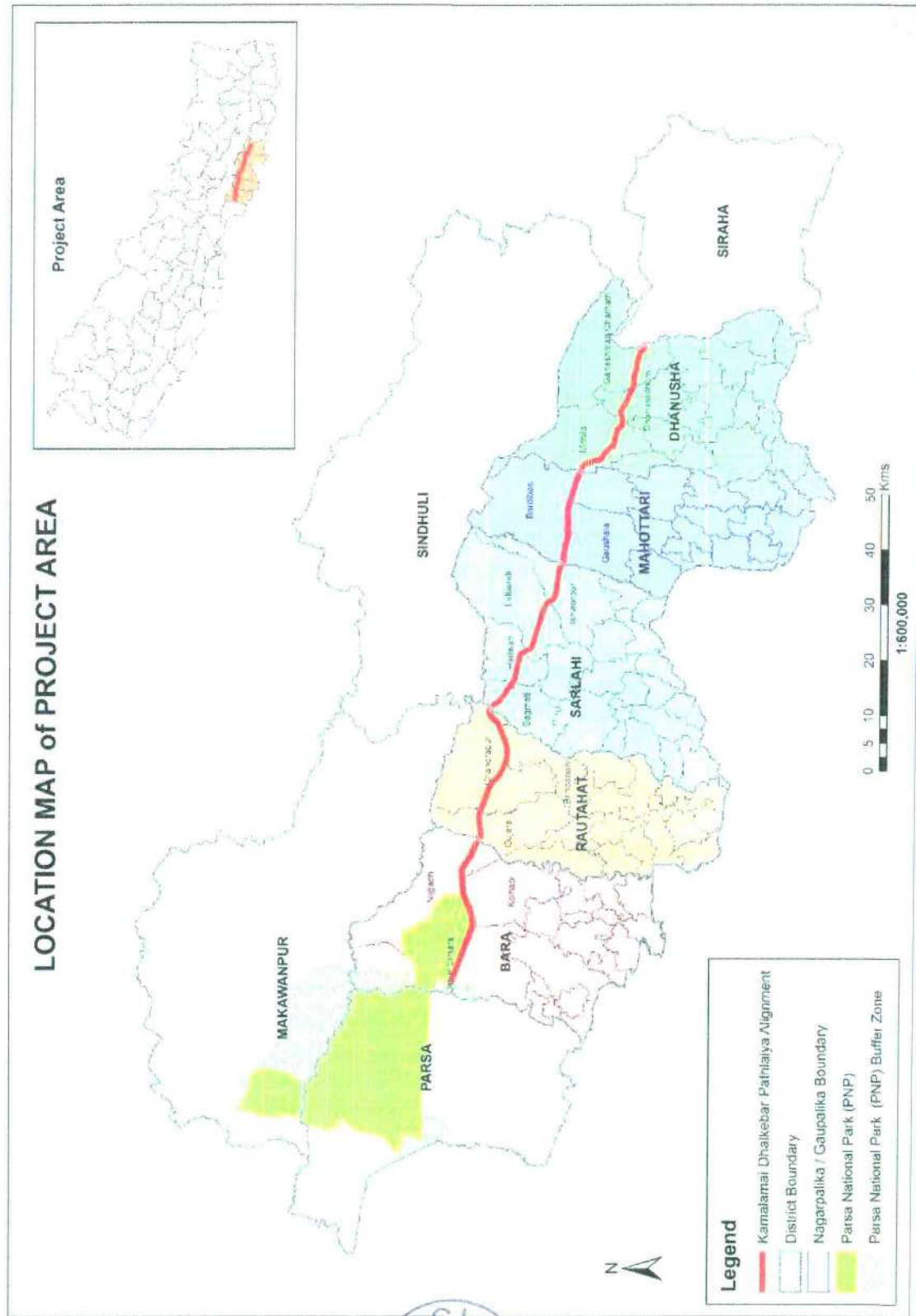


Figure 2-1: Proposed Road Alignment in Map of Nepal

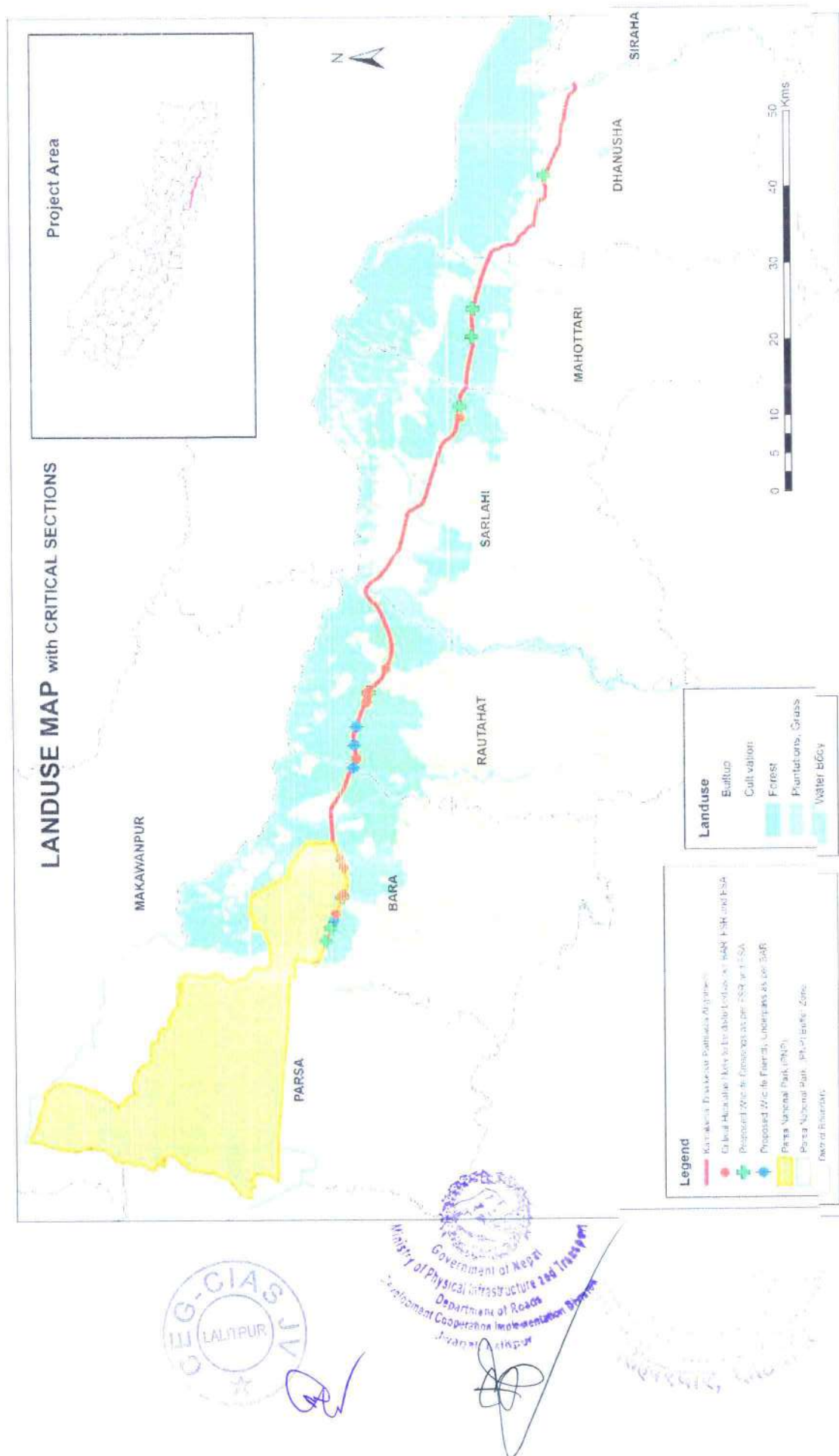


Figure 2-2: Land Use Map of Project Area with Critical Sections

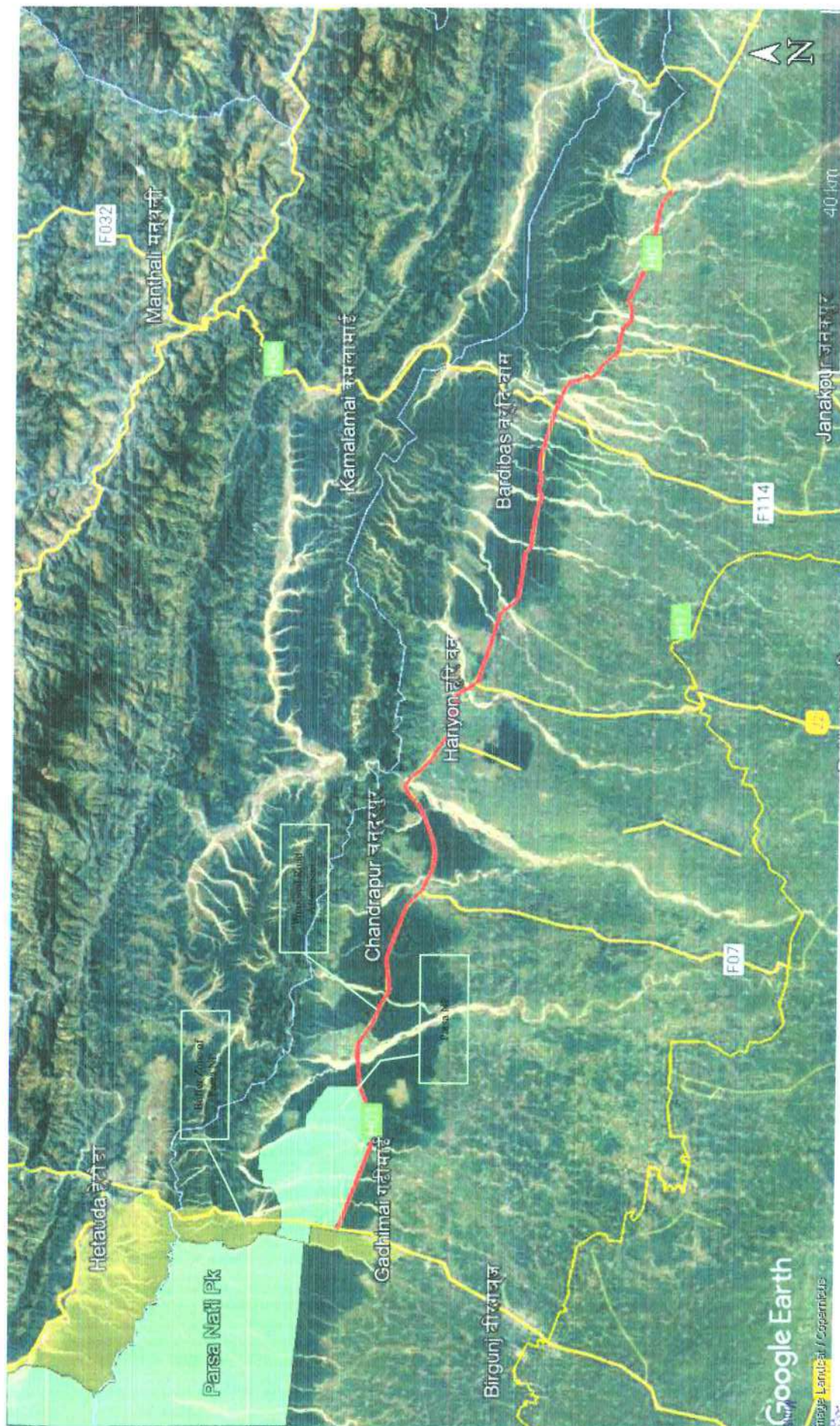


Figure 2-3: Proposed Road Alignment in Google Earth

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2.4 Nature/Type

The proposal (KDP road section) is of service-oriented nature. The upgraded road will assist in coping with increased vehicular movement within project area. Further, existing damaged and deteriorated road surface will be smooth and durable.

