

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

of

TUNAMUNA KHOLA BRIDGE PROJECT (70 m) Madi-Thori Road, Chitwan

Package No : DoR/GESU/337/073/74/010

Submitted to:

Ministry of Forest and Environment (MoFE)
Singhadhubar, Kathmandu, Nepal

through

Ministry of Physical Infrastructure & Transport
Singhadhubar, Kathmandu, Nepal

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On Behalf of:

Postal Highway Project
Department of Roads
Ministry of Physical
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Aaloknagar, Kathmandu

कार्यकारी सारांश

१. परिचय

प्रस्तावित टुनामुना खोला पुल पूर्वपश्चिम हुलाकी राजमार्गको माडी ठोरी सडक अन्तर्गत चितवन जिल्ला माडी नगरपालिका वडा नं. ८, जिवनपुर, र वडा नं. ८, खरकटा विच भई बगिरहेको खोलामा निर्माण गर्नको लागि प्रस्ताव गरिएको छ । प्रस्तावित पुलले माडी न.पा. को वडा नं. ८, जिवनपुर, वडा नं. ८, खरकटालाई जोड्ने छ । प्रस्तावित आयोजना क्षेत्र समुन्द्री सतहबाट १९५ मी. पर्दछ । नदीको जलाधार क्षेत्र प्रस्तावित पुल निर्माण क्षेत्रबाट २४.०२ वर्ग कि.मी. रहेको छ । प्रस्तावित टुनामुना खोला पुल मोटरेबल ब्रिज हो । यसको लम्बाई ७० मी. रहेको छ भने मुख्य चौडाई ७.५ मी. रहेको छ । पुलको दुवै किनारामा १.७५ मिटर चौडा फुटपाथ निर्माणका लागि प्रस्ताव गरिएको छ ।

२. प्रस्तावक र परामर्शदाता

आयोजनाको प्रस्तावक, भू वातावरण तथा सामाजीक शाखा, सडक विभाग चाकूपाट ललीतपुर रहेको छ । र वातावरणीय प्रभाव मूल्यांकन अध्ययन तथा प्रतिवेदन तयारी सम्बन्धी कार्यका लागि नर्थ स्टार – ईटेको – होमल्याण्ड जेभी लाई जिम्मेवारी दिइएको थियो ।

३. प्रस्तावको सान्दर्भिकता

नेपाल सरकारले उक्त क्षेत्रमा यातायात विकासका लागि सडक बनाईसकेको छ । निर्माण भईसकेको सडकमा पुल नहुँदा सबै मौसममा यातायात सञ्चालन गर्न सकिएको छैन र स्थानिय बासीहरुलाई यातायातमा कठिनाई भईरहेको छ, । तसर्थ यस सडकमा सबै मौसममा यातायात सञ्चालन गर्न पुल निर्माण गर्नु आवश्यक देखिन्छ ।

४. प्रस्तावको तार्किक व्याख्या

प्रस्तावित पुल चितवन राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रभित्र पर्दछ । वातावरण संरक्षण ऐन, २०५३ तथा वातावरण संरक्षण नियमावली, २०५४ र यसमा परिभाजनहरुले निर्देशित गरे बमोजिम प्रमुख पुलहरु निर्माण गर्नु पूर्व वातावरणीय प्रभाव मूल्याङ्कन गरी उक्त मूल्याङ्कन प्रतिवेदन वन तथा वातावरण मन्त्रालयबाट स्वीकृत गराउनु पर्ने प्रावधान छ । वातावरण संरक्षण नियमावली २०५४ को अनुसूची २ क (३) नियम ३ अनुसार, कुनैपनि निर्माण लागतका अन्य कार्यहरु राष्ट्रिय निकुञ्ज, सम्बेदनशिल क्षेत्र, संरक्षण क्षेत्रभित्र प्रस्तावित राष्ट्रिय निकुञ्ज, संरक्षण क्षेत्र, वन्यजन्तु, आरक्षण क्षेत्र, मध्यवर्ती क्षेत्र, पुरातात्विक क्षेत्र र सिमसार क्षेत्र, वातावरणीय नाजुक क्षेत्रमा पर्ने हो भने वातावरणीय परिक्षण मूल्याङ्कन आवश्यक पर्दछ ।

५. वातावरणीय प्रभाव मूल्याङ्कनको उद्देश्य

वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन अध्ययनको मुख्य उद्देश्य आयोजना क्षेत्रको भौतिक, जैविक, सामाजिक, आर्थिक तथा सांस्कृतिक वातावरणमा पर्ने प्रभावहरु पत्ता लगाउनु, योजना प्रभावित क्षेत्रमा पर्ने असर बारेमा सम्बन्धित क्षेत्रका बासिन्दा र सम्बन्धित Stakeholder लाई जानकारी गराउनु, नकारात्मक प्रभावको न्यूनिकरणका उपायहरु र सकारात्मक प्रभाव बढाउने उपायहरु बारे सुझाव दिनुका साथै वातावरणीय अनुगमन योजना बनाई कार्यान्वयन गराउनु, वातावरण व्यवस्थापन कार्यक्रमका लागि संस्थागत रूपरेखा तयार पार्ने हो ।

६. कार्यविधि

यो वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयार गर्दा प्रकाशित एवं अप्रकाशित प्रतिवेदनहरूको समिक्षा एवं नक्साको अध्ययन गरिएको छ । आयोजना स्थलको भौतिक, जैविक, आर्थिक, सामाजिक तथा सांस्कृतिक स्थिति चेकलिष्ट, नमूना सर्वेक्षण, नाप जाँच, परिक्षण, मुख्य व्यक्तिहरूको सहभागितामा छलफल तथा अन्तक्रिया बैठक गरी प्राथमिक तहका सूचना सामाग्री सङ्कलन गरिएको थियो । नगरपालिका प्रोफाईल, केन्द्रिय तथ्यांक विभागबाट प्रकाशित जनगणना (सेन्सस सर्वे) प्रतिवेदनमा रहेका आर्थिक, सामाजिक र वातावरण सम्बन्धी सूचनाको अध्ययन गरिएको छ । आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन तयारीको क्रममा प्रतिवेदन सम्बन्धी जानकारी गराउने लक्ष्यका साथ मिति २०७५/०४/१२ गते, जनजिवन मा.वि. खरकटा, माडीमा सार्वजनिक सुनवाई कार्यक्रम गरियो । संरक्षण ऐन, २०५३ तथा वातावरण संरक्षण नियमावली, २०५४ र यसमा परिमार्जनहरूको निर्देशित गरे बमोजिम प्रमुख पुलहरू निर्माण गर्नु पूर्व वातावरणीय प्रभाव मूल्याङ्कन गरी उक्त मूल्याङ्कन प्रतिवेदनको अवलम्बन गरिएको छ । मस्यौदा प्रतिवेदनमा अनुकूल प्रभावलाई अधिकतम गर्ने र प्रतिकूल प्रभावलाई न्यून गर्ने उपायहरू रहेका छन् । यसै गरी संरक्षणका उपायहरूको कार्यान्वयन, वातावरणीय अनुगमन तथा परिक्षणको लागि एक वातावरण व्यवस्थापन योजना तयार गरिएको छ ।

७. विद्यमान वातावरणीय अवस्था

प्रस्तावित टुनामुना खोला पुलले हुलाकी राजमार्ग अन्तर्गत माडी वडा नं. ८, जिवनपुर, वडा नं. ८, खरकटा जोड्दछ । यस टुनामुना खोला निर्माण हुने स्थाने ८४°२३' १५.३६' देशान्तर तथा २७°२६' १२.३६' अक्षांशमा पर्दछ । प्रस्तावित पुल मोटरबल पुल हो र समुन्द्री सतहबाट १९५ मिटरको उचाईमा रहेको छ । यस पुलको लम्बाई ७० मीटर रहेको छ । पुल डिजाइनका क्रममा नै पुलको चौडाई ७.६ मी. र १.५ को फुटपाथ रहेको छ । आयोजना क्षेत्रमा उप-उष्ण प्रकारको हावापानी पाइन्छ ।

प्रस्तावित आयोजना प्रभावित नगरपालिकाको जम्मा जनसंख्या ३९४३८ र प्रभावित वडा नं.८, जिवनपुर, वडा नं. ८, खरकटाको जम्मा जनसंख्या २८०८ रहेको छ । यस क्षेत्रमा ब्राम्हण, क्षेत्री, दलित र जनजाति: गुरुङ, मगर आदी जातिको बस्ती रहेको छ । आयोजना क्षेत्रमा रहेका प्रायः मानिसहरू हिन्दु र बौद्ध धर्म मान्दछन् । यस क्षेत्रमा प्रमुख पेशा कृषि रहेको छ, त्यसपछि व्यापार, वैदेशिक रोजगार र नोकरी (सर्भिस) आदि रहेका छन् । प्रस्तावित पुल नदीको बगर खाली बाँजो जग्गामा निर्माण हुन गईरहेको छ । पुल निर्माण क्षेत्रमा कुनैपनि बोट विरुवा काट्नु पर्ने छैन र पुल निर्माण गर्दा कुनैपनि कृषि जन्त्य खेतीपाती पनि नास गर्न पर्दैन । पुल निर्माण क्षेत्र वरिपरी केहि पातलो भारपात उम्रेको छ । प्रस्तावित पुल निर्माण क्षेत्र भन्दा पर जंगल रहेकाले खासै जंगली जनावर भेटाईएन । स्थानियको अनुसार कहिलेकाँहि रातिको समयमा हात्ति देखिने गर्दछ । यस क्षेत्रमा पाईने प्रमुख चराचुरुङ्गीहरूमा कागज, कोइली आदि छन् । यस खोलामा केहि प्रजातिका माछाहरू रहेका छन् ।

यसका अतिरिक्त वातावरण प्रभाव मुल्याङ्कनले नेपाल सरकारका अन्य ऐन, नियम, कार्यनीति, आवधिक योजना तथा तिनले निर्देशित गरेको मापदण्डको मातहतमा रहनु पर्नेछ । यस्ता कानूनी प्रावधानहरूमा नेपाल सरकारको, नीतिगत दस्तावेज, नेपालको सडक क्षेत्रको वातावरणीय मुल्याङ्कन, सडक विभाग पुल नीति तथा रणनीति, २० वर्षे सडक योजना, सार्वजनिक सडक ऐन, वन सम्बन्धी ऐन तथा नियम, भू तथा जल संरक्षण ऐन, जलचर संरक्षण ऐन, जलस्रोत ऐन, जग्गा प्राप्ति ऐन तथा नियम, श्रम ऐन, बालश्रम ऐन, वातावरणीय व्यवस्थापन निर्देशिका, राष्ट्रिय वातावरणीय प्रभाव मूल्याङ्कन निर्देशिका, रोडसाइड बायो ईन्जिनियरिङ्ग, जैविक

विविधता सम्बन्धी महासन्धि, लोपोन्मुख जंगली वनस्पति तथा जीवजन्तुको अन्तर्राष्ट्रिय व्यापार सम्बन्धी महासन्धि आदि आकर्षित रहेका छन् ।

८. प्रस्तावका आँकलन गरिएका असरहरु

८.१ सकारात्मक प्रभावहरु

परियोजना निर्माणका क्रममा तत्काल देखिएका सकारात्मक प्रभावहरुमा स्थानीय बासिन्दालाई रोजगारी, बजार विस्तार तथा विकास र स्थानीय जनताको दक्षता अभिवृद्धि रहेका छन् । आयोजना निर्माणका क्रममा करिब १० जना दक्ष र ५० जना अदक्ष गरि ६० जनाले रोजगारी पाउनेछन् । आयोजनासँग सम्बन्धीत कार्यमा (रोजगारीमा) ठेकेदार कम्पनी मार्फत गरिब तथा पिछडिएका स्थानीय जनताले प्राथमिकता पाउनेछन् । यस चरणमा हुने अन्य लाभहरुमा बजार बढ्ने र व्यापारमा वृद्धि हुने र कामदारहरुको शीपमा बुद्धि हुने अवसर प्राप्त हुनेछ । पुल सञ्चालनबाट सडकले प्रभावित क्षेत्रका बासिन्दालाई बजार, सामाजिक सेवा प्रदायक स्थान तथा देशका अन्य भागहरुसम्म पुग्न छिटो, छरितो, सुलभ, सस्तो तथा सुविधाजनक पहुँचको अवसर प्रदान गर्नेछ । यसै गरि परियोजना सञ्चालनको अवस्थामा हुने सकारात्मक प्रभावहरुमा यातायातको सुविधा, आर्थिक विकास, पर्यटकीय विकास तथा घरेलु तथा साना उद्योगको विकास र प्रवर्द्धन रहेका छन् ।

८.२ नकारात्मक प्रभावहरु

आयोजना निर्माणका क्रममा देखिनसक्ने नकारात्मक प्रभावहरुमा व्यवसायिक स्वास्थ्यमा असर, जल तथा वायु प्रदूषण, खोलाको डाइभर्सन गर्नु पर्ने, एप्रोच रोड निर्माणका असर, सरसफाई, सडक दुर्घटना, रोग फैलने, सामाजिक सेवाका सुविधाहरुमा पर्ने असरहरु हुन् । आगन्तुक र स्थानीयमा पर्ने भैँ(भगडा, सामाजिक व्यवहारमा परिवर्तन, हुलदङ्गा जस्ता असरहरु पनि देखिन सक्दछन् । आयोजना संचालन अवस्थामा पर्ने प्रभाव मध्ये जिवनपुर र खरकट्टामा पुल तथा सडक छेउमा बजार बढ्ने, जसले गर्दा सामाजिक व्यवहारमा परिवर्तन, ट्राफिक जाम र सडक सुरक्षामा असर पर्ने देखिन्छ । कामदारहरुबाट वन्यजन्तु र वनस्पतिको तस्करी एवं दुरुपयोग जस्तो नकारात्मक असरहरु पनि आयोजनाबाट देखिन्छ । यातायातको संचालनले बिटुमिन, ग्रेज लुब्रिकेन्ट निस्कन्छन्, जसले पानी प्रदूषित गर्छ । त्यसैगरी जलजीवनमा पनि प्रभाव पर्दछ । आयोजनाले खोलाको पानी डाईभर्ट गर्नु पर्ने हुँदा माछा तथा अन्य जलचरको स्थानांतरणमा छोटो समयका लागि असर पर्न सक्छ । प्रस्तावित पुलको उचाइ ४.९२ मीटर भएकाले, हात्ती तथा ठुला जङ्गली जनावर आवत जावतमा असर पर्ने देखिदैन । निर्माणका क्रममा प्रयोग हुने सामग्रीहरु (ढुङ्गा, गिट्टी बालुवा र अन्य) स्थानीय सरकार तथा नगरपालीकाले स्वीकृत गरेको स्थानबाट मात्र उत्खनन् गरीने छ र ढुवानी गर्दा बातावरण मैत्री तरीकाबाट गरिने छ ।