2.5 Salient Features of the Project and Components

The proposal is to upgrade KDP road section (130 km) from existing two lane to four lanes along with associated bridges at seventy-six locations. In case of dense settlements, extra service lanes of 6.5 m width will also be constructed on each side. Salient features of the Project are given in table below:

Table 2-3: Salient Features of the Project

Name of the Sub-Project	Upgrading of Kamala-Dhalkebar-Pathlaiya Road section of Mahendra Highway	
Location		
Province	Madesh	
Start Point	Kamala Bridge (Ch: 236+698) 26°52'40.73"N latitude and 86° 8'24.20"E longitude	
End Point	Patlaiya Junction (Ch: 366+667) 27°11'57.66"N latitude and 84°58'50.76"E longitude	
Name of District and Municipalities	1. Siraha district: a) Karjanha 2. Dhanush district: a) Ganeshman Charnath municipality, b) Dhanusadham municipality, d) Mithila municipality 3. Mahotari district: a) Bardibas municipality b) Gaushala municipality 4. Sarlahi district: a) Ishworpur municipality, b) Lalbandi municipality, c) Hariwan municipality, d) Bagmati municipality 5. Rautahat district: a) Brindaban municipality, b) Chandrapur municipality, c) Gujara municipality 6. Bara district: a) Nijgadh municipality, b) Kolhabi municipality and c) Jitpur Simara sub metropolitan city.	
Major Settlement	Godar Bazar, Birendra Bazar, Dharapani, Puspapur, Dhakebar, Badahari, Lalgadh, Bardibas, Phuljor, Raniganj, Lalbandi, Nawalpur, Hariwon, Bagmati, Chandranigahpur, Nijagadh and Pathalaiya.	
Geographical Feature		
Terrain	Plain	
Geology	Alluvial deposit with deep to very deep, poorly drained, high-water table, and silt to silt loam textures	
Altitude (maximum and minimum)	Maximum 227 at Ch 266+300, Bardibas and minimum 105 at start (Kamala river)	
Climate	Tropical	
	Existing	Proposed
Road Classification		
Classification	Class II	Class I as per AHDS
Length of Road	130 km	130 km
Road Pavement		



Sub-base Material	15 cm	20 cm
Base Material	10 cm	15 cm
Dense Bituminous Macadam	0 cm	10 cm
Wearing Course	DBST	Asphalt Concrete (4 cm)
Cross-section		
Right of Way	50 m	50 m
Carriageway Width	7.0m (Average)	18 m (7.0 m on either side with 4 m center median), further 6.5 m service road width in either side of roads in urban areas.
Formation Width	(10 – 12) m	24 m
Shoulder Width	1.2 m	2.5 m
Side Drain (width)	Side Drains are available at Dense settlement area	Open drain in rural areas and trench type with cover for footpath in urban areas
Design Standard		
Standard		NRS-2070
Design Speed		100 kmph
Gradient (Maximum and Minimum)		5 %
Minimum Radius of the Horizontal Curve		Maximum as per design and minimum should be at least 870 m as per NRS-2070.
Camber		2.5 %
Super Elevation		7 %
Crossings		
Bridges	Total -76nos. 50-75m – 9nos. 75-100m – 7nos. 100-150m – 3nos. 150-200m - 3nos. 200-300m - 3nos. 300-400m – 4nos. 640m – 1no.	
Culverts	122 nos	
Causeway	23nos.	
Traffic Data (January 2022, Base Year Traffic)		
AADT, Vehicle/day	13249 at Kamala-Dhalkebar section and 8306 at Nijgadl-Pathlaiya section	
AADT, PCU/day	15386 at Kamala-Dhalkebar section and 12067 at Nijgadl-Pathlaiya section	
Total Project Cost	NPR 8856.29 Crores	

Source: Design 2022

The project components are:



Construction/Upgradation of Road: Upgradation of 130 km road section of Mahendra Highway from Kamala to Pathlaiya to four lanes which includes civil works, earth works, grading, paving, drainage, cross drainage, construction of bridges, culverts, wildlife crossings, people and cattle crossings, bus terminals and other structures.

Supplementary and Associated Facilities: This includes operation of supplementary and associated facilities such as construction camp and labor camps, quarry and borrow pits, crusher plant, hot mix plant, batching plant etc.

Maintenance of road: Regular maintenance of road is required to preserve the road in its originally constructed condition, protect against resources and user safety and provide efficient, convenient travel along the route. It covers different types of maintenance as routine maintenance, recurrent maintenance, specific maintenance, and emergency maintenance.

2.6 Project Related Activities

Pre- Construction Phase

The project activities identified during this phase are: finalization of design, bidding and selection of the construction contractor and deployment of the supervision consultant, compensation of land (if any), relocation of public utilities, tree felling process including identification and numbering of trees to be felled, identification of land for setting up of temporary contractor camp, labor camps, quarry site and borrow pit identification, material storage yard, preparedness, awareness to contractor's staff, location of storage yards and others etc. As Right of Way (ROW) of the proposed road section is already under DOR and all the construction activities will be done within ROW, no extra permanent land is required for the project.

Construction phase

The project activities during this phase are:

- Cutting of trees and site clearance,
- Setting up of all construction and labour camps and plants including batching plants, hot mix plants, crushers etc.,
- Commencement of quarrying, and crushing activities,
- Civil works such as earth works, foundation excavation, structure construction, material storage and handling, construction yards and worker's yards construction, grading, pavement, drainage and cross drainage, road embankment, movement of vehicles and equipment, operation of Diesel Generator (DG) sets, crushers etc.
- Construction of structures related to animal pass, water holes (water ponds as water sources for animals), social structures etc.
- Road side plantation, Greenery, etc. (within and beyond ROW)
- Examine the construction induced impacts
- Implementation of Environmental Management Plan (EMP)

Detail activities to be done during construction phase are shown in construction schedule section (section 3.3 below).



Operation Phase

The activities to be performed during operation phase of proposed road are as follows:

- Reinstatement of environment camps, quarry sites, borrow pits, labor camp, material storage yards etc.
- Management of water holes, animal crossings
- Pavement maintenance and rehabilitation works.
- Road furniture.
- Maintain the green area along the road alignment.
- Implementation of EMP

2.7 Construction Plan

2.7.1 Area of Land Required

It is noticed that around 60.61 km of the road section passes through forest area. This also includes 14 km of road section passing through southern boundary of Parsa National Park. However, all the road structures will be constructed within existing ROW of the road. This land is under the ownership of DOR. Hence, no extra permanent land is required for the project. For temporary facilities (contractor and labor camps, construction yard and stockpiling yard) around 7.5 ha of agricultural and barren land shall be leased/rented.

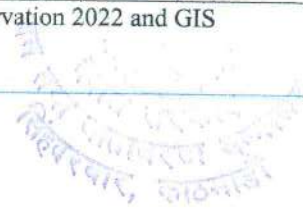
2.7.2 Type of Land

It is noticed that around 60.61 km of the road section passes through forest area. This also includes 14 km of road section passing through southern boundary of Parsa National Park. All the road structures will be constructed within existing ROW of the road. This land is under the ownership of DOR. Hence, no extra permanent land is required for the project. However, in few places (Dhalkebar and Bagmati area), there may be slight change in design for curve improvement which may lead to land acquisition. Further, if the project intends to develop recreational/service area, this may require land acquisition. If required, this will be finalized during EIA study. For temporary facilities (contractor and labor camps, construction yard and stockpiling yard) around 7.5 ha of agricultural and barren land shall be leased/rented. The proposed road alignment traverses through different land use types. These are given in table 2-4:

Table 2-4: Summary of Land Use that the Road Alignment Traverses

Land Use	Road Length (km)	%	Existing Area (ha)	Area Required (ha)	Ownership
Forest Area	69.605	53.54	55.684	139.21	DOR
Agricultural land with houses/sparse settlements	37.34	28.72	29.872	126.956	DOR
Dense Settlements	17.815	13.70	17.815	57.008	DOR
River and Flood Plain	5.24	4.03	3.144	6.288	DOR
Total	130	100	106.515	329.462	

Source: Field Observation 2022 and GIS



2.8 Requirement for Proposal/Project

2.8.1 Required Human Resource

Road construction involves a variety of works who each contribute something to the process. Workers include labors, equipment operator's truck drivers, inspectors, foremen and engineers. Workers needed to have proper training, insurance and certification to be able to work on job site. The local people will be given due priority for all the construction related works as per their skills, expertise, experience and knowledge. The proposed project will involve a large number of skilled and unskilled labors during the construction in various phases. Human resource required for the project will be estimated and presented in EIA report after design is final.

2.8.2 Construction Materials (Quantity and Resources)

For the upgrading of the road and associated bridges, construction material (Sand, Gravel, Stone, Cement, Aggregates, Concrete, Bitumen, lumber, steel etc.) are required. Tentative quantities of major construction materials required for the project are given in table below.

Table 2-5: Construction Materials Required

Material	Unit	Quantity required
Soil	Cum	5,185,510.983
Steel	MT	17,499.868
Aggregate	Cum	3,016,627.724
Bitumen	Ton	29,952.594
Cement	Ton	220,347.940
Sand	Cum	187,896.742

Source: Draft Detailed Design Report 2022

Sand, stone and gravel will be used from Initial Environmental Examination (IEE) approved river bed extraction sites within project affected municipalities. It is noticed that banks of rivers like Kamala, Baluwa, Jaladh, Basai, Lokhandehi, Bagmati, Lamaha and Bakaiya have plenty of construction materials and associated municipalities have approved these sites for extracting river bed materials. These materials will be extracted as per standards related with extraction sale and management of stone, aggregates and sand, 2077. Beside this, construction materials can also be sourced from authorized suppliers/crusher plants. Other materials can be sourced from nearest market centers along East West Highway.

2.8.3 Construction schedule

It is estimated that the construction of proposed road section will be completed within three years. Construction Schedule of the proposed road upgradation works is given in table below. The construction of proposed road project will be implemented through the contractors.



Table 2-6: Work Schedule for the Proposed Road Upgradation

S.N	Description	Months																																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
1.	General (insurance of works, equipment, third party insurance etc.)																																					
2.	Additional tests for material and work																																					
3.	Property acquisition (buildings, land and other structures)																																					
4.	Provide and maintain traffic safety, control measures and temporary diversions where necessary																																					
5.	Relocation of services																																					
6.	Provision and maintenance of labor camps																																					
7.	Clearing of grass and vegetation, leveling the surface																																					
8.	Earth work (excavation for road widening and foundation of structures in all types of soil including disposal of excavated material at approved environmentally safe tipping sites)																																					
9.	In filling and back filling, construction of embankments, shoulders and other miscellaneous filling and backfilling																																					
10.	Construction of road embankment and side drains																																					
11.	Construction of bridges and cross drainage structures																																					
12.	Sub-base, Base and Shoulders (preparation of subgrade to designed grade and chamber including watering and compaction, supply, place and compact quarry sieved sub-base materials and crusher run improved sub base course materials)																																					
13.	Bituminous course																																					
14.	Turfing along road embankment and Plantation: supply and planting rooted grass slips, shrubs and tree samplings.																																					
15.	Miscellaneous Works (supply and place permanent traffic sign, standard size sign boards, one kilometer and five-kilometer stone (RCC), edging, gabion parapet-safety barriers for vehicle safety on the edge of road, delineator post etc.																																					
16.	Project Completion and DLP Period Start																																					


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2.8.4 Type of Energy Used (Source, Quantity consumed)

For the construction of the road different types of the energy will be required. The labors will need gas for cooking and heating purposes. The kerosene will be needed for bitumen that is used for black topping of the road. Vehicles and machineries will use diesel and petrol. As the project is part of East-West Highway and passes through different settlement regions, the pressure on local fuel demand will be negligible considering the small scale of project works. The use of forest wood for heating and cooking will be strictly prohibited.

2.8.5 Technology Used

The construction technology for the proposed road and bridges is primarily mixed type i.e., labors with machine based. In this technology construction of simple structures (like gabion walls, drainage lining etc.) will be done by labor and heavy works (like excavation, pavement etc.) will be done by machines.

2.8.6 Associated / Ancillary Facilities

For the proposed project, different associated/ancillary facilities are required like contractor and labor camps, construction yards, stockpiling yards, quarry and burrow pit sites, crusher plant sites, hot mix plants, batching plants etc. For labor camps, construction yards and stockpiling yards, agricultural lands adjoining the road alignment will be leased (possible chainages at 237+700, 241+430, 259+200, 290+500, 311+000 and 325+100). Even for crusher plant sites, hot mix plants, batching plants, agricultural lands away from dense settlements will be leased (possible chainages at 237+400, 262+000, 305+500 and 343+600). For quarry sites and burrow pits different rivers within the project area have sufficient quantity and respective municipalities have even approved sites for quarrying and burrowing. River bed materials required for the project can be extracted from such sites by paying royalties to the concerned municipalities.

Table 2-7: Information of Burrow Places

Location/ River	From Existing Road		Description of Materials	Remarks
	Road Left/Right	Offset		
Kamala River (Chisapani)	Right	7000m on U/S of bridge	Material for sand and aggregate is of good quality	The material to be used for concrete is found suitable.
Ratu Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	
Banke Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	
Maraha Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	
Lakhandehi Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	
Bagmati River	Left/Right	1000 m on both side of bridge	Material is of good quality	
Chandi Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	



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Location/ River	From Existing Road		Description of Materials	Remarks
	Road Left/Right	Offset		
Lamaha	Left/Right	1000 m on both side of bridge	Material is of good quality	
Dhansar	Left/Right	1000 m on both side of bridge	Material is of good quality	
Bakaiya Khola	Left/Right	1000 m on both side of bridge	Material is of good quality	
Rapti	Left/Right	1000 m on both side of bridge	Material is of good quality	

Source: Design Report 2022

For such facilities reinstatement and decommission plan after project completion will be proposed in EIA report.