यस परियोजनाले १.७ हेक्टर जमिनमा असर पर्ने छ, जसमध्ये ०.०७७ हेक्टर स्थाई रुपमा प्रयोग हुन्छ भने १.६२ हेक्टर अस्थायी रुपमा प्रयोग हुन्छ । आयोजनाको क्रममा कुनै पनि व्यक्तिगत जग्गा प्राप्ति गरिने छैन । क्याम्पको लागि पनि सरकारी जग्गा प्रयोग गरिने छ । आयोजना क्षेत्र भित्र कुनै सांस्कृतिक महत्वका स्थलहरु छैनन् । तसर्थ नकारात्मक असरहरु देखिदैनन् ।

९. प्रस्तावको विकल्प विश्लेषण

यस प्रस्तावको लागि विभिन्न विकल्पहरु यस प्रकार रहेका छन् । परियोजनाका विकल्प, डिजाइनको विकल्प, प्रस्तावित स्थलको विकल्प, प्रविधिको विकल्प, कार्यान्वयनको विकल्प, समय अवधिको विकल्प र कच्चा पदार्थको विकल्पहरु दिइएको छ । यातायातका साधनहरुमा रोपव र, बोटिङ जस्ता माध्यम स्थाई र भरपर्दो

साधन हुन सक्दैनन् । त्यसैले प्रस्तावित पुल भौगोलिक, भौतिक, जैविक, सामाजिक तथा साँस्कृतिक वातावरणका हिसाबले उक्त प्रस्तावित स्थान नै सबैभन्दा राम्रो विकल्प रहेको छ । माडी ठोरी हुलाकी सडक खण्डमा पर्ने प्रस्तावित मोटरबल पुल निर्माण स्थान उक्त क्षेत्रको लागि उपयुक्त उपयुक्त देखिएको छ । माडी नगरपालिकाका बासिन्दाहरुलाई यसबाट धेरै फाइदा पुग्ने देखिन्छ ।

१०. वातावरणीय व्यवस्थापन योजना

वातावरणीय व्यवस्थापन योजना, प्रस्तावित आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको प्रमुख अंग हो, जसलाई वातावरणीय संरक्षण निमावलीमा पनि प्रमुखताका साथ उल्लेख गरिएको छ । आयोजना निर्माण र संचालन अवधिमा आयोजना संचालनबाट आउने नकारात्मक प्रभाव न्यूनिकरण तथा सकारात्मक प्रभाव अभिवृद्धिकरण उपायहरु कार्यान्वयन गरि आयोजना क्षेत्रको स्वच्छ वातावरणलाई दिगो तथा वातावरणको गुण स्तरलाई उच्च राखिने छ । जारी गरिएको अध्ययनको कार्यसूचीको आधारमा वातावरणीय व्यवस्थापन योजना समेट्नु पर्ने विषयहरुमा प्रभाव न्यूनिकरणका उपायहरुको अवलम्बन, वातावरणीय निरिक्षण योजना, वातावरणीय लेखा परिक्षणको खाका र वातावरणीय व्यवस्थापन योजना कार्यान्वयन गर्ने प्रशासनिक ढाँचा पर्दछन् । वातावरणीय व्यवस्थापन योजना अवलम्बन तथा कार्यान्वयन गर्ने प्रस्तावकको दायित्व भित्र पर्दछ र यसका लागि वन तथा वातावरण मन्त्रालय भौतिक तथा निर्माण योजना मन्त्रालय, सडक विभाग र जिल्ला समन्वय समितिसंग समन्वय गरि गर्नु पर्ने छ । यसको निम्ती छुट्टै वातावरणीय इकाई स्थापना गरि वातावरणीय व्यवस्थापन योजना अनुरूप काम भए नभएको निरिक्षण गर्ने र ठेकेदारहरुको निम्ति प्रविधिक सल्लाह दिनुको साथै, योजनाको समयतालिका अनुसार वातावरणीय सुचकहरुको स्थलगत अनुगमन गर्नु पर्ने दायित्व रहेको छ ।

प्रस्तावित आयोजना निर्माण र संचालन अवधिमा आयोजना संचालनबाट आउने नकारात्मक प्रभाव न्यूनिकरण तथा सकारात्मक प्रभाव अभिवृद्धिकरणका उपायहरु कार्यान्वयन गर्नका लागि अनुमानित लागत ने. रु ६,४४७,०००.००/- र अनुगमनका निम्ती हालको बजार मुल्यका आधारमा वार्षिक अनुगमन लागत ने.रु. ७८०,०००/- र वातावरणीय लेखा परिक्षणका निम्ती अनुमानित ने. रु ४००,०००/- रहेको छ । आयोजना वन्नु पूर्वको वातावरणीय अवस्थिति, अनुमति, वातावरणीय लेखा परिक्षणमा प्रयोग हुने मुल दस्तावेज हुन् । वातावरण संरक्षण नियमावली २०५४ को अधिनमा रही वन तथा वातावरण मन्त्रालयले आयोजना संचालनको २ वर्ष पछि वातावरणीय लेखापरिक्षण प्रतिवेदन तयार गर्ने छ ।

११. निष्कर्ष

प्रस्तावित आयोजनाको निर्माणले स्थानिय साथै राष्ट्रिय दृष्टिकोणबाट फाइदाजनक सावित हुने छ । समाजका लागि यस योजनाले यातायात लगायत अन्य क्षेत्रको दिगो विकासमा सहयोग गर्ने छ । तथापि आयोजनासंग गाँसिएर आउने नकारात्मक प्रभावहरु पनि आउने नै छन्, तर आयोजनाले समाजमा पार्ने सकारात्मक प्रभावको तुलनामा नकारात्मक प्रभाव कम छ । नकारात्मक प्रभावहरुलाई न्यूनिकरण गर्ने प्रतिवेदनमा सुचिकृत न्यूनिकरणका उपायहरुको प्रयोग गरिनेछ । त्यसकारण आयोजनालाई सञ्चालन गराईराख्न सुझाव दिइएको सबै न्यूनिकरणका उपायहरुको अवलम्बन गरि अघि वढाउन सुझाव दिइएको छ ।

SUMMARY IN ENGLISH

1. Introduction

The Tunamuna Khola Bridge is proposed to be constructed across Tunamuna Khola along the Madi-Thori Postal Highway. The proposed bridge will connect two settlements Jiwanpur, Ward no.8 & Kharkata, Ward no. 8 of Madi Municipality of Chitwan district. The proposed bridge is located at the level of 195 m from the masl. The area of catchment at the point of bridge construction is 24.02 km². The proposed bridge is moterable whose length is 70 m and width is 7.5 m. And 1.75 m foot path is proposed on both sides.

2. Proponent and Consultant

The proponent of the Tunamuna Khola Bridge is the Department of Roads (DoR), Geo-Environment and Social Unit (GESU) and North Star Engineering Consultant (P) Ltd, ITECO Nepal (P) Ltd and Homeland JV are Consultant.

3. Relevancy of Proposal

Nepal government has constructed transportation service in this sector. Local people are facing problem of transportation in every weather due to lack of bridge in this road. Hence there is necessary to build up bridge for regular transportation service.

4. Rationality of Proposal

The project is located inside the buffer zone of Chitwan National Park (CNP) therefore the project requires EIA & its approval from the Ministry of Population and Environment (MoPE). According to the EPR, 2054 and its amendments the project category given in its Schedule 2 K (3) pertaining to Rule 3 “Implementation of any project in National Parks, wildlife sanctuaries and conservation area” requires Environmental Impact Assessment. The rationale behind conduction of EIA for this project is to predict the environmental consequences of the prescribed Bridge development project and to ensure that the potential problems are foreseen and addressed at an early stage in project planning and design.

5. Objectives of EIA

The objectives of conducting of EIA for this project is to identify the physical, chemical, biological, socio-economic and cultural aspects of the existing environmental condition, provide information to locals and concerned stakeholders about the environmental implications of the proposed project, recommend appropriate preventive and curative measures, including benefits augmentation measures, environmental management plan along with monitoring and auditing.

6. Methods adopted for EIA study

During the preparation of this EIA report, published as well as unpublished literature and maps have been studied. Field studies about physical, biological and socio-economic and cultural environment at the proposed project site, were conducted in an extensive manner. Information collection technique and tool was walkthrough survey, key informants interviews, discussions and interaction meeting by using the checklist, visible inspection and measurement. Socio-economic information was collected and compiled through secondary sources like Municipality profile, census survey report 2011 of Central Bureau of Statistics. A public hearing event was organized at Janjivan Secondary School

Kharkata Madi, on July 28, 2018 during preparation of EIA report. The report has been prepared in accordance with the Environmental Protection Regulation, 1997 and its amendment as per need of environmental assessment before construction of major bridges. Similarly, the implementation modality of environmental protection measures, environmental management plan and environmental auditing has been prepared.

7. Existing Environmental Conditions

The proposed bridge will connect two market place, Jiwanpur, Ward no.8 & Kharkata, Ward no. 8 of Madi Municipality of Chitwan district.

Geographically, the location of the bridge to be constructed is proposed at 84° 23' 15.36" longitude and 27° 26' 12.36" latitude. The proposed bridge is located at an altitude of 195 m. The proposed Tunamuna Khola Bridge is Motorable Bridge. The span of the bridge is 70 m. The carriage way width of the bridge is 7.5 m and 1.75 m foot path along the both side of the bridge has been incorporated since the design of the bridge. The nearest settlements are Jiwanpur, & Kharkata. The total populations of Project Affected Municipality (PAM) & Project Affected Ward (Ward No. 8) are 39,438 & 2,808 respectively of this Tunamuna Bridge Project Area.

Brahmin-Chettri, janajati, & Dalits, are the main ethnic caste found in the settlements. The majority of populations follow Hindu & Bouddha religion in this area. Agriculture is their major occupation followed by Trade/Business, Foreign Employment Service etc.

The project is going to construct at barren land of river flood plane. There is not any forest and agro-plant species at the project site. But there is some sparse vegetation of few weeds and invasive plants species at bank of river channel. The observed invasive and weedy plants are like *Michania micrantha*, *Lantana camera*, *Parthenium histerophorus*, *Eupatorium adinophorum*, *Ageratum conizoids* and *Calotropis gigantean*.

The statutory environment legal provisions (Environment Protection Act, 1997, and Environment Protection Rule, 1997 as amended 1999, 2007, 2009 and 2010), for the development of major bridges, requires an IEE Study and its approval from the Ministry of Physical Infrastructure and Transport. Apart from the EPA and EPR, the IEE study has to comply with a range of GoN Policy, Guidelines, Acts, Regulations and International Treaties and Conventions such as: Policy Document, Environmental Assessment in the Road Sector of Nepal, DoR Bridge Policy and Strategy, 2004, 20 Year Road Plan, 2002-2022, Public Road Act, 1974, Forest Act, 2050 (1993), its amendments (1995) and Forest Rules (1995), Local Self-Governance Act, 1998, Soil and Water Conservation Act, 1982, Aquatic Animal Protection Act, 2017 (1960), Water Resources Act, 1992, Land Acquisition Act, 1977 and Land Acquisition Rules, 1969, Labour Act, 2017, Child Labour (Prohibition and Regulation) Act, 2000, Environmental Management Guidelines, Geo Environmental Unit, DoR, National EIA guidelines, 1993, Roadside Bio-engineering, DoR, GoN, Convention on Biological Diversity, 1992, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), (1973 amended 1979).

8. Impact of the proposal

8.1 Beneficial

The immediate beneficial impacts from the project construction phase are employment opportunity to local people, protection of land, possible market development and enhancement in technical skills. About 60 person; 10 skilled and 50 unskilled, will get job during project construction period. The

major beneficial impacts during operation phase are accessibility and transportation facility, economic increment, tourism development and promotion to cottage industries and benefits from the increased land value.

8.2 Adverse

During the implementation of project probable adverse impacts seen are occupational health safety risks to the workers and general public, dust and water pollution, poor sanitation, road and work site accidents, Stock piling, Spillage of construction chemicals, Land use change, Diversion of river, Diversion of road, Extraction of Construction materials, Approach road construction, Soil erosion, pressures on local resource on communities. Labor from outside the area can lead to conflict situations such as increase in alcohol consumption, gambling, prostitution, and women trafficking. Such problems during the overall project construction and operation phases need special attention. Other adverse impacts during operation phase are new settlement and market development at Jiwanpur, & Kharkata change in social behavior, increased traffic congestion and road safety measures etc. The height of proposed bridge is 4.92 meter, so there will not be disturbed on the tallest wildlife (Elephant) under bridge movement. The raw materials will be extracted from approved extraction sites of local government or municipality. The extracted materials will be transported through environmental friendly technique.

The bridge project is envisaged to impact on the land use of about 1.7 ha of the land. 0.077 ha land for permanent construction sites and 1.623 ha land for temporary purpose is needed. No private land acquisition is required. For the camp sites also, government public land is available. There are no cultural places found nearby the proposal area. So, no adverse impact on them is anticipated.

On the other hand, during the construction of bridge, impact on aquatic life, effect on ground vegetation such as invasive and weed species and bushy areas and disturbance to wildlife migratory route, could be expected to some extent. Movement of vehicle regularly and accidental release of bitumen, grease, oil, etc which could pollute the water body.

9. Alternative of the proposal

Possible alternatives of the project, such as no project option, project location, project design, time schedule, processes etc are analyzed in this section. The proposed location has been finally determined to be appropriate along the Madi-Thori postal highway road section to cross Tunamuna Khola from the proposed location. Concrete motorable bridge has been found most suitable and construction of bridge will have tremendous benefits to locals of Madi municipality.

10. Environmental Management plan

To ensure implementation of mitigation measure and assure the environment quality during project construction and operation of the project areas, an Environmental Management Plan (EMP) has been projected to avoid/minimize/compensate the envisaged impacts of the project during project construction and operation phases such that the project is sustainable from environmental perspective. The environment management plan is designed with four basic elements such as project environmental management structure, Environmental mitigation Management Plan, Environmental Monitoring plan and Environmental Auditing Plan. The proponent has the prime responsibility for the implementation of the environmental management plan in-coordination with the other project stakeholder, which includes Ministry of Forest and Environment, Department of Environment, District Coordination Committee and Municipality. A dedicated environmental management unit/cell

during construction and operation phase of project manned by the qualified environmental experts will be constituted under the project management office, whose sole responsibility will be to monitor the implementation of environment mitigation measure and to keep track of the environmental and social safeguard activities of project. This unit also will also responsible for the periodic impact monitoring on social and natural environment. Besides, the environment management office will regularly monitor the environment indicator at specified location with an objective to identify any any unforeseen for tor the implementation of corrective action if needed the project environment friendly.

The project proponent needs to ensure to implement these measures during the construction and operation of the project. A total of NRs. 6,447,000.00 is envisaged for the mitigation measures for the project. Proponent itself will be responsible to allocate the mitigation cost required for the project. In the EIA report Monitoring and Auditing Cost of project has proposed NRs 780,000.00 and NRs. 400,000.00 respectively. Auditing will performed by ministry of Forestry and Environment after two of project construction.

11. Conclusion

The local communities and concern stakeholders will be benefited after construction of proposed project. Environmental Impact Assessment study of proposed project will support on sustainable development of transportation and other social development sector. There will raise project adverse impact during construction and operation, though adverse impacts are very low with respect to beneficial. Project will apply all suggested mitigation measures of this report for minimizing the adverse impacts. Therefore, it is recommended to operate proposed project with due consideration and implementation of the entire recommended mitigation measures with environment management plan.

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Acronyms and Abbreviations

AAPA	Animals Protection Act
amsl	Above Mean Sea Level
CBOs	Community Based Organizations
CFC	Compensation Fixation Committee
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNP	Chitwan National park
CSR	Corporate Social Responsibility
DCC	District Coordination Committee
DIA	Direct Impact Area
DoR	Department of Roads
EFG	Environmental Financial Guarantee
EIA	Environmental Impact Assessment
EMAP	Environmental Management Action Plan
EMP	Environmental Monitoring Plan
EPA	Environment Protection Act, 1997
EPR	Environment Protection Rules, 1997
ESMF	Environmental and Social Management Framework
ESSA	Social System Analysis
GESU	Geo-Environmental and Social Unit
GoN	Government of Nepal
IEE	Initial Environmental Examination
IIA	Indirect Impact Area
M	Meter
MoFE	Ministry of Forest and Environment
MoPIT	Ministry of Physical Infrastructure and Transport
MoSTE	Ministry of Science and Technology
NGO	Non-Governmental Organization
PAM	Project Affected Municipality
PWD	Public Works Directives
RMP	Road Master Plan
SRN	Strategic Road Network
SWCA	Soil and Watershed Conservation Act
TKBP	Tunamuna Khola Bridge Project
ToR	Terms of Reference
ZOI	Zone of Influence

1 INTRODUCTION

1.1 General Background

The proposal is construction type project and aims to deliver the services related to transportation and public movement to cross the Tunamuna Khola . This is a part of construction project along the postal Highway of Madi-Thori Road Section. Tunamuna Khola, especially in the rainy season is one of the major barriers for the road connectivity along this section. With the construction of the bridge, the life standards of local people of Madi Municipality are expected to increase accessibility upto Bharatpur and Thori. Local people will have access to the market for their produced goods, the raw materials and other necessary goods can be brought from the markets of Bharatpur, Chitwan. Apart from market and goods, improvements in health, education, and other social and economic service sectors is also expected. Furthermore, during construction phase the bridge project will also encourage the regional commercial activities and the employment opportunities to rural people.

1.2 THE PROPONENT

The proponent of the Tunamuna Khola Bridge is the Department of Roads (DoR), Geo-Environmental and Social Unit (GESU). The executing agency of this project is Department of Roads, Bridge Branch under Ministry of Physical Infrastructure and Transport (MoPIT).

The complete address of the Proponent is:

<p><u>Geo-Environmental and Social Unit (GESU)</u></p> <p>Department of Roads (DoR)</p> <p>Ministry of Physical Infrastructure & Transport, GoN</p> <p>Chakupat, Patandhoka, Lalitpur, Nepal</p> <p>Telephone number: 01-5529075</p> <p>Email: gesunit@dor.gov.np</p>	<p><u>On the behalf of</u></p> <p>Postal Highway Project</p> <p>Department of Roads</p> <p>Aaloknagar, Kathmandu</p>
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1.3 The Consultant

North Star Engineering Consultant (P) Ltd and ITECO Nepal (P) Ltd JV, Lalitpur (herein after called as the Consultant) is consultant on behalf of the project for conducting EIA study. The Consultant will follow all the prevalent acts, rules, polices and guidelines of Government of Nepal while preparing the report.

The mailing address of the Consultant:

North Star – ITECO Nepal – Homeland JV

Jawalakhel, Lalitpur

Tel: 01-5535302

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1.4 Study Team

Team Leader / Environmental Expert	:	Hari Datt Joshi
Physical Environment Expert (Engineer)	:	Shrawan Kumar Thapa
Biological Expert (Biologist)	:	Jay Raj Mishra
Sociologist	:	Hukuma Dhakal
Hydrologist	:	Hari Lal Bhattarai

1.5 Rationality for conducting EIA Study

According to the EPR, 2054 and its amendments the project category given in its Schedule 2 K (3) pertaining to Rule 3 “Implementation of any project in National Parks, wildlife sanctuaries and conservation area” requires Environmental Impact Assessment. The project is located inside the buffer zone of Chitwan National Park (CNP) therefore the project requires EIA & its approval from the Ministry of Population and Environment (MoPE). The rationale behind conduction of EIA for this project is to predict the environmental consequences of the prescribed Bridge development project and to ensure that the potential problems are foreseen and addressed at an early stage in project planning and design. Based on the analysis, Environment Management Plan can be drawn to ensure impact monitoring and mitigation planning.

1.6 Objectives of EIA Study

The objectives of conducting of EIA for this project is

- To document physical, chemical, biological and socio-economic and cultural baseline environmental conditions of the proposal development area from primary and secondary sources.
- To identify and adequately assess potential adverse and beneficial environmental impacts due to proposal development and operation in deferent alternative sceneries of proposal to assess different alternative development options on environmental ground.
- To elucidate the TOR stipulated environmental issues and predict environmental impacts and their significance in terms if nature, extent, duration and magnitude for the selected development option
- To propose appropriate, practice and cost effective mitigation measure for the identified environmental impacts to avoid or minimize or compensate adverse impacts and capitalize maximum positive impacts for the selected alternative
- To identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction and operation phases of the proposed developments in relation to the sensitive receivers and potential affected uses;
- To prepare a comprehensive environmental management plan comprising of mitigation, monitoring and auditing plans associated with proposal development and operation
- To present the finding to the concerned stakeholders of the proposal development area in a public hearing meeting and take their concerns and suggestions with regard to the proposal development;

- To prepare a comprehensive EIA report as per the format stipulated in the EPR incorporating the concern and suggestions of the concerned stakeholders to facilitate objective making by the concern decision makers of the Government of Nepal

2 PROJECT DESCRIPTION

2.1 Relevancy of the proposal

EIA of the proposed TKBP is necessary in order to assess the environmental consequences of the implementation of the proposal and suggest appropriate, practical and site specific mitigation measures for adverse impacts and enhancement measures for beneficial impacts. This Khola, is one of the major barriers for the road connectivity along this section at rainy season. The construction of the bridge, will be increased accessibility up to Bharatpur and Thori and expected to increase the life standards of local people of Madi municipality due to road service. Local people will have access to the market for their produced goods, the raw materials and other necessary goods can be brought from the markets of Bharatpur, Chitwan. Apart from market and goods facilities, the construction of bridge is also expected to help on improvements in health, education, and other social and economic service sectors. Furthermore, during construction phase the bridge project will also encourage the regional commercial activities and the employment opportunities to rural people. Hence construction of bridge project can support on achieving target of sustainable development goals set by Nepal government. Public will safely implemented this project with realizing the sensitiveness of National Park.

2.2 Assess to the project

The Tunamuna Khola Bridge is proposed to be constructed across Tunamuna Khola along the Madi-Thori Postal Highway. The proposed bridge will connect two market place, Jiwanpur, Ward no.8 & Kharkata, Ward no. 8 of Madi Municipality of Chitwan district. Locally, this proposed bridge project will assure the accessibility of local people of Madi with Bharatpur and Thori throughout the year. Nationally, the bridge project will help to establish a permanent link with Mahendra Highway.

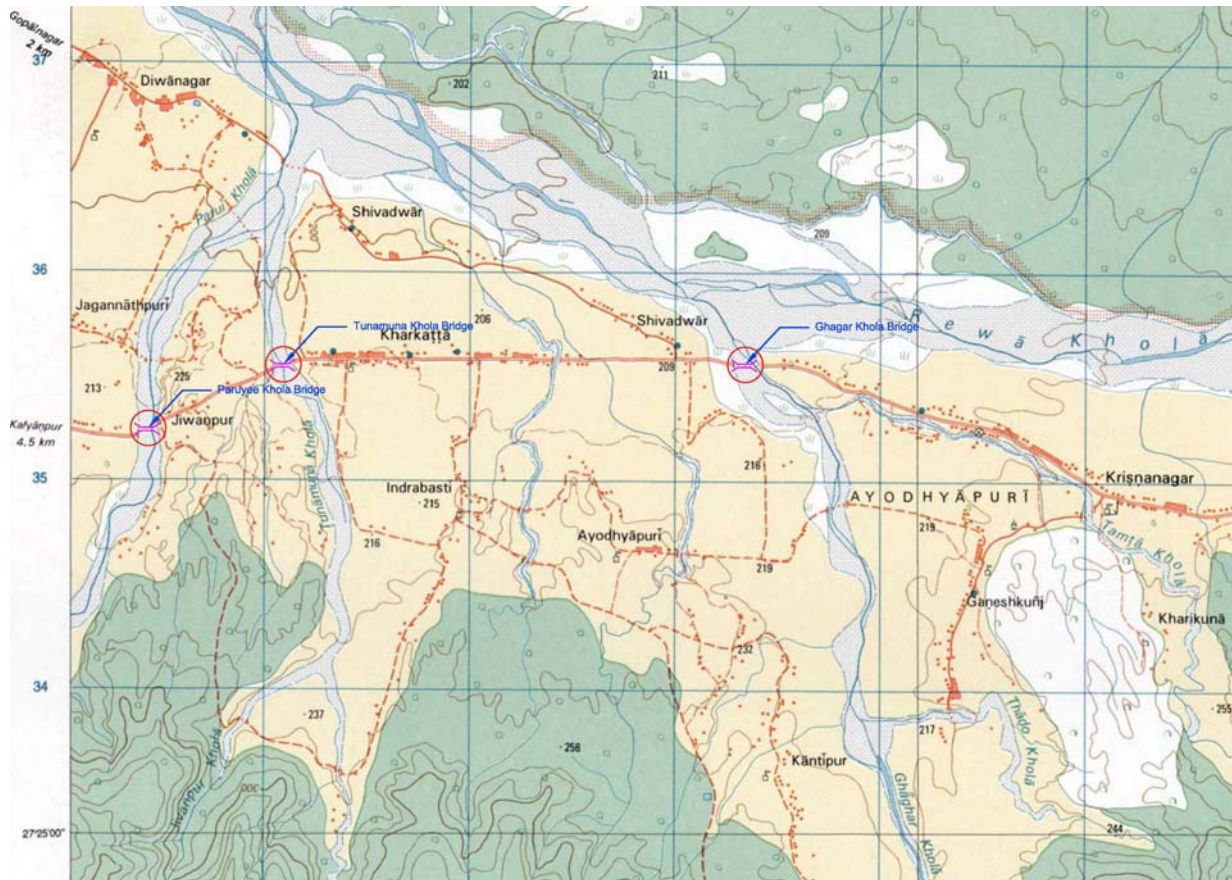
The total length of the proposed bridge is 70 m . The detail features of affected municipality, wards and settlements of the bridge project is shown in Table1.

Table 1: Affected Municipality; Wards and settlements of the Tunamuna Khola Bridge

S.N.	District	Municipality	Ward No.	Nearby Settlements (Proposed Bridge Site)
1	Chitwan	Madi	8	Right: Kharkata, Ward no. 8, Madi Left: Jiwanpur, Ward no. 8, Madi

The location of proposed Bridge Project is shown in Figure 1 below.

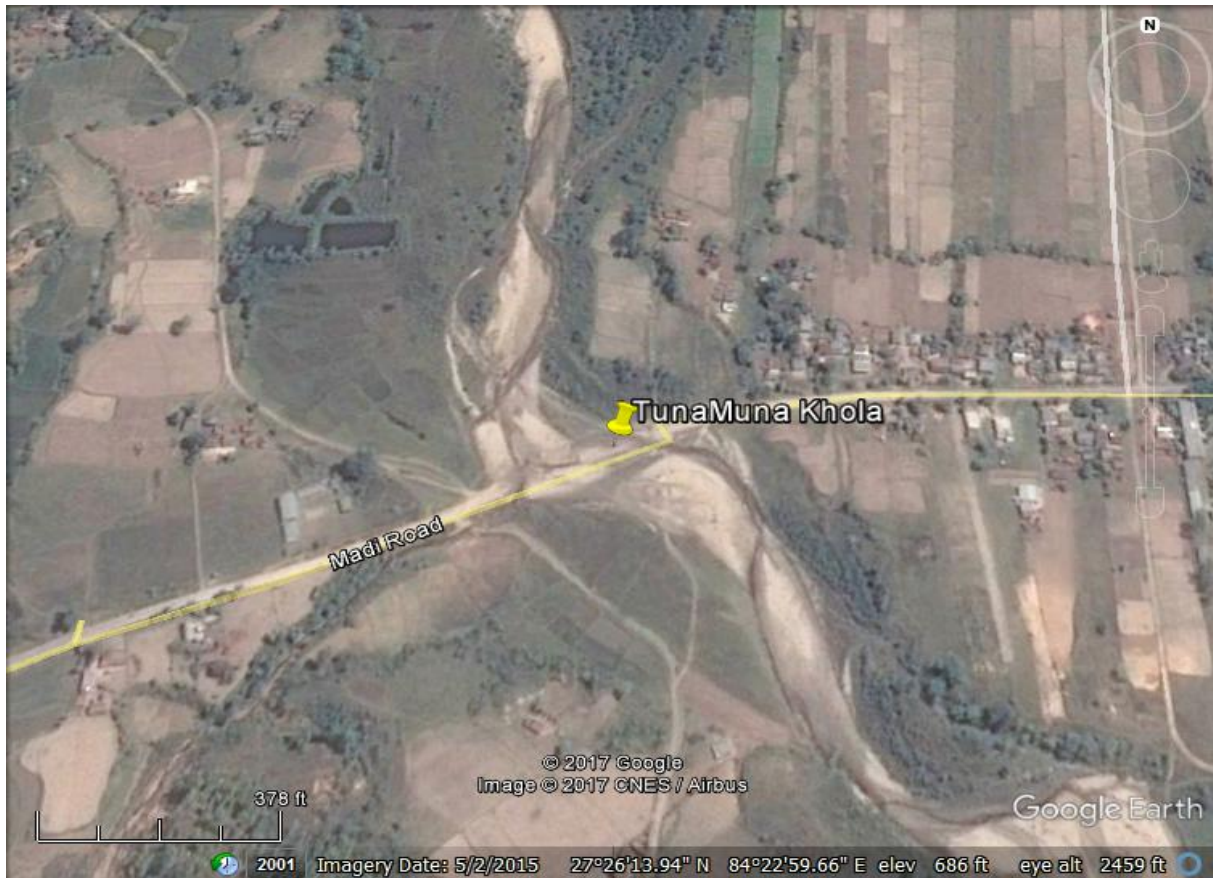
Figure 1: Project Area of Tunamuna Khola Bridge Project Area



2.3 Project Location

The proposed bridge lies in Chitwan District of Province number 3 of Nepal. Geographically, the location of the bridge to be constructed is proposed at $84^{\circ} 23' 12.36''$ E longitude and $27^{\circ} 26' 15.36''$ N latitude. The elevation of the district varies from 121 m to 1797 m from mean sea level. Elevation of river bed was found 195 meter from sea level during the field verification. The project location is shown in google map in Figure 2.