3. Data Collection

3.1 Data Required for Preparation of the Report

3.1.1 Physical and Chemical Environment

- Topography, geomorphology, geology, flood/water logging/fragile environment of the project area
- Land use pattern
- Climate (Temperature, Precipitation, Hydrology etc.)
- Air, Noise and Water quality of the project area.
- Project auxiliary facilities like camp site location, quarry and burrow pit sites, stockpiling yards, construction yards, spoil/muck disposal sites etc.
- Different chemicals to be used during construction

3.1.2 Biological Environment

- Floral diversity of the project area
- Faunal diversity of the project area
- Wildlife habitat and foraging zone
- Wildlife movement corridors
- Aquatic life
- NTFPs found in the project area, Ethnobiology
- Forest Management Practices

3.1.3 Social, Economic and Cultural Environment

- Demography Such as Population, age, sex, households etc.
- Ethnicity, Religion and Language
- Settlement pattern and migration
- Education and literacy
- Gender Aspects
- Health and Sanitation
- Occupations
- Agricultural land and cropping pattern
- Energy used pattern
- Communication, transportation and irrigation
- Rituals and festivals
- Religious and pilgrimage sites
- Relocation of public utilities (water supply, waiting sheds, irrigation, electrical poles, drainage etc.)
- Displacement of religious trees, chautaris, temples, shrines, ponds
- Informal encroachers and their temporary sheds, shops, etc.
- Traffic safety, movement and traffic diversion



3.2 Project Area Delineation

The Project Influence Area (Zone of Influence) have been divided into following three categories:

Right of Way (ROW): Twenty-five meters both sides from center line of the proposed road have been considered within ROW of the proposed road.

Direct Impact Area (DIA): an area up to 300 m (150 m both sides of project alignment) have been considered for a larger analysis of land use and other environmental features. This area will also include ancillary facilities required for the Project including borrow and quarry sites, spoil disposal areas, worker camps, construction camps, sources of materials etc.

Indirect Impact Area (IIA): an area of up to 2 km strip (1 km on either side of the project alignment) will be studied for indirect impact zone for the Project.

3.3 Methods to be used while Collecting Data

3.3.1 Literature Review

- a) Maps related to land forms, geographical location, land use, land potential and related studies

For this, administrative, topographic maps and land use maps from Department of Survey, geological maps from Department of Mines and Geology and International Centre for Integrated Mountain Development (ICIMOD) etc. will be studied.

- b) Design Report of KDP 2023 (including hydrological report, geotechnical report, survey report, etc.)

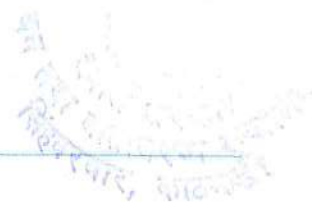
- c) Aerial photographs of project location

For this, aerial maps from google earth and image captured from drone survey during feasibility study will be studied.

- d) Data on flora and fauna of the project implementation site

For this, following literatures will be reviewed:

- Biodiversity Assessment of East-West Highway and Bridges, Nepal (Kakarbhitta-Pathalैया Section), 2017, SRDP, WWF, The World Bank.
- Baseline report of KDP 2022, Kamala- Dhalkebar- Pathlैया Section (130 km) with associated Bridges of the Mahendra Highway, SRCTIP, DCID, DoR, MoPIT
- Environmental and Social Assessment (ESA) Report, 2020, Kakarbhitta – Pathalैया Road Corridor, including Kamala -Dhalkebar – Pathalैया Road Segment, of Mahendra Highway (MRM), SRCTIP, DCID, DoR, MoPIT
- Study on Mapping of Elephant Corridor Across Fast Track Alignment, 2015, The World Bank, Aviyan Consulting (P) Ltd.
- Use and Effectiveness of Wildlife Crossing in Nepal, Results from the Wildlife Underpasses Built along Narayanghat-Mugling Road in Barandabhar Corridor Forest, 2019, Hariyo Ban Program, WWF



- Red data book of the fauna of Nepal, 1995, Suwal, R.N., Verheugt, W.J.M and Smith, C., Nepal Department of National Parks and Wildlife Conservation, Kathmandu

Beside this, available publications from Department of National Park and Wildlife Conservation and District Forest Offices will also be collected and reviewed.

- e) Geological and other risk assessment data (if available)
- f) Information on air and water quality and noise level before and after implementation of the project
- g) A matrix or line diagram relevant to EIA
- h) List of references used or cited during report preparation and other secondary data and related report, studies and publications

3.3.2 Field Study

3.3.2.1 Methods to be adopted for Physical Environment

a) Walkthrough/Direct Observation

The study team will walk through the road alignment observing and noting down all the sensitive locations and physical hazard zones. The Soil type, embankment stability, erosion, river cutting, water lodging and flood prone area etc. of the project area will be collected through site observation, measurements, geological maps, hydrological and geotechnical reports and consultations.

b) Air, Water and Soil Sample Collection

Air quality (PM₁₀, PM_{2.5}, TSP, CO) of the project area (1 day, 24 hours) will be identified through high-volume air sampler. For water quality, water samples from major rivers and ground water sources will be collected and tested in lab (parameters like TSS, conductivity, total nitrate, pH, arsenic, E. coli etc.). Similarly, soil samples from agricultural land adjacent to proposed road alignment will be collected and tested in lab (parameters like pH, moisture content, organic matter, nitrogen, phosphorous, potassium, sodium etc.).

c) Measurement of Noise Level

Data on noise quality will be collected through sound level meter (REED R8080). Recording interval will be set to 2 seconds. Data will be analysed through the windows software for Model R808 which will directly give the value of Leq.

Monitoring locations for air, water and noise are given in table below.