Figure 2: Project Location on Google Earth Map



Source: Department of Survey (1996)

2.4 Salient Features of the Project

The Salient Features of the Tunamuna Khola Bridge Project is shown in Table 2.

Table 2: Salient Features of the Tunamuna Khola Bridge Project

Project	Tunamuna Khola Bridge Project
General Information	
River	Tunamuna Khola
Project affected Municipality	Madi
Address of left and Right bank	Right: Kharkata, Ward no. 8, Madi Left: Jiwanpur, Ward no. 8, Madi
Location of the Bridge	
Geographical Location	
Latitude:	27° 26' 12.36" N
Longitude:	84° 23' 15.36" E
Name of the Road	Madi - Thori Road
Type of the Road	Highway
Altitude	195 m
Hydrology	
Catchment Area of the Bridge Site (km ²)	24.02
Design return year Flood	100 years
Design Discharge at 100 years of return period (m ³ /sec)	109.887
River type	Perennial
Average Rainfall (mm/daily)	311.2
Discharge only water flow (Qp)	84.56 m ³ /s
Geology and Geomorphology of Bridge Site	
Left Bank	Deposition of Sand, Silt, Gravels & Clay
Right Bank	Deposition of Sand, Silt, Gravels & Clay
Number of Bore holes performed	NA
Bridge Description	
Type of Bridge	Pre-stressed RCC Bridge
Length of Bridge	70 m
Number of the Span of Bridge	2x30 m
Carriage Way width	7.5 m
Width of Footpath on either Sides	1.75 m (including Railing)
The clear height of the bridges from river bed level to the bottom of superstructure (beam)	4.92 m
Thickness of Concrete Deck Slab	0.30 m
Free Board Height (m)	2.25 m
Sub-structure	
Type of Foundation	Open Well foundation
Depth of Foundation	4.09 m
Construction Period	2 yrs
Defect Liability Period	1 yr
Life of Bridge	50 yrs
Project Cost	NRs. 5,74,79,484.72

Source: Feasibility Study of Tunamuna Khola Bridge Project, 2017

2.5 Local Construction Materials Requirements

Local construction materials of various types are required for construction of the new bridge project. These include paving materials comprising sub base; sand, stones and aggregate for masonry and concrete works and fill materials for the project. The details about quantity of raw materials required for the construction of bridge has been listed in the given below Table. 3. These materials will be extracted from DCC/Municipality approved crusher plants/ approved quarry sites of GoN.

Quarrying & borrow pit sites

Table 3: Details of extraction materials and rehabilitation plan

Extraction Materials	Quantity	Duration	Impact mitigation and Rehabilitation Plan
Boulder (m3)	1380	Throughout the project period	<ul style="list-style-type: none"> – Protection of arable land – Restricted extraction (i.e. in the areas without tree cover, away from dwelling, archaeological, religious or cultural sites, without water logging problem) – Stockpiling all topsoil separately and reapplication for natural replenishment – Provision of adequate drainage outlet to prevent surface water ponding – Re-vegetation for reclamation of land – Establishment of fish farm ponds for deeply excavated area if applicable
Sand (m3)	930		
Gravel (m3)	1550		
Filling Material for approach road (m3)	17500		
Gravel for approach road (m3)	580		

2.6 Construction Technology

The new bridge construction will require mostly mechanized construction for pavement and earthworks. Transportation of materials will be mechanized. However construction works such as earthwork, simple masonry structures, bio-engineering works etc. will be generally labor intensive with use of light equipment. The proponent must develop the diversion road for vehicle transportation.

2.7 Project Support Facilities

The project will require following facilities for its development and operation in the long term.

Camp/labor site

Sufficient housing facility during the project construction for labor force is not available in the nearby villages. During, construction two temporary camps have been proposed at the left bank of Tunamuna Khola. There is sufficient river flood barren land on both side of river bank. If project need additional land for temporary use of labor camp, contractor can contract with concern person/agency with providing compensation.

Spoil Disposal Areas

The excavated foundation materials and spoil generated from construction of bridge will be used for filling up the approach road. Open burning of waste will be completely prohibited.

Construction Yard, Parking and Stock Piling of Construction Materials

Main stock piling area will be at the Kharkata settlement of Madi Municipality -8. This proposed site is situated at the right bank of Tunamuna Khola river flood barren area. The construction yard & parking area will also be set up together, which will be useful for parking vehicles & storage of required materials for construction activities. There is no need of acquiring the public and private land property as well as other private and public properties permanently. River barren land will be sufficient for construction yard and parking area. If project need temporary private and public land and other properties, the compensation agreement will be prepared in mutual coordination with land owner/property owner and project staff.

Institutions Involved in Project Implementation

Department of Road (DoR) will be the government institution involved in the implementation of the project. DoR will depute a project team comprising Project Manager, Engineer and other support staffs to implement and manage the project. The Project Manager will be assisted by the consultant. The consultant will have the responsibility of construction supervision and contract administration of civil works contracts to be executed by contractors. There will be contractors involved in construction of this new bridge works. The contractor will have its own site organization responsible for construction activities as per the contract agreement. Local people can be involved in labor intensive works. NGOs/CBOs may be involved in social safeguard activities.

2.8 Project Activities

The details of the project activities from pre-construction to the operation and maintenance phase is presented in summarized form in Table 4.

Table 4: List of Project Activities

S.N.	Project Stage	Activities
1	Pre-construction	Site survey and pre-feasibility Study
2		Project area delineation and alignment marking
4		Identification of temporary private land to be acquired by the project
5		Locating camp/labor sites, spoil disposal areas, quarrying and borrow pit sites
6	Construction	Clearance of nearby trees of bridge site
7		Material procurement (operation of quarries)
8		Transport of materials from the site of extraction to the site of construction
9		Operation of construction equipments and machineries
10		Construction of approach road
11		Construction of river and road diversion
12		Embankment construction in river and changed in river regime (If needed)

13		Overall Bridge Construction
14	Post-construction	Overall improvement of bridge
15		Camp site restoration
16		Environmental enhancement of spoil disposal area
17		Rehabilitation of quarry sites and borrow pits
18	Operation stage	Repair and Maintenance

2.9 Project Area Delineation

Project sites as well as environmental impacts that will be caused due to project construction and implementation on Physical, Socio-economic & biological aspects is defined as impacts component. Adverse and beneficial impacts are expressed on the basis of proximity of activity and magnitude of impact.

For this reason, the project impact areas are broadly defined as Direct Impact area and Indirect Impact areas. However, because of small scale of construction activities confined in a small area, the impact area is confined to small scale. The impact area of the proposed project is predicted to extend within Ward No. 8 of Madi Municipality, where the construction and operation activities of the proposed project will occur. The entire area of bridge construction site as well as adjoining areas within 500m from the boundary of bridge construction site is defined as **Direct Impact Area**. The administrative boundary of Ward No. 8 of Madi Municipality is defined as **Indirect Impact Area**. Based on the environmental impacts of the project, the project-affected areas are classified in the following Table- 5. These impact areas are delineated by studying the various features and details of project site such as topographical condition, land use, social settings, construction and operational modality of the proposed project, etc as well as technical consideration of the proponents technical team and EIA study team.

Table 5: Project Area Delineation

Category	Reason	Project Affected Areas
A Directly Impact Area (DIA)	Construction areas of project activities (Construction, camp facilities, excavation, stock piling including river training approach road)	500 m both upstream and downstream of bridge cross-section along the proposed Tunamuna Khola.
B Indirectly Impact Area (IIA)	Construction activities during construction and operational activities during operation of project can affected adjoining area or wards that join both section of the proposed Tunamuna Khola Bridge	Ward no. 8 of Madi Municipality
C Zone of Influence (ZOI)	Operational activities during operation of project can affected area other than category A & B with both beneficially and adversely.	Madi Municipality

Source: EIA, Field Visit, 2017

3 EIA STUDY METHOD

The EIA study methodologies have complied with the stipulated methodology in the ToR document (Annex I) approved by the MoFE. Highlights of the methodologies used for the EIA study are briefly described in succeeding sections to evaluate affected physical, biological and socio-economic and cultural environmental resources of the project area.

3.1 Desk Study

Available primary and secondary literature in the form of reports and maps (topographic maps, land use map, aerial photographs etc) were collected and reviewed from different sources (ref. References). Similarly published and unpublished reports pertaining to environmental standards, Acts, Regulations etc were also collected and reviewed focusing on the ToR identified specific issues and related baseline environments.

3.2 Field Study & Site Inspection

Field studies were conducted in the proposed project site in an extensive manner. The following methodology were applied to conduct various information for Environmental Impact Assessment of the proposed project.

3.2.1 Physical Environment

Information about topography, climate, meteorology (temperature, precipitation etc.), geology and land stability information, land use pattern, concerning physical resources of the project area were collected from available topographical maps, aerial photographs, GIS maps. This information were collected and reviewed through secondary sources. Information related to water quality of river and air quality, were collected and reviewed through secondary sources and site inspection. This is a construction project, will not generate effluent on river water system. The water quality parameters of river at bridge construction site may not be changed due to the construction and operation of project. Therefore, there is no need to test water quality of river during the period of EIA study. Noise level were measured with help of noise meter. We were also collect other relevant information through site observation with taking site specific photography, consultation with local communities and stakeholders. We gathered relevant to project information from field survey and interpret it.

3.2.2 Chemical Environment

The use of various chemicals spillage including fuel, lubricants, oil, acid, cement, bitumen etc. during Bridge construction works may adversely affect the local environment through leakage, fume etc. Thus, this aspect were addressed by documenting existing sensitive areas where such chemical related activities can affect.

3.2.3 Biological Environment

Information on the flora and fauna, Protected, Rare and Endangered species, sensitive habitats and species of commercial importance in the project area were collected. Documentation was done as baseline information on (i) Buffer Zone of Community Forest Area; (ii) Wildlife in the project site

including mammals, birds, reptiles and amphibians and (iii) Habitat for sensitive species of birds and mammals known in the study area.

The vegetation survey was carried out by walkover survey throughout the project area. Checklist of observed animal, bird and plant was prepared during site inspections/ field observation along project affected area. We were also prepared the check list for collection of fish species from river and population of fish was not carried out, because project activity would not affect the fish habitat and movement. At the same time secondary sources were reviewed about biodiversity of Chitwan National Park and Buffer Zone area.

3.2.4 Socio-Economic and cultural Environment

Socio-economic baseline features of the project area including population, ethnicity, employment facilities and education, health and sanitation condition, settlement pattern, migration, religion, cultural and religious sites, land holding size, crop production and cropping pattern (agriculture), livestock, sources of energy and energy consumption, infrastructure, market centers, industry etc were collected. This information were gather through secondary sources like Municipality profile, census survey report 2011 of Central Bureau of Statistics. Baseline of community property and common infrastructures within the project foot print areas was evaluated based on the information collected by direct observation and community consultation (public interaction). At the same time collect information related to temples, religious fields, chautaries, gumba, cemeteries, festival areas etc. were also observed through site inspection.

3.3 Impact Analysis

The environmental impact both beneficial and adverse were elaborately identified, predicted and evaluated to the extent possible, for both construction and operational stages. Each impact identified, predicted and evaluated by using standard methods and techniques on physical, biological, socio-economic and cultural aspects. The impacts were studied in terms of their nature, magnitude, extent and duration. For the assessment of the project impacts, the project activities during construction and operation periods were overlaid on the baseline and consequences of each the activities were examined based on expert judgement, and past experience in other projects. The project footprint on the baseline is used to determine the direct and indirect impact. The extent and duration of impacts were determined by the activity duration and consequences of impacts in the surrounding. Reversibility and irreversibility of the impact is judged based on the possibility of rehabilitation of the changed conditions by implementing mitigation measures. Collective judgement of the experts in the subject is used to evaluate the impacts significance in the project context.

National EIA Guidelines 1993 was used for the reference for the impact identification, prediction and evaluation. Magnitude of the impact were classified into High (H), Medium (M) and Low (L), extent will be classified in terms of Site Specific (SS), Local (L), and Regional (R). Similarly, the duration of impact will be further classified into Short Term, Medium term and Long term.

Scoring of Impacts

Nature of Impact: D = Direct; IN = Indirect; Magnitude, H = High (60); M = Medium/Moderate (20); and L = Low (10), Extent, R = Regional (60), L = Local (20); and S = Site-specific (10), Duration, LT = Long-term (20), MT = Medium-term (10); and ST = Short-term (5), The

points/scoring are taken from the National EIA Guidelines, 1993. Significance of Impact rated if total score: More than 75: Very Significant, 50-75: Significant, Less than 50: Insignificant

3.4 Public consultation and public hearing

Throughout the EIA study, starting from the scoping phase to the drafting of the EIA report, stakeholder consultation at the local is one the key activities of the EIA study team. At the start of the EIA study, a 15 days public notification was published in the national daily to inform the people of the project development area with regard to the project and were asked to register their concerns (environmental, socio-economic and cultural) prior to the preparation of EIA ToR. Concerns of stakeholders (locals directly impacted by the project and local living close to the project area and also impacted indirectly, various local and district level interest groups) were documented at the scoping stage by organizing scoping sessions the local area with an objective to incorporate the locals concern on the project in EIA ToR.

Similarly, during the EIA study consultative were organized at various project locations for various purposes such as collection of baseline information, opinion regarding mitigation and enhancement option etc. Such consultative meetings included mixed groups as well as target women groups. The directly and indirectly impacted communities were interacted individually or in group using structured and unstructured questionnaires. Apart from these, knowledge individuals from the local area as well as direct offices were interested during the various stage of EIA study. This EIA report is prepared keeping in view of the concerns, demands and expectations of the local people. Similarly mitigation measures and enhancement measures designed in this report addresses the concerns and expectation of the local area people. With preparation of the draft report addresses the concerns and expectation of the local area people.

A public hearing is mandatory for projects requiring EIA according to EPA 1997 and EPR 1997. Under the EPR 1997, the public has the right to examine relevant project information and make their concerns, opinions and suggestions known to the proponents and other concerned authorities. Rule 7, Sub-Rule (2) of the EPR 1997 states, “whilst preparing the report of Environmental Impact Assessment, the proponent shall organize a Public Hearing about the proposal where the proposal is to be implemented and collect opinions and suggestions.”

Public hearing event was organized at Janjivan Secondary School Kharkata Madi, on July 28, 2018 (12 Shrawan 2075) Sunday at Karobar Rastriya Daily Newspaper. The place was situated at mid-point of three bridge projects and was easily accessible to the people from project affected three wards.

Prior to the event, a team was deployed to the project site in advance to disseminate the objective, date, time and venue of the event taking place. Detailed information was provided through public notice printed in Nepali which was affixed at strategic public locations in the affected wards of Municipality as well as presented in person to the local government and non-government organizations. The public notices were also affixed on the notice boards of Municipality, Project affected wards of Municipality, Chitwan National Park, District Coordination Committee, District Forest Office, Division Road Office, and schools of the affected areas (attached at AnnexII). The public notice included information regarding the subject, time, location, and brief information on the project.

The event was participated by around 130 local people including community heads, officials of the local government, teachers, social workers, vulnerable groups, women and disadvantage people.

The event was facilitated by an EIA team member who shed light on major details of the project and the report. Project summary in Nepali was distributed to all participants as soon as they entered the venue. The event took the form of interaction where by the participants shared their concerns, issues and suggestions regarding the project. The concerns, issues and suggestions collected during the event are presented in Chapter 5.

3.1 Recommendation Letters from Municipality Office

The recommendation letters from Municipality Office were issued by the Municipality office with accomplishment of public hearing program and are attached in Annex III.

4 LITERATURE REVIEW

The proposed Tunamuna Khola Bridge Project attracts the following policies, laws, guidelines, manuals and standards of Government of Nepal (GoN). Apart from the GoN policies, laws, guidelines and standards, the project will also attract the international convention treaties to which Nepal is a signatory. The relevant national policies, acts, rules and guidelines attracted by the proposed project are as follows:

4.1 Constitution

Constitution of Nepal

The constitution of Nepal focuses on raising the standards of living of the general public. The constitution asserts that; The State shall pursue a policy of raising the standards of living of the general public through the development of infrastructures such as education, health, housing and employment of the people of all regions, by equitably distributing investment of economic investment for the balanced development of the country.

Similarly, Article 35 (5) states that the state shall make such arrangements as may be required to keep the environment clean. The State shall give priority to the prevention of adverse impacts in the environment from physical development activities, by increasing the awareness of the general public about environmental cleanliness, as well as to the protection of the environment.

4.2 Policies and Plan

Fourteenth Periodic Plan (frame work) (2073 -2075) (2017-2019)

Fourteenth periodic plan has conceptualized the sustainable development and healthy environment with its goal of conducting activity that adapts the climate change. Plan has focused on minimization and adaption of adverse impact of development activity by environmental assessment.

Policy Document, Environmental Assessment in the Road Sector of Nepal, 2057 (2000)

The purpose of the policy document is to ensure that development improves the way of life for the people affected, without damaging the natural surroundings. Sometimes a degree of damage is inevitable. In such case, an environmental assessment should find ways of reducing or compensating for the damage. The policy document suggested five types of environmental assessment activities viz. Screening, Initial Environmental Examination, Scoping, Environmental Impact Assessment and Monitoring. Appendix B of the document classified the bridges with the span more than 20m as a major bridge.

Land Acquisition, Resettlement and Rehabilitation Policy, 2071 (2015)

Land Acquisition, Resettlement and Rehabilitation Policy, 2015 was endorsed for infrastructure development project in Nepal. The objectives of policy are to avoid displacement wherever possible

and if not, minimize as far as possible. If population displacement is unavoidable, mitigate adverse impact by providing adequate compensation and rehabilitation assistance to affected person, family and community. And to create conducive environment for timely completion of the project by simplifying land acquisition, valuation, compensation, resettlement and rehabilitation process.

DoR Bridge Policy and Strategy, 2061 (2004)

The DoR Bridge Policy emphasizes on safety, reliability and cost-effectiveness. To achieve the goals, the policy has highlighted the following bridge strategies.

- Strengthening the existing institutional capacity.
- Establishing economic and financial norms.
- Institutionalizing bridge maintenance and emergency works.
- Incorporating environmental and social aspects in the management of bridges.
- Establishing project management cycles.
- Technical support and standardizing bridge definitions with other organizations.

4.3 Acts and Regulation

Environment Protection Act 2053 (1997), Environment Protection Rule, 2054 (1997) & its amendment

Nepal has enacted a comprehensive and umbrella type environmental act, the Environment Protection Act (EPA) 1997, and followed by Environmental Protection Regulation 1997 and as amended (1999, 2007, 2009 & 2010) which are now enforced through appropriate regulatory measures.

Section 3 of the Act requires the proponent to conduct an IEE and EIA in relation to the prescribed proposals. Section 4 of the Act prohibits implementation of development proposals without prior approval of the concerned agencies or Ministry of Population & Environment (MoPE) as specified by the Act. Section 5 of the Act provides that all the IEE/EIA of the development proposals should be presented to the concerned agencies for approval. Under section 7 of the Act, industries or any others development projects owners are required not to discharge, emit or dispose waste, sound, radiation or any such acts which will cause pollution or to allow pollution to be caused in a manner which is likely to have significant adverse impacts on the environment or to harm human life or public health. Further, the section stipulates that causing pollution or allowing such pollution to be caused a punishable act.

The proposals requiring IEE studies are broadly listed in Schedule 1 under Rule 3 of the EPR enforced under the provisions of EPA. Under the Road Sector of the Schedule 1, it is mandatory to conduct IEE study for construction of major bridges. As per Rule 5, proponent of both IEE and EIA proposals has to prepare Terms of Reference (ToR) of the proposal for approval.

Rule 7 of EPR provides that the proponent shall, on the basis of the approved work schedule pursuant to Rule 5, prepare the report of initial environmental examination (IEE) in the format as indicated in Schedule 5, and the report. Under sub rule 2, Whilst preparing the IEE report, the

proponent shall affix a notice in the concerned Rural Municipality or Municipality, Office of the District Development Committee, school, hospital, health post and individuals requesting to offer their written opinions and suggestions within 15 days with regard to the possible impact of the implementation of the proposal on the environment where the proposal is to be implemented and prepare a Deed of Public Enquiry (Muchulka) of that deed. The said 15 days notice shall also be published in a national level daily newspaper. After the publication of such notice, the opinions and suggestions so received shall also be included in the final report.

Rule 12 of EPR stipulates that the proponent is obliged to follow the terms of conditions set by concerned agencies or MoSTE in the approval letter during project implementation and operation. Rule 13 provides that the concerned agency to be responsible for the project monitoring.

Public Road Act, 2031 (1974)

The Public Road Act is the governing legislation for construction and operation of roads in Nepal. The Act prohibits the construction of permanent structures (buildings) in a defined distance from the rural road, i.e., the road agency has the authority over everything within the right of way. The act makes provision for cases where road projects temporarily require land and/or other properties during construction, rehabilitation and maintenance. A Compensation Fixation Committee (CFC) determines compensation in case of loss of assets, business or production. Provisions are also detailed for compensation for the extraction of construction materials. Article 19 of the Act mandates requirement of permission from the Department of Roads to carry out activities within the limits of the road boundaries. As per Article 29, local governmental offices have to give notice to the DoR prior to the start of activities in the limits of the public roads. The Act empowers DoR to acquire any land on a temporary basis (for storage facilities, construction camps, etc.) during road construction and upgrading. The temporary acquisition of land containing any buildings (e.g. houses, sheds, temples and schools) is avoided wherever possible. The Act also empowers DoR to “lift earth, stone or sand from any adjoining land” during construction and upgrading works.

The Act does not provide for leasing of land. However, DoR is required to pay compensation for any damages caused to buildings, crops and trees, where the farming activity of the landowner is interrupted, and where the landowner has to incur expenses to restore the land after its return. Compensation is determined between DoR and the titleholder, or through mediation, involving officials from the relevant VDC (now Rural Municipality) and District Development committee (Now District Coordination Committee). The GoN may prohibit, through notification in the Nepal Rajapatra (Government Gazette), the construction of any permanent structure (other than walls) within 6 m of the road formation edge.

National Parks and Wildlife Conservation Act 2029 (1973)

Article 5, stipulate provisions of restriction on damage to forest product and to block, divert any river or stream flowing through national park or reserve, or any other source of water or use any harmful or explosive materials without obtaining a written permission; Article 9 lists the protected wildlife prohibited for hunting ; Article number 13 prohibits collection of samples from national parks and reserve without obtaining licence.

Wildlife Reserve Rules 2034 (1977)

Rule 4 stipulates provision of entry pass to enter into the Parks or Reserve, Rule 6 stipulates restricted activities within the parks and Reserve, Rule 11 stipulates prior approval for any research activities or study within the parks or reserves.

Buffer Zone Management Rules, 2052 (1996)

Chapter - 3 of buffer zone management regulation, 2052 (1996) have provided power and responsibility to warden for preparation of management work plan of buffer zone and its implementation within the park area for community development, environmental conservation and the balanced utilization of forest resources of the buffer zones. Chapter-4 describe about Formation of Users' Committee, Registration of the Users' Committee, Functions, Duties and Powers of Users' Committee, Work Plan of Users' Committee, Dissolution of Users' Committee, Fund of Users' Committee and Auditing of Users' Committee. Chapter-5 describe about the Prohibited Activities within the Buffer Zone, Order can be Given to Stop or to Rectify Activities, No Damage shall be caused, Approval to be sought. Similarly Chapter-6 related to forest development and Chapter-7 related to community development around buffer zone.

Forest Act, 2049 (1993), its amendments (1995) and Forest Rules 2051 (1995)

Forest Act, 1993, its amendment (1999) and Forest Regulation (1995), recognizes the importance of forests in maintaining a healthy environment. The Forest Act requires decision makers to take account of all forest values, including environment services and biodiversity, not just the production of timber and other commodities. The basis of the Act's approach to forest and forest products is "resource oriented" rather than "use oriented".

Section 49 of the Act prohibits reclaiming lands, setting fires, grazing, removing or damaging forest products, felling trees or plants, wildlife hunting and extracting boulders, sand and soil from the National forest without the prior approval. Section 68 of the Act empowers GoN to use any of forest. In case any damage is to be occurred to any person or community while giving assent to use the Forest pursuant to Sub-section (1), Government of Nepal shall have to make proper arrangements in this regard. Similarly, Forest Rules, 1995 detailed the legal measures for the conservation of forests and wildlife. Based on forest legislation, 13 plant species are included in the level of protection list. GoN has banned the felling, transportation and export of Champ (*Michellia champaca*), Khayar (*Acacia catechu*) and Sal (*Shorea robusta*).

Local Government Operation Act 2074

Schedule 3 has describe about work responsibility and right of Rural Municipality and Municipality. Rural Municipality and Municipality has right to protect and secure Rural Municipality and Municipality properties. Rural Municipality and Municipality have right to identify and documented the probable natural resources and valuable resources within its premises. Rural Municipality and Municipality has right to fix charge of natural resource such as stone, silt, boulder, etc. to sell and export within its premises. Local government has right to prepare local policies, acts, standards, planning related to environmental protection and biodiversity and its implementation and monitoring for better management natural resources.

Soil and Water Conservation Act, 2039 (1982)

The mismanagement of watersheds leads to the degradation of valuable land by flooding, water-logging, and accelerated silt in storage reservoirs. In order to properly manage the watersheds of Nepal, the Soil and Watershed Conservation Act (SWCA) was enacted in 1982. Section 3 empowers Government of Nepal can declare any area of Nepal as a conserved watershed area, specifying the borders thereof. Section 4 provides that a watershed conservation officer has the authority to implement the following works in protected watershed areas:

- Construct and maintain dams, embankment, terrace improvements, diversion channels and retaining walls,
- Protect vegetation in landslide-prone areas and undertake afforestation programmes, and
- Regulate agricultural practices pertinent to soil and watershed conservation.

Section 13 empowers The Watershed Conservation Officer may prohibit the commission of any acts that may cause soil-erosion or soil cutting in a land where any of the acts has been done under Section 4 and in vicinity of such land.

Aquatic Animal Protection Act, 2017 (1960)

The Aquatic Animals Protection Act, 1960 (AAPA) indicates an early recognition of the value of wetlands and aquatic animals. Section 3 renders No person shall knowingly use any kind of electric current, explosive substance or poisonous substance with intention of catching and killing any aquatic animal in any water. AAPA has been in effect since 1961, yet both noxious and explosive materials are increasingly used in water bodies throughout Nepal. There is no reported case of prosecution for a breach of AAPA. This demonstrates the government's ineffectiveness in developing a surveillance system for conserving aquatic life.

Under section 4, the government is empowered to prohibit catching, killing and harming of certain kinds of aquatic animals by notification in the Nepal Gazette. However, any notice under this Section has never been published by the government.

Water Resources Act 2049 (1992) and Water Resources Regulations 2049 (1993)

The objective of this Act is to make legal arrangements for determining beneficial uses of water resources, preventing environmental and other hazardous thereof and also keeping water resources from free pollution. The Act striving to minimize environmental damage to water bodies, especially lakes and rivers through environmental assessment impact studies and the proponent who wish to use water resources for various purposes should prepare EIA report before a license can be granted. The Act stipulates that soil erosion, landslides or any significant impact on the environment should be avoided in all uses of water resource.