Table 3-1: Work Schedule for the Proposed Road Upgradation

Air Quality, Noise Level	Chainage for monitoring
Dhalkebar	257+500
Lalbandhi	294+600
Forest area	317+700
Nijgadh	344+000
Forest Area (adjoining Parsa NP)	364+000
Surface Water	Chainage for monitoring
Kamala River	237+500
Bagmati River	313+500
Bakhaiya River	347+400

Wetland	325+150
Pond	329+150
Ground Water/Drinking water	Chainage for monitoring
Dhalkebar	257+000
Bardibas	267+500
Lalbandi	295+000
Bagmati	313+000
Chandranigapur	327+000
Nijgadh	346+000
Pathlaiya	367+000
Soil Quality	Chainage for monitoring
Kamala	241+000
Bardibas	266+000
Raniganj	291+000
Bagmati	311+000
Nijgadh	344+000

3.3.2.2 Methods to be adopted for Biological Environment

a) Walkthrough/Direct Observation/Indirect Sign Survey

Walk-through survey will be conducted at project site to make general observation of the vegetation type and wildlife. Beside this critical habitat analysis will be done within road sections passing through dense forest region. For wildlife, indirect survey / observation of signs (e.g., scats/droppings, scratches, calls, pugmarks, carcasses, scales) and direct observation of indirect indicators such as nests, dens, burrows will be done and analyzed.

b) Sampling

For sampling of vegetation, quadrat survey will be done. For this, quadrat sample of 10x10 sq.m. will be laid in critical sections and trees, herbs and shrubs in these sections will be measured/counted.

c) Transect Walk/Point Count

Total count of trees that are to be affected due to project activities will be done along with measurement of diameter and height as per Forest Regulation 2079. The tree volume will be calculated as per Forest Regulation 2079 for which volume equations and biomass prediction of forest trees of Nepal, Sharma and Pukala, 1990. For this following formula will be used,

$$\ln(V) = a + b \cdot \ln(d) + c \cdot \ln(h)$$

$$\text{Or } V = \text{EXP}[a + b \cdot \ln(d) + c \cdot \ln(h)]$$

Where V= Stem Volume of tree in deca meter which has to be divided by 1000 to convert to cubic meter

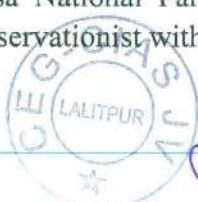
a, b, and c are constant values as per trees

d is diameter of tree measured at diameter at breast height (i.e. 1.3 m)

h is height of the tree

d) Key Informant Interview and Consultations

During field visit, the biological team will organize consultation meetings with warden of Parsa National Park, District Forest Officers, local People, wildlife researcher and local conservationist within project area. These consultations will be fruitful in identifying wild life



and vegetation within project area, possible areas of wildlife crossings, boundaries of different forest groups etc.

Verification of collected list of flora and fauna with GoN laws, IUCN red List and CITES Appendices will be done.

3.3.2.3 Methods to be adopted for Social, Economic and Cultural Environment

a) Walkthrough/Direct Observation

Direct observation of project affected structures, informal inhabitants, historical, cultural, religious and archeological importance and other socioeconomic and cultural variables will be done during walkthrough survey.

b) Stakeholder Consultation

Different stakeholders within direct impact area and indirect impact area will be identified and consultation meetings will be organized with directly affected people, IPs, elderly groups, women headed households, schools, government officials, local leaders, community actors and other stakeholders for documentation of their views on project. For stakeholder consultation, following methods will be adopted:

- i. Focus Group Discussion (FGDs): FGDs will be conducted among different stakeholders including CFUGs, Indigenous groups, women groups, directly affected households etc. along the road alignment. FGD facilitators, note takers/time checkers will be deployed. Checklist for FGDs is given in Annex 1.
- ii. Household Survey: Census survey within all the directly affected households and sample survey covering 20% of adjoining settlements will be done through household questionnaire.
- iii. Key Informant Interview (KII): Key Informants along the road alignment like warden of Parsa National Park, DFOs, mayors and ward presidents etc. will be interviewed to know the general environmental setting of the project area and their view.
- iv. Group Discussions: Local people residing near the road alignment will be gathered in groups and discussions with them will be done to collect information on social and cultural sites and practices.

Most of the KIIs, FGDs and group discussions within major settlements along the road alignment have already been conducted during scoping exercise.

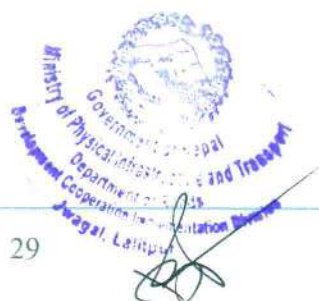
3.4 Public Hearing

In order to ensure the public involvement and involvement of local government, public hearing will be conducted within the project area as per rule 6 (1) of EPR 2077 and collect comments and suggestions from related stakeholders including local people, users' groups, and local representatives. For informing people about public hearing and inviting them in public hearing, notice will be prepared and published in national daily newspaper. Further, notice will be pasted in major settlement areas, offices, organizations etc. along the road alignment. Locations for public hearing will be finalized after consultation with local representatives and proponent.



3.5 Report Preparation and Presentation

The EIA report will be prepared as per the provision of schedule 12 pertaining to rule 7 (5) C of EPR, 2077. As WB has provided financed assistance for the preparation of DPR and ESIA study and it is expected that WB will provide financing for the implementation of the project, the EIA report will be prepared in English language and brief report will be prepared in Nepali as per Rule 7 (8) and (9) of EPR, 2077. Draft report will be presented in presentation meeting held by GESU/MoPIT/MOFE as required and final report will be prepared and submitted for approval after incorporating comments/suggestions provided during the presentation meeting.



4. Policies, Acts, Rules, Guidelines, Standards, Conventions, Agreements

Brief review of relevant national environmental legislations including constitution, policies and plans, acts and regulations, manuals/guidelines, international conventions and treaties, and standards has been carried out and presented hereunder.

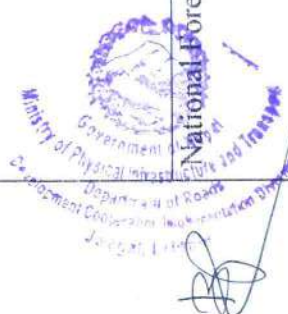
Table 4-1: Review of relevant Acts, Rules, Regulations and Guidelines

	Articles/rules/clauses, etc.	Related description
Constitution Constitution of Nepal	Article 30 (1)	Every person shall have the right to live in clean and healthy environment
	Article 30 (2)	The victim shall have the right to obtain compensation, in accordance with law, for any injury caused from environmental pollution or degradation
	Article 51	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
Policy and Plan		
National Gender Equality Policy 2077	Section 6. Long Term Thought	Gender Equitable Nation Construction
	Section 7.Scenario of Thought	Ensuring substantive and meaningful participation of women in all sectors and maintaining gender equality through economic and social transformation
	Section 8. Target	To establish equality between women, men, gender and sexual minorities in legal and practical terms, including economic, social and political empowerment of women.
	Section 10. Strategy	Changing the tradition of gender-based division of labor and increasing women's participation in the labor market and assessing women's contribution to the economy
Fifteenth Plan (2076/77 - 2080/81)	Chapter 2, Long term Vision 2043, Section 2.10	Assumes that the development of overall transport sector will create a strong and reliable foundation for the economic and social transformation of the