It is mandatory under Rule 17 I to the regulation that any person or corporate body, who desires to obtain a license for utilization of water resources must state in his application that appropriate measures will be taken to lessen the adverse effects due to the project on the overall environment. Measures are to be taken for the conservation of aquatic life and water environment and for mitigating social and economic effects of the project in the concerned area. Local labor should be utilized and local people should get benefits after the completion of the project. Rule 19 stipulates

that the water resources committee shall publish notice giving detail information about the project to people.

Land Acquisition Act, 2034 (1977) and Land Acquisition Rules, 2026 (1969)

Land Acquisition Act 2034 (1977) & Amendment, 2049, is the main legislation to guide the involuntary acquisition of land in the country. Government can acquire land at any place in any quantity by giving the compensation pursuant to the Act for the land required for any public purpose or for the operation of any development project initiated by government or government authorized institution (sections 3 and 4).

Solid Waste Management Act, 2068 (2011)

This Act outlines the duties of local government to take action to control waste generation, disposal or collection and has provisions for various punitive measures against those engaged in activities detrimental to the intentions of the Act. As per the Section 9, rule 38, (Ta and Tha) and rule 39 (8), haphazard generation, discard or collection of waste from household, industrial and other commercial activities.

Labor Act, 2074 (2017)

The Labor Act mandates the employer to give priority to the Nepalese citizen while employing personnel and workers in company. As per sec 58 of the act, Outsourced employees can be engaged in the work as prescribed by the Ministry by publishing a notice in Nepal Gazette upon recommendation of Central Labor Advisory Council. Such outsourced employees shall be engaged in the works which is other than the core works of the entity. As per section 28 of Labor Act, 2074 working hours continue to be 8 hours a day and 48 hours a week. The overtime wages is also continued to be one and half time of his/her ordinary rate of wages as per sec 31 of Labor Act, 2074. As per sec 30 of the new act, the maximum overtime has been increased to 24 hours a week. As per Labor Act, 1992, the worker and employees appointed under section 4(1) shall be kept on probation period unless he/she completes the continuous period of one year. Further, the continuous period of 1 year means the period of 6 month engaged at a work during the period of twelve months in an Enterprise or a period served continuously in a Seasonal Enterprise. The labor act prohibits the employment of the child or under-aged person. The employer will not force the workers to work for long hours other than defined by the law. The employer has the responsibility to ensure the healthy environmental conditions of the workplace as defined by the law.

Child Labor (Prohibition and Regulation) Act, 2056 (2001)

The Child Labor (Prohibition and Regulation) Act 2000 is the main legal expedient to prohibit engaging children in factories, mines or similar risky activities and to make necessary provisions with regard to their health, security, services and facilities while engaging them in other activities. Under the Section 3 of the Act, child having not attained the age of 14 years is strictly prohibited to be engaged in works as a laborer. Similarly under Section 4, engagement of child in works as a laborer against his/her will by way of persuasion, misrepresentation or by subjecting him/her to any influence or fear or threat or coercion or by any other means is prohibited. Under Section 6, in case any Enterprise has to engage a child in works, an approval has to be obtained from the concerned

labor office or any authority or official prescribed by that office and form the father, mother or guardian of the child.

Ancient Monument Preservation Act 2013 (1956 AD): Still in force, provides effective preservation and autonomy over the monument. The main objective of Ancient Monument Preservation Act 2013 (1956 AD) is to maintain peace and order by preserving the ancient monument and by controlling the trade in archaeological objects as well as the excavation of the place of ancient monuments and by acquiring and preserving ancient monument and archaeological, historical or artistic objects. According to Section 3 of sub-section 1 to 10 has clearly describe legal provision of how preserve ancient monument area and provision of permission before new construction, reconstruction of physical structure within the Ancient Monument area.

4.4 Manuals, Guidelines and Standards

Environmental Management Guidelines, Geo Environmental Unit, DoR, 2054 (1997)

The Environmental Management Guideline consists of environmental mitigation measures to be incorporated into DoR projects, procedures for public participation, and socio-economic consideration. The Environmental Mitigation Measures are broken down into 12 categories or activities and a method for implementation is given for each mitigation measures. The 12 categories are i) Quarries, ii) Borrow Pits, iii) Spoil and Construction Waste Disposal, iv) Work Camp Location & Operation v) Labor Camp Location & Operation, vi) Earthworks/Slope Stabilization vii) Use of Bitumen viii) Stockpiling of Materials ix) Explosive, Combustible and Toxic Materials Management x) Setting Up and Operation of Stone Crushing Plants xi) Water Management and xii) Air & Nose Pollution. These environmental mitigation measures should be used in conjunction with good engineering design, construction, and operation practices. The guideline also suggests considering the various socio-economic issues like land acquisition and compensation, economic impacts and cultural heritage. The various implementation strategies are also suggested in the guideline.

National Environmental Impact Assessment Guidelines 2049 (1993)

To address environmental impact assessment as envisaged by NCS 1987, National Environmental Assessment (EIA) Guidelines were endorsed by Government of Nepal on 27 September 1992 and 35hakur35 on 19 July, Volume 1993, Number 5. The guideline provides criteria for project screening and initial environmental examination (IEE). This includes scoping, preparation of terms of reference for EIA, methods for EIA report, impact identification and prediction, impact mitigation n measures, review of the draft EIA report, impact monitoring, evaluation of impact studies, impact auditing, community participation and schedules and annexes to IEE and EIA.

Many of the guideline provisions are now included in the Environment Protection Act 1977 and Environmental Protection Regulation 1997. EIA in Nepal has now become legally mandatory. However, as the National Environmental Guidelines, 1993 have not been issued under the environmental Protection Act (1997), they do not have any legal force. It is a policy guideline issued by the Government that is still followed in the matters which are not covered by the Environmental Protection Act (1997) and Environmental Protection Regulations (1997).

Roadside Bio-engineering, DoR, GoN, 2059 (2002)

The Roadside Bio-engineering, A Reference Manual provides a theoretical background for the use of vegetation in engineering. In addition to covering the principles underlying techniques of slope stabilization, the manual outlines those aspects of the ecology, geology, geography and law of Nepal that would be of relevance to practicing bio-engineers. The manual is intended for office use and provides standard specifications for bio-engineering works.

Environmental and Social Management Framework (ESMF), 2069 (2013); Amendment

The Department of Roads (DoR) with assistance of the World Bank conducted an Environmental and Social System Analysis (ESSA) in order to make existing ESMF compatible for bridges and strengthen the existing structure and function of the GESU within the DoR. The GESU in close contact with World Bank prepared the addendum to the ESMF and is approved on 2069/12/5 (2013/3/18) and DoR has made decision on 2069/12/27 (2013/4/19) to circulate the addendum to all the stakeholders for effective implementation along with the main ESMF document. Along with addendum, following expressions are made to be considered:

- 1) The word “road” is to be read as “road and bridges”
- 2) The word “environmental” is to be read as “environmental and social”
- 3) The word “construction” is to be read as “construction and maintenance”
- 4) The word “EA” is to be read as “EA and SA”

Environmentally Friendly Local Governance Framework, 2013

During the tenure of PEI (Poverty Environment Initiatives), the government produced various knowledge documents following the principle of sustainable development such as Conceptualized Environment Friendly Local Governance (EFLG) framework. The framework is developed under the principles of equity, subsidiary, harmonization and alignment, participation and collaboration, mutual accountability, downward accountability and transparency and a Sector Wide Program Approach (SWAp). The EFLGF accommodates all the programs and activities that are being implemented by the government with the support of various development partners. It strengthens the integrated bottom up planning process, coordination and collaboration amongst the various sectors. It helps crating demand from local communities for integrated environment friendly infrastructure development and also enhances capacity of local bodies and other service providers for effectively delivering the message of sustainable development to grass route level communities.

Bridge Inspection Manuals, 2062 (2005)

The prime objective of this inspection is to safeguard the bridge for the general movement of the public. The inspection result will be the basis to program the routine maintenance and to priorities additional maintenance as well as rehabilitation works. There are four categories of inspection: i) Superficial ii) Routine iii) Principal iv) Special. The routine inspection is the bridge inspection that the Division will carry out each year. This is a general examination of the structure to detect evidence of distress that might require repair or maintenance attention. The other inspection that is primarily used in the Division is the Superficial, or informal inspection. The principal inspection

consist of a more detailed inspection of the structure generally from within the touching distance, and often involving a certain amount of nondestructive testing. This will normally be undertaken by qualified bridge engineers either from the consultant or the Bridge Unit. The special Inspection is carried out to investigate a specific problem, after a major accident or event, such as earthquake or flooding, or passage of unusually heavy loads.

Nepal Bridge Standard 2067 (2010)

These standard categories the bridges in four types with their specifications. Design, loading geometric standard clearances are mentioned in the standard provisions urged by standards are useful for construction of bridges and environmental mitigation as well.

National Water Quality Standard, 2062 (2005)

Nepals drinking water quality standard come into force in Nepal after its publication in ministry of physical planning and works. The standard provides the maximum concentration limit of fifteen physical parameters, ten chemical parameters and two micro jums for drinking purpose. Ministry of environment has published waster waster standard for various sector of industries and also for discharging to common waste water treatment plant.

National Ambient Air Quality Standard 2069 (2012)

Ministry of environment (then ministry of environment) has also published the ambient air quality standard has mentioned different parameters like TSP, PM10, SO2, NO2, CO, lead benzene PM 2.5 with their maximum permissible concentration and test method.

National Diesel Generator Emission Standard 2069 (2012)

Ministry of population and environment (then Ministry of Forest and Environment) introduced the national disel generator emission standard for new and in use diesel generator with a capacity of 8 kw to 560 kw.

National Noise Quality Standard 2069 (2012)

Ministry of environment (then ministry of environment) has published the noise quality standard has mentioned for six place like industrial sector, business sector, rural residence area, urban residence area, mixed residence area and peace area with their permissible level. In addition ministry has also published maximum noise permissible level for household using instruments like water pump set, diesel generator etc.

4.5 International Conventions and Treaties

Convention on Biological Diversity, 2049 (1992)

The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding. Under the Article 14 of the convention, the each contracting party should introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), (1973 amended 1979)

The convention classifies species according to criteria where access or control is important (e.g. I - species threatened with extinction; II - species which will become endangered; III - species that are protected; E - Endangered; V - Vulnerable, R – Rare (CITES 1983). The project will have to minimize impacts to the CITES species as far as possible.

ILO 169 convention, 1989

ILO convention number 169 is a legally binding international instrument which deals specifically with rights of indiginious and tribal people. Convention securs right of indiginious and tribal people to be informed about the project and to get proper mitigation and compensation for the impact of project.

5 EXISTING ENVIRONMENTAL CONDITION

5.1 PHYSICAL ENVIRONMENT

5.1.1 Physiography and Topography

The chitwan district is a part of Terai belt of Nepal, which extends from the Siwalik range in the north, and extends to Indo gangatic plain. On the other hand Chitwan is an inner-noon valley between the Siwalik Hills in the south and the Mahabharat hills to the north. The elevation of the Chitwan district has ranged from 121 m to 1797 m asl. The topography of district mainly consists of gentle plain. The topography of this district mainly consists of gentle plain.

Table 6: Elevation of the project district, Chitwan

Min Elevation [m asl]	121
Max Elevation [m asl]	1,797
Average Elevation [m asl]	945

Source:DDC (Now DCC) profile 2073/74

5.1.2 Climate

This districts falls within the tropical to sub-tropical climate zones. The average temperature of summer and winter varies by almost 15°C as shown in the figure below. The minimum average temperature experienced in the project area is 15°C in winter (Dec – Jan - Feb), which gradually increases to reach around 30°C in midsummer (June-July). The project area is considered warm to hot in Nepal.

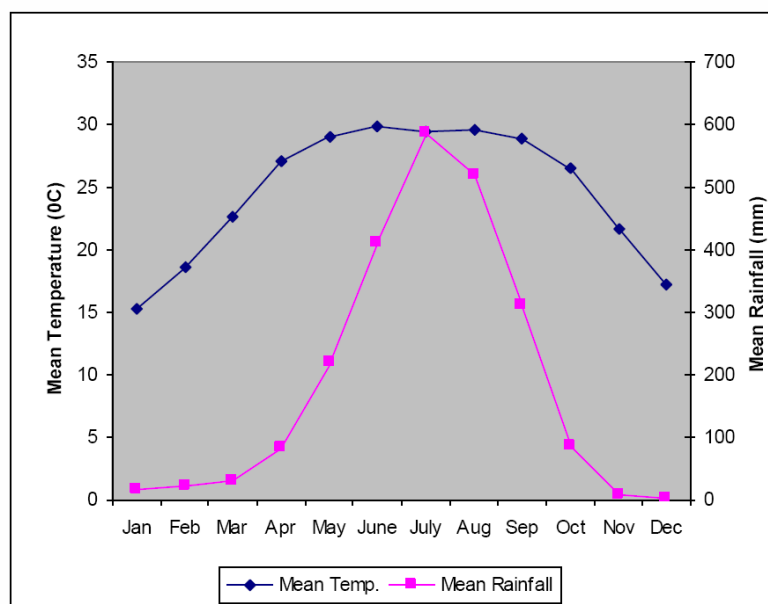


Figure 3: Temperature and Rainfall pattern of the study area

The climate of the study area is strongly influenced by the South Asian monsoon system. Almost 90% of the precipitation

Climate station at Rampur, Chitwan, Nepal (27°37'N 84°25'E, 256 masl)

(rainfall) is the result of the monsoon, which occurs between April – August, with the peak during June – July. The twenty four hour average max. rainfall (mm/daily) is approximately 311.2 mm, which reaches the peak up-to 600 mm in the mid of the monsoon season.

As a result of the monsoon, the project area is very wet during summer, whereas, the winter experiences little rainfall, and considered dry. *Source: DHM 2017*

5.1.3 Geomorphology and Geology

Most of the rivers and streams in Nepal flow from the north towards the south, generally with high velocity due to high river gradient. In the Terai plain, due to mild bed slope, the river deposits substantial amount of sediment causing shifting, meandering, widening and braiding, scour bank erosion and under cutting, inundation of lower Terai during monsoon, and siltation on farm land & causes desertification.

The Inner Terai Valleys of Nepal comprise several elongated river valleys in the southern lowland Terai part of the country. These tropical valleys are enclosed by the Himalayan foothills, viz the Mahabharat Range and the Siwalik Hills farther south. The Inner Terai Valleys are filled up with coarse to fine alluvial sediments. The Chitwan Valley is one of the Inner Terai Valleys.

The geomorphology of the bridge site area comprise of barren alluvium terraces used for the cultivation, some barren land, settlements and some community forest area. Being formed with the loose alluvial material, the riverbank conditions of all the bridge sites are not stiff. Scouring seems possible, hence bank protection measures seems necessary. The flow is with mild gradient. The three kholas, where bridge construction is proposed, flow towards the north from south and meet Rewa Khola, which is flowing from east to west direction.

The geological formation of the area is with Siwalic Sedimentary System having alluvium deposition consisting mainly of finer clastics like sandstone, siltstone, shale and some marbles. Mixed with fine materials like sand and silt, the fine boulders make a formation of alluvium terrace which is loosely compacted. Hence, side cutting of the rivers is possible. To protect against scouring of the bank, a properly managed bank protection work seems necessary. As the velocity of rivers in plain area is not so much, possibility of bed erosion is less on these rivers. *Source: Department Mining and Geology, 2017*

5.1.4 Rainfall

Rainfall of the Project District

Climate of the district changes with topography and elevation. Max. temperature of the district observed in year 2000 was 39 °C in the month of May, and min 3.5 °C in the month of January. Total rainfall in the district in year 2000 is 2025 mm with max. 24 hour rainfall being 100 mm in the month of June, 2006.

Rainfall in the Catchment of Tunamuna Khola

The meteorological station at Rampur, chitwan are nearer to the catchment area of proposed bridge axis A frequency analysis has been carried out based on available data from 1989 to 2013 to obtain 24 hrs. Hence, it is selected for rainfall data to use in calculation of flood.

The 24 hours maximum rainfall data generated from the DHM is shown in Table 7.

Table 7: Twenty four hours maximum rainfall in the catchment of Tunamuna Khola

Year	Max 24 Hours Value	Year	Max 24 Hours Value
1990	96.8	2003	296.3
1991	126.1	2004	73.5
1992	86.6	2005	89.2
1993	227.5	2006	110.0
1994	175.9	2007	154.7
1995	97.8	2008	78.5
1996	72.0	2009	140.2
1997	158.8	2010	172.0
1998	247.6	2011	118.9
1999	211.6	2012	82.9
2000	100.3	2013	168.4
2001	141.3	2014	241.1
2002	270.8		

Source:DHM, 2017

5.1.5 Hydrogeology

The large aquifer system underlying Chitwan's dun valley is predominantly filled with highly porous, permeable, and unconsolidated to poorly consolidated alluvial or fan deposits that date from the Late P Holocene. These unconsolidated valley fill deposits consist of thickly bedded conglomerates with pebble to boulder clasts in a fine-grained matrix. They are locally called dun fan gravels or dun gravels. The sediments are finer toward the confluence of the Rapti and Narayani rivers. Deposits here form the main aquifer system, which is characterized as being homogeneous in nature as is evident from the hydraulic properties recorded in tube-well logs. Previous researchers named the aquifers Bhabar deposits. River fans and ancient river terraces are found mainly in the valley. The Bhabar Zone area in Chitwan District covers an area of about 280 km² while that of the dun valley is about 800 km². The valley contains colluviums around the periphery and a thick pile of very coarse and poorly sorted fluvial deposits in the main valley. The sediments in the valley are characterized by a widespread occurrence of hard, cemented conglomerate about 9–10 meter thick with a 2–3 meter thick clay layer overlying it. In the southeast part of the valley near the Rapti River, a 2–3 meter thick clay layer overlies fine sands. Very thick gravel and boulder deposits subsequently underlie this. The porosity and permeability of these deposits are high and generally form good aquifer conditions. Both types of aquifer, unconfined/confined or semi confined/leaky, are present in the area (Malla R and Karki K, 2016).

5.1.6 Catchment Area of Tunamuna Khola

The Tunamuna khola is Intermittent stream. Its catchment is in Southern basin. The khola originates from the Mountain range. The highest point of catchment which is 524m. The total catchment area of the river at the bridge site is 24.018 km². The length of river from the origin to the bridge site is 10.175 km. The maximum elevation of the catchments area is 524m and minimum elevation at bridge site is 186.5m. The average slope of the river from its origin to the proposed bridge site is about 0.0331 or about 3.316%. The catchment area & proposed bridge location is shown in Figure 4.

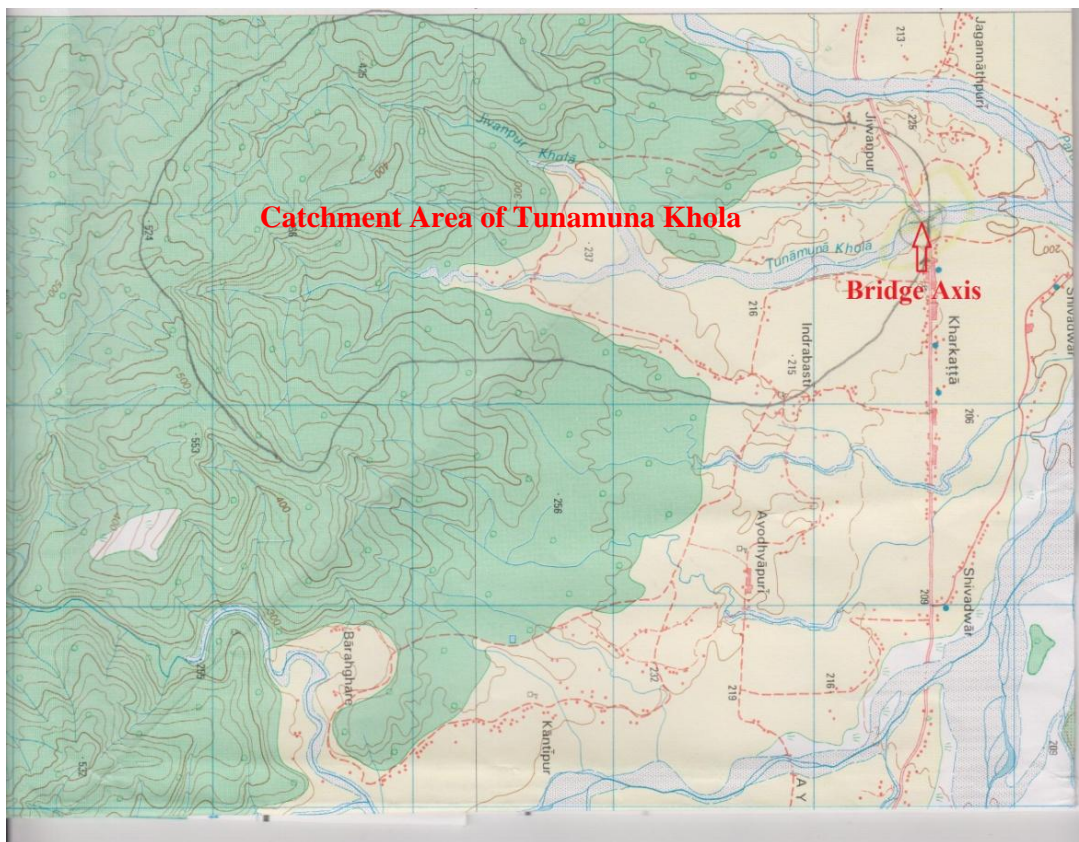


Figure 4: Catchment Area and Bridge Location

Source:DHM,2017

Design Flood

The bridge is medium type and the catchments Area is also medium, the discharge for return period of 100 years is recommended for design discharge. The maximum discharge using above methods for return period of 100 years is summarized below in Table 8.

Table 8: Summary of flood Discharge

Discharge m ³ /sec for 100 yrs	Method
155.539	WECS/DHM method
252.99	Area-Velocity method
838.54	Rational Method
84.65	Regional flood frequency Method
100.97	Medium Hydro Study Approach
118.539	Modified Dicken's Method

The above table shows that the discharge calculated by Rational Method is Maximum and discharge calculated by Regional flood frequency method is Minimum. The high food level is noted as the mark is obtained in the river bank, rocks, big boulder in the river side and also from interviewed with old persons in the vicinity of the area that had occurred in the past years. Nevertheless, the discharge calculated by the Area-Velocity Method has been adopted because the discharge calculated by the Rational Method depends upon different parameters and hence not considered as authentic then the Area-Velocity method which is solely adopted for Nepal condition. So the design discharge is adopted =252.99m³/sec. Source:DHM, 2017

5.1.7 Seismological Study

The Himalayas are the product of continental collision of the sub-diction between the Indian plate and Eurasian plate. The collision was initiated in the early Tertiary period and the convergence between the two plates is estimated as 41-61 mm/yr. Nepal is located on the boundary between the Indian and Eurasia plate, along which the relative shear strain of about 2cm per year has been estimated. The existence of Himalaya range with the world's highest peak in evidence is the continued tectonic activities beneath the country. Therefore, Nepal is seismically very active.

The development of longitudinal thrust faults and strike slip transverse faults are the results of continued sub-diction of Indian plate underneath the Eurasia plate. This process is continuing which is evidence by the lifting of the Himalayas and occurrence of frequent earthquakes of various magnitudes. In Nepal earthquakes have occurred periodically and there have been several devastating earthquakes within this century. Therefore, the seismic parameters required as input in the design of bridge foundation structure, are very significant and should consider very carefully.

The epicenter map of Nepal exhibits the majority of earthquakes occurrence in a zone that passes through the midland mountain region of Nepal. This zone runs NW-SE direction as a longitudinal trend of Nepal. The region beneath the high concentration of earthquake epicenter is considered to be high stress accumulation zone for the source of earthquake in Nepal.

The information of the historical and instrumentally recorded earthquakes in Nepal and India are available in the project area. Major earthquake events occur with magnitude 7. *Source: Department Mining and Geology, 2017*

5.1.8 Air, Noise and Water Quality

There are no any instrumentally monitored databases of air and water quality in the project area. ICIMOD observed particulate matter (PM₁₀) in ambient conditions in January 2016 from three villages - Ghokrella, Badreni and Gathauli in east, west and north, with reference to Chitwan National Park Air Quality. The concentrations of Black Carbon (BC) and Particulate Matter (PM) in the ambient air were considerably higher than WHO standards. Measurements revealed that the ambient 24-hour average PM₁₀ was about 130 µg/m³, and PM_{2.5} was about 100 µg/m³ which was three folds higher than the WHO standard of 50 µg/m³ and 25 µg/m³ of PM₁₀ and PM_{2.5} respectively. A 24-hr average ambient black carbon was about 8.8 µg/m³, shooting up to 180 µg/m³ during burning hours. This may be cause of natural and public activities within park and outside park (ICIMOD, 2016). Regarding the location of project, the project area is devoid of industrial activities and the consequences from these activities toward air quality and water quality is insignificant. However, the domestic activities may have potential deterioration of surface water quality, and ambient air quality to some extent. And average noise level was observed 50 dB during day time at bridge construction site. Therefore the quality of air, water and the noise level in the surroundings of the project alignment are envisaged to be within the accept tolerance limit

5.1.9 Land use

The Chitwan National Park in Chitwan district has influenced in the landuse of this district. Unlike other district of Terai region, larger area of this district is covered by forest. Chitwan has 1,42,422 Ha of forest, which is 65% of its total area followed by cultivated land of 46,814 Ha (21%) as presented in Table 9. The project will affect 1.7 ha. Land and out of this 0.077 ha. Land will be used permanently and remaining 1.623 ha. Land will used temporally.

Table 9: Land use of Chitwan districts

Landuse	Area in Chitwan district [Ha]
Cultivated	46,814
Non Cultivated	8,465
Pasture	10,417
Forest	1,42,422
Others	11,336

Source: DDC (Now DCC) Profile, Chitwan, 2073/74

There is no tree and shrub species but sparse herb vegetation within core area of bridge construction site. This is public barren land.

5.1.10 Existing situation of the road (Existing baseline)

The Thori-Bharatpur road section joins the project area with Bharatpur Chitwan. It is located at the distance of 52 km far from Bharatpur, Chitwan. At present double lane blacktopped road as well as earthen motorable access road joins this project area with Bharatpur and Thori. The construction of proposed Tunamuna Khola Bridge will increase road network and easy accessibility within the project area.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 General Introduction about project site

The project site lies within the Buffer Zone of Chitwan National Park, world heritage site. This is tropical vegetation zone. Tropical Shorea-Terminalia forest, Acacia -Dalbergia forest is major forest type at river plane at Buffer Zone of Chitwan National Park. In case of project site there is not forest and wild life habitat. And project site lies at river flood plane with scattered settlement in the right and left side. As the bridge axis is exactly matches with road axis there is no need of acquiring private land and public land.

5.2.2 General Overview of Chitwan National Park

Chitwan National Park, the oldest National Park in Nepal lies in the lowlands or Inner Terai of southern central Nepal on the international border with India. The park's boundaries extend from the Daune Hills on the west bank of the Narayani River eastward 78 km to Hasta and Dhoram rivers. The park is bounded to the north by the Narayani and Rapti rivers and to the south by the Panchnad and Reu rivers and a forest road. It was declared a national park in 1973 and was designated as a World Heritage Site in 1984. It has an area of 932 sq. km. About 570 species of flowering plants are known to occur in the Park. In CNP, 16 land cover types: 4 types of Sal forest associations (lowland Sal, mixed Sal, degraded Sal and hill Sal), 3 types of riverine forest associations (Trewia-Bombax, Acacia- Dalbergia, and mixed riverine), 2 types of short grassland associations (flood plain grassland and short grassland), 3 types of tall grassland associations (swampy tall grass, tall grass and wooded tall grass), 2 types wetland (rivers and lakes). The given below table presented some important features about Chitwan National Park.

Table 10: Overview of Chitwan National Park

<u>Overview of Chitwan National Park</u>	
Established Date	1973 (2029 BS)
World Heritage Site declared	1984 (2040 BS)
IUCN Category	II
Area	932 sq km
Altitude	110m to 850m
Physiographic region	Terai-Siwalik
Districts Covered	Chitwan, Nawalparasi, Parsa and Makwanpur
Park Head Quarter	Kasara, Chitwan
Management sectors HQ	East-Sauraha = (34440 ha area covered)
Centre-Kasara	(27810 ha area covered)
South-Bagai	(30890 ha area covered)
West-Amaltari	(25060 ha area covered)
Vegetation Types	Mainly Sal forest, mixed hardwood forest, Riverine Forest and Grassland
Flora and Fauna	More than 600 plant species, 60 mammals, 576 birds and 49 amphibians and reptiles.

Source: **CNP & Buffer Zone Management Plan, 2000**

The major commonly found some vegetation, mammals, birds, reptiles and amphibians, and fish species within Chitwan National Park and Buffer Zone are presented in **Annex IV.1, Annex IV.2, Annex IV.3, Annex IV.4, Annex IV.5, Annex IV.7**. And the lists of some Endangered, Threatened Species found in the CNP are listed in **Annex IV.6**.