	Articles/rules/clauses, etc.	Related description
National Environmental Policy 2076	Macroeconomic and Sectoral Vision (d) Infrastructure Sector	country. Development and expansion of transport infrastructure and services will be carried forward in a planned manner to meet the long term needs of the transport sector.
	Section 3.4, Table 3.1, S.N. 3.1	Indicators of accessible, safe and modern transportation have been mentioned The status of 2075/76 and target for 2080/81 are mentioned
	Table 3.1 S.N. 7.2	Environmental balance and sustainable use
	Table 3.1 S.N. 7.3	Climate change adaptation
	Section 6. Target	Ensuring citizens' right to live in a clean and healthy environment by pollution control, waste management and green promotion
	Section 7. Objectives	1. Prevention, control and reduction of all types of pollution including water, air, soil, sound, electromagnetic waves, chemical and radioactive 2. Managing waste generated from all sources including domestic, industrial and service sector 3. Mainstreaming environmental concerns in all dimensions of development
	Section 8. Policy, Section 8.2 Environmental mainstreaming	1. Based on the extent, magnitude and duration of the environmental impact, the approval process will be made transparent and simplified by the proponent before implementing the proposal. 2. Arrangements will be made to carry out the project by selecting suitable options so that there is a balance between environment and development. 3. Arrangements will be made to allocate the required funds by the proponent for reducing the adverse effects caused by the environmental impact and enhancing the adaptation effect while preparing the environmental study report.
	Section 8.5 Sustainable Development	1. Environment friendly structures will be built during the construction of physical infrastructures

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National Climate Change Policy 2076	Articles/rules/clauses, etc.	Related description
	Section 7. Objectives	c. To promote green economy by adopting the concept of low carbon emission development f. Mainstreaming or internalizing climate change issues in policies, strategies, plans and programs at all levels and thematic areas of the nation.
	Section 8. Policy 8.2 Forest, Biodiversity and Watershed Conservation	d. An action plan will be formulated and implemented for protection of rare and endangered wildlife and flora and sensitive ecological systems that are at risk of climate change.
	Section 8.5 Industry, Transport and Physical Infrastructure	d. Climate related risk reduction measures will be adopted during design and construction of physical infrastructures
	Section 6. Objectives	4.Conservation, restoration and sustainable use of forests, flora, fauna and biological diversity. 7.Restoring forests that have been damaged in various ways without reducing the current forest area.
	Section 8. Policy 8.1 Forest Land Tenure	Strategy and program: If there are no option to use forest to carry out projects of national priority or national pride, the federal government will plan to use forest area based on laws, guidelines and procedures, and in order to compensate the reduced forest area by using forest area, the federal government will also plant trees and restore the forest by coordinating with the provincial and local governments.
National Land Use Policy 2072	8.4 Biodiversity Conservation	1. Protection and management of rare, endangered and protected wild animals and plants will be done
	Section 5. Long term view	Achieving social, economic and environmental development and prosperity in a sustainable way by optimum utilization of available land and land resources

	Articles/rules/clauses, etc.	Related description
	Section 8. Policy and Strategy	2.3 (c) Maintaining balance between physical infrastructure development and environment 2.3 (g) Ensuring conservation and promotion of biological diversity 7.2 If forest land is to be used for implementation of national priority projects, then, arrangements for mandatory plantation in equal land without reducing will be done. 9.3 Construction or expansion of roads that promote soil erosion, adversely affect arable land and endanger local settlements will be discouraged. 10.2 While implementing the development construction works, in order to maintain a balance between land, environment and development, the principle of sustainable development will be adopted along with considering the impact of climate change.
Land Acquisition, Resettlement, and Rehabilitation Policy for Infrastructure Development Project 2071	Section 7. Policy	7.1 To create a situation where there is no displacement of local people, families or communities or as little displacement as possible due to the implementation of the project. 7.2 In case of displacement due to the project, minimizing the adverse effects of the project provide opportunities for compensation and economic-social benefits to the affected person, family or community. 7.3 Make land acquisition, compensation, rehabilitation and evaluation work simple, easy, transparent and fair, creating an environment to complete the project within the stipulated time.
National Wetland Policy 2069	Section 11. Policy to Prohibit Wetlands Adverse Actions	3. Prohibition on dumping of chemical and household waste, industrial discharge, use of pesticides, use of electric waves and dumping of explosives in wetlands
National Child Policy 2069	Section 7. Major Objectives of Policy	7.1 Protecting children from all types of physical or mental violence, harm or abuse, neglect, exploitation and sexual abuse.
	Section 9. Strategy (Related with	As child labor can impact on long term physical and psychosocial


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	Articles/rules/clauses, etc.	Related description
 National Transport Policy 2058	Objective 7.1)	development, for its redress monitoring mechanism to check whether any industries or enterprises are employing child labor or not should be made effective. If any employer is found using child labor, then immediate rescue of such child should be done and employer should be punished. Integrated relief facilities will be provided for rehabilitation of child.
	Section 5.8	Construction, improvement and management of the means of transport shall be done in harmony with the environmental effect
	Section 7.1.5	Manage the design, construction and maintenance of the roads with minimal environmental effects
Acts Environment Protection Act, 2076	Section 3: Preparation of Environmental Study Report	1. The proponent has to prepare the environmental study report as specified for the proposed proposal. 5. A public hearing should be held while preparing the environmental study report.
	Section 4: Detail Analysis of Alternatives	1. In the environmental study report, the proponent shall make a detailed analysis of the adverse effects that may occur on the environment during the implementation of such a proposal and the various options that can be adopted for its mitigation, and recommend the option that is suitable for the implementation of the proposal.
	Section 12: Environmental Audit	After completion of 2 years from the date of commencement of service of the proposal, within 6 months, the MoFE or designated agency shall carry out an environmental audit and keep the environmental audit up to date.
	Section 13: Prohibition	Anyone who implements a project without the approval of the environmental study report or in a manner contrary to the approved environmental study report can stop such project.
	Section 3 Land Tenure of National Forests	(1) The land ownership of the national forest area shall remain with the Government of Nepal.
Forest Act 2076		

	Articles/rules/clauses, etc.	Related description
		(2) Without the decision of the Cabinet of Ministers of Government of Nepal, it is not possible to change the use of the national forest area, to provide the right of use of the national forest to anyone, to transfer the right through mortgage or other means.
	Section 12 No settlement or resettlement within forest areas	(1) No forest area containing trees shall be used for settlement or resettlement.
	Section 41 Land use of forest areas shall not be changed	No part of the national forest shall be used in such a way as to change the land use of the forest area. However, this arrangement will not be applicable in the case of forest area provided to any project as per the decision of Nepal Government for infrastructure development
	Section 42 use of forest area	Regardless of what is written elsewhere in this Act, if there is no other option than to use the forest area to implement a national priority project, and if there is no significant adverse impact on the environment during the implementation of such project, the Government of Nepal may approve the use of any part of the national forest for such project.
Land Use Act 2076	Section 8 Land use shall not be changed	(1) According to Section 4, the land classified for one purpose cannot be changed to use it for another purpose. (7) Notwithstanding anything contained in sub-section (1), the Government of Nepal may change the existing land use of the following places: (b) Places to establish projects of national pride or priority development projects, industrial areas, special economic zones etc.
The Act Relating to Children, 2075	Section 66: Offences against the child	66. Offences against the child: (1) If any person does any act of violence referred to in sub-section (2) or sexual abuse referred to in sub-section (3), he or she shall be deemed to have committed the offence against the child under this Act. (2) If any person does any of the following acts against a child, he or she shall be deemed to have committed the act of violence against the child: (3) If any person does any of the following acts against a

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	Articles/rules/clauses, etc.	Related description child, he or she shall be deemed to have committed child sexual abuse: www.lawcommission.gov.np 31 (a) To show, or cause to show, him or her an obscene picture, audiovisual recording or other material of similar kind or display, or cause to display, such expression or gesture that reflects obscene or sexual conduct or behaviour to him or her or display, or cause to display, child pornography; (b) To distribute, store or use any actual or fictitious obscene picture or audio-visual material of him or her, (c) To propose, lure, coerce or threaten him or her for sexual activity, (d) To use him or her in the production of an obscene act and material, (e) To touch, kiss, hold sensitive parts of body of him or her, embrace him or her with sexual intent or cause him or her to touch or hold sensitive parts of own body or body of another person or render him or her unconscious with sexual intent or display, or cause him or her to display sexual organs, (f) To use, or cause to use, him or her for stimulating sexual lust or sexual excitement, (g) To use, or cause to use, him or her for the purpose of sexual gratification, (h) To engage, or cause to engage, in child sexual exploitation, (i) To use, or cause to use, him or her with the intent of providing sexual services, (j) To use, or cause to use, him or her with the intent of engaging in sexual abuse, (k) To use him or her in prostitution or other sexual work. (4) Notwithstanding anything contained in sub-section (3), anything that is expressed by means of writing, speaking, gesturing or displaying any word, picture, audio, visual means and object or material on a sex related matter without displaying obscenity with the aim of imparting information and education or an act done in good faith in the course of making treatment of the child or saving the child from an accident or risk shall not be deemed to constitute an act of sexual abuse.
Local Government Operation Act 2074	Section 11 Rights of Rural Municipality and Municipality	(2) Without prejudice to the generality of subsection (1), the functions, duties and rights of rural municipalities and municipalities shall be as

	Articles/rules/clauses, etc.	Related description
Labour Act, 2074		follows: d. Local Taxes, Service Charges and Duties g. Local level development projects j. Local market management, environmental protection and biodiversity t. Local roads, rural roads, agricultural roads and irrigation No one should employ children in any work contrary to law.
	Section 5 Child labor shall not be employed	
	Section 6 Non-discrimination	(1) Employers shall not discriminate against workers on the basis of religion, race, sex, caste, origin, language or ideological belief or any other similar basis.
	Section 7 No discrimination in remuneration for equal work	(1) There should be no discrimination in remuneration for work of equal value between workers on the basis of gender.
	Section 68 To formulate safety and health policy	(1) Subject to this Act, the rules made under this Act and the instructions given in accordance with this Act or the rules made under this Act, the employer shall formulate and implement a policy related to the safety and health of workers and other persons at the workplace.
	Section 71 Duties of responsible persons	For work related to any workplace, equipment, material or substance, it will be the responsibility of the responsible person to ensure that it is safe and healthy.
	Section 74 Establishment of Safety and Health Committee	(1) In an organization employing twenty or more workers, the employer shall form a safety and health committee as specified in such a way that the workers are also represented.
	Section 76 Stopping work in case of immediate danger	(1) Any work if not stopped immediately can cause physical injury or danger to the worker or someone else, or if there is a serious impact on his health or there is unexpected damage or loss of any equipment, object or substance, the worker involved in such work shall inform the employer or responsible person according to section 71.


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	Articles/rules/clauses, etc.	Related description
		(2) Upon receiving the information as per sub-section (1), the employer or the responsible person shall immediately give appropriate instructions in this regard. (3) If the employer or the responsible person is not immediately available to give the information as per sub-section (1), the worker himself can stop such work.
	Section 78: Special provisions relating to occupational safety and health	(1) The safety and health standards to be followed by the organization related to the following subjects shall be as prescribed.
	Section 80: Arrangements should be made for the control of infectious diseases	(1) The employer shall make appropriate arrangements for the prevention and control of infectious diseases at the workplace.
	The Act Relating to Rights of Persons with Disabilities, 2074	(1) The persons with disabilities shall have the right to have easy access to other services and facilities that are open or provided for the public, including educational institutes, housing, workplaces, buildings, roads, transportation, and electronic communication services.
	Section 18. Right to movement	The persons with disabilities shall have the right on an equal basis with others to make movement with their assistant materials and assistance of persons of their choice.
Control of International Trade of Endangered Wild Fauna and Flora Act, 2073	Section 3. Prohibition on Trade or Transaction of Threatened or Vulnerable wild fauna or flora or specimen thereof	(1) No person shall purchase, sell, possess, use, plant, rear, captive breed, transport or import or export or cause to be done so a threatened or vulnerable wild fauna or flora or a specimen thereof.
The Sexual Harassment at Workplace (Prevention) act 2071 (Amendment 2075)	Section 3: Not to commit or cause to Commit Sexual Harassment	No person shall commit or cause to be committed sexual harassment in workspace.