5.2.3 National Park and Buffer Zone Forest (BZF)

The project lies in the Buffer zone which is an area peripheral to the park and is also regarded as a zone of impact. The DNPWC brought forth the Buffer Zone policy in 1993 under the fourth amendment of the National Parks and Wildlife Conservation Act 1973. Buffer Zone Management Regulation was passed on 1996 and the Buffer Zone of CNP was declared in the same year. Total area of Buffer zone is 767 sq. km. (GON, 2000).

5.2.4 Ward wise Forest Cover at Madi Municipality

There are 73 Buffer forest and Community forests in the Park area (GON, 2000). Forest area covering of 11221.5 ha) lies in the project affected Municipality. Shrub land and grassland covers only 128 ha and 119 ha in the project affected Municipality.

Sal forest, Riverine forest and Terai mixed hardwood forest are the major forest types. The buffer zone forests function as an extended habitat for animals from the park, and serves as the main source of fuelwood and fodder for the Buffer Zone residents.

Table 11: Forest Cover in Project Affected Municipality

Sector	S.N.	District	Municipality (Ward No.)	Forest Cover (ha)	Shrub Land (ha)	Grass land (ha)
South/Madi	1	Chitwan	Madi-1,2 & 3	444.50	-	-
	2	Chitwan	Madi-4,5 & 6	1947	-	-
	3	Chitwan	Madi 7,8 & 9	1647	-	-
	4	Chitwan	Madi 10, 11 & 12	7183	128	119
Total (ha.)				11221.5	128	119

Source: CNP and Buffer zone Resource Profile

The project affected Municipality has one buffer zone community forest which is given below:

Table 12: List of BZUCF in the project affected Municipality

S.N.	Name of Buffer Zone Users Community Forest	Area (ha)	Municipality/Location	District
2	Ayodhayapuri Buffer Zone Community Forest	11221.5	Ayodhyapuri-Bagai	Chitwan

Source : EIA field Survey, 2018

5.2.5 Ethno-botany, Medicinal Plants and Non-Timber Forest Products (NTFPs)

Various plant species found in the CNP and buffer forests have traditional and medicinal value. Some of the plant species like Baruwa, Khar, Babiyo, Bamboo, Khadai, Bet Amriso, Siru, Kans, and Narkat are used by local people which has ethno botanically important. And the medicinal plants like Biruwa jhar, Dharmaruwa, Harro, Barro, Asuro, Kurilo, Pilpla, Khar, Nimpatta, Bark of Phaledo, Datiwan, Gajo etc. are also found in the CNP and Buffer forests as well. But at the project site, only available of weeds and invasive plants, these plants are not used by ethnicity

5.2.6 Vegetation at project site

The project is going to construct at barren land of river flood plain. There was not observed any forest and agro-plant species at the project site. But there was found some sparse vegetation of few weeds and invasive plants species at bank of river channel. The observed invasive and weedy plants were like *Michania micrantha*, *Lantana camara*, *Parthenium hysterophorus*, *Eupatorium adenophorum*, *Ageratum conyzoids* and *Calotropis gigantea*.

5.2.7 Wildlife at project site

Chitwan National Park is home to almost 68 species of mammals. But Project site does not lie within wildlife habitat, but sometime this is migratory route for Elephant.

River Fish

Chitwan National Park is home for more than 120 species of fishes. Tunamuna Khola is also a seasonal river. During winter and dry season, volume of flow water drastically decreases and sometimes dries up. The following major fish species have reported in Tunamuna Khola after consultation with public and CNP-buffer zone staff. Those are Faketa (*Barilius Vagra*), Baam (*Monopterusuchia*), Buduna (*Garra* sp) Singhi (*Heteropneustes fossilis*) Katile (*Neolissocheilus hexagonolepis*) Hile (*Channa gachua*), etc.

Herpetofauna

Chitwan National Park is home to almost 49 species of reptiles and amphibians. However, based on discussions with villagers, sometimes, herpetofauna like snakes, lizards species are seen within project site.

Birds

The project site is within the buffer zone of CNP. Chitwan National Park is home for more than 576 species of birds. As per public consultation and site inspection, following birds species have reported around the project site are Kaag (*Corvus splendens*) Chil (*Hieraaetus kienerii*), Khar mujur (*Choriotis nigriceps*) Haleso (*Treron spp*), Bhangera (*Passer domesticus*), Suga (*Psittacula spp.*) Dangree (*Acridotheres fuscus*) Maina (*Gracula religiosa*), Dhanesh sp., etc.,

5.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

The project affected district is Chitwan district and One Municipality i.e. Madi is identified as project affected Municipality.

- Project Affected District: Chitwan
- Project Affected : Madi Municipality
- Project Affected Wards: 8

The baseline of socioeconomic & cultural environment of Zone of Influence and Direct Impact Area are described in this chapter.

5.3.1 Population and Demography

According to the CBS 2011, the total population of the Chitwan district is 579,984 consisting of 279,087 male and 300,897 female. The average household size is 4.38 which is slightly lower than the national average (4.88). The male population is 48.12 % and female constitute 51.88 %. The detail Population and Average HHs of Chitwan district is shown in Table 13.

Table 13: Population and Average HHs in Chitwan district

District	Average H/H Size	Total No. Of Households	Total Population	Male	Female
Chitawan	4.38	132,462	579,984	279,087	300,897

Source: CBS, 2011

The total populations of Project Affected Municipality (PAM) & Project Affected Ward (Ward No. 8) are 39,438 & 2,808 respectively of this Tunamuna Bridge Project Area. The total number of households in this project area of PAM & PAWs is 8,934 and 571 respectively. The detail population of the project affected area is shown in Table 14.

Table 14: Population of the Project Affected Area

Project Affected Municipality /Project Affected Wards	HHs	Total	Population		Population density
			Male	Female	
Madi Municipality	8934	39,438	17,988	21,450	172 person/sq.km with forest and and 482 person/sq.km without forest.
Ward No. 8	571	2808	1495	1317	

Source: CBS, 2011

5.3.2 Ethnic Composition

The inhabitants in the project affected Project area are mostly Brahmin (50.2%) and followed by janajati (24.35%), Chhetri (14.6%), Dalit (6.25%) and others by 4.6%. Source: CBS, 2011

5.3.3 Literacy and Educational Institutes

About 88% of people are literate and 12% of people are illiterate from the affected Project area. The percentage of secondary is also higher in this municipality. The percentage of just able to read and write is 15.28%, secondary education is 70.16% and remaining have acquired higher education. There are thirty educational institutions. Out of them one Madi campus, two are plus two school, 3 are secondary school, 6 are lower secondary and 18 are primary school within Madi municipality.

Table 15: Educational Institutes

Educational Institutions	Number
Campus	1

<i>Higher Secondary</i>	2
<i>Secondary</i>	3
<i>Lower Secondary</i>	6
<i>Primary School</i>	18

Municipality Profile, 2073/74

5.3.4 Occupation and Livelihoods

The predominant occupation of the people living in the project area is agriculture (65.55%), which is subsistence and business type. Besides agriculture, other occupations that provide employment and income to the locals are business (12.65%), services (9.35%), remittance 4.20% (excluding India), wage labour (5.87%), Indian services (1.86%) and others 0.52%. *Source: CBS, 2011*

5.3.5 Human Resources

DPR report is silent about number of skilled and unskilled human resource required for project implementation. EIA study team has tentatively estimated about 10 skilled including engineer and non-engineer, and about 50 unskilled human resources will be required for six month regularly to complete total task of bridge construction. The regular daily work of bridge construction will not be possible due to technical procedure and other environmental cause. Non-technical human resource will be available within project implementing municipality, though specific task related technical human resource may not be available. Most of skilled human resources are migrated to outside municipality and outside country.

5.3.6 Water Supply and Sanitation situation

Water Supply: The main sources of drinking water in the project area are piped tube-well, well, tap water, etc. About 45% household used Tubewell / handpump, 31% used uncovered well/kuwa 11% household used Tap/piped water, 5% household used covered well/kuwa and remaining household have used other sources like river streaming etc for drinking and daily household uses.

Sanitation situation: Out of 8960 household, 5,707 Households have with toilet facility of flush toilet, 1484 households have without toilet facility and toilet facilities have not sated on 18 household

Table 16: Sanitation Situation within municipality

Total Number of household	Households without toilet facility	Households with toilet facility of flush toilet	Toilet facility not stated
8,960	1,484	5,707	18

Source: CBS, 2011

5.3.7 Energy

Fire wood is major source of energy for cooking and heating. About 66% household completely depend on fire wood, 27% household have developed Gobar gas/ biogas, 6 % household used LPG gas and remaining household within municipality used other sources like cow dung, electricity and kerosene for cooking purposes. Electricity and Solar are the major sources of light in project area. Users of LPG gas are high only in urban area/settlement. *Source: CBS, 2011*

5.3.8 Landholdings

About, 2.5% households of Project Area are landless, 50.43 % has land between 0 to 5 Kattha, 26.15% has land between 5 to 10 Kattha, 12.52% has land between 10 to 20 kattha and 8.4% has above 20 kattha or 1 bigha. *Source: Municipality Profile, 2073/74*

5.3.9 Food Sufficiency

The project area is one of the major place of agricultural and food production of Nepal. As per consultation with representative and local people of municipality, optimum number of people are cultivated other land for their agriculture production. So only less than fifty percent household might be food surplus from their own production. The household, who have not reach own production, they are depending on market as well as purchase from others household. *Source: EIA Field consultation, 2075*

5.3.10 Livestock holding

People from project area are cattle, buffalo, goats, pigs and poultry. Cattle and buffalo are kept for milk, ghee and manure. Pigs and goats are kept for meat and sale. Poultry are kept for eggs and meat production and sale. About 20% of HHs have cattle (cow), buffalo (46% HHs), goats and pigs (47% HHs) and 20.68% HHs have poultry. This is major sources of income in this area. As per public consultation with municipality representative and local people a single household can earn at least 5-10 thousand/year from livestock. *Source: EIA Field consultation, 2075*

5.3.11 Health Care Institutions

The number of government health facilities, health post, existed in Madi Municipality is seven including one hospital having bed capacity 75.

5.3.12 Industry

There are 4 diesel mills, 3 electricity mills, 2 furniture industry, 3 dairy collection centre, 1 brick industry, 4 poultry farm and 2 fish farm in the project affected area. *Source: Municipality Profile, 2073/74*

5.3.13 Religious Activities

Hindu festivals and rites prevail in this region as Chhetri/Thakuri, Dalit, Magar, and *Brahmin* are the major castes, most of which are Hindus. Dashain, Tihar; Shivaratri; Tij; Janai Purnima and Fagu Purnima are the major festivals observed by different communities. Major historical area in the

project influenced area are Jiwanpuri Kalika, Bageshwori temple, Ganeshtan, Shivaghat etc. *Source: Municipality Profile, 2073/74*

5.3.14 Irrigation

There are no irrigation schemes in the project affected area.

5.3.15 Development Projects

There is postal highway projects in the project affected area.

5.4 Public Hearing and Issues Raised by Stakeholders

5.4.1 Public hearing event

A public hearing event was organised at Janjivan Secondary School Kharkata Madi, on July 28, 2018 (12 Shrawan 2075) Starday at Karobar Rastriya Daily Newspaper. The programme was started at 11:00 AM and scheduled as follows.

Table 17: Guests and Speakers in Public Hearing

Name of Person	Representative	Attended as	Opinions/Suggestions
Mr. Krishna Raj Adhikari	Chairman, Madi Mun-8	President	<ul style="list-style-type: none"> Committee to be formed in the local level for coordination in the bridge construction work and for maintaining the quality in construction. Closing the program
Mr. Thakur Prasad Dhakal	Mayor of Madi Municipality	Chief Guest	<ul style="list-style-type: none"> Considerable length of the River banks should be protected with River bank protection work upstream and downstream of the River. Prominently, Ghagar khola needs more river bank protection work towards upstream side by 500 m. Local people, during the construction of the bridge, should act as a watch dog in coordination of Municipality, in order to maintain the required quality of bridge construction. The concerned agency should give emphasis on timely submission of the EIA report for the early initiation of bridge construction work.
Mr. Khadk Bhujel	Teacher- Janjivan Secondary School, Kharkata	Program Facilitator	<ul style="list-style-type: none"> Program Facilitation and express the importance of speakers.
Mr. Hari Datt Joshi	Environmental Expert, North Star - ITECO - Homeland JV	Presenter	<ul style="list-style-type: none"> Made the presentation of Summary of EIA Study

Name of Person	Representative	Attended as	Opinions/Suggestions
Mr. Sushil Jha	Ranger of Chitwan national Park	<i>Speaker</i>	<ul style="list-style-type: none"> • It is urgent need for Public • Buffer Zone will support project
Mr. Birendra Bahadur Bhandari	Representative of Rastriya Prajantra Party	<i>Speaker</i>	<ul style="list-style-type: none"> • Project should be construct on time
Mr. Mukti Nath Neupane	Representative of Teachers	<i>Speaker</i>	<ul style="list-style-type: none"> • Exact River boundary to be identified • River Training to be done accordingly
Mr. Mathura Bahadur Bhandari	Chairman of Madhyabarti	<i>Speaker</i>	<ul style="list-style-type: none"> • Transparency to be maintained during bridge construction • Required to watch the construction work during its construction
Mr. Bal Krishna Sapkota	Chairman, Madi Mun-7	<i>Speaker</i>	<ul style="list-style-type: none"> • The contractor, nominated for the construction of bridge should be responsive to local people • People should be aware themselves as watchdog while the construction work will beginning • Good quality of construction materials (especially, Sand) to be used in the construction of bridge • The contractor should be serious in making the diversion road. He should be careful not to obstruct the public property unnecessarily. • The contractor nominated in the construction, should not show carelessness on work and public property.
Mr. Naradmuni Paudel	Representative Nepal Communist Party	<i>Speaker</i>	<ul style="list-style-type: none"> • Weakness of the organizer to convey the notice of public hearing to all stakeholder • Span of Ghagar Khola seems less in comparison of the existing river width • Emphasized on the necessity of Riverbank protection. • Animal damage agriculture product during their north-south movement. After bridge construction under bridge space will be narrow and intensity of damage will increase, so project thinks about compensation. The local bodies (Particularly, the Madi Municipality) cannot bear the responsibility of River bank protection by itself. • There should be provision for the security of construction workers against attacking of wild animals during the construction work. • The project should not use the sand of the local Rivers of Madi area • It was necessary to conduct the EIA Study before the award of contract, but it was initiated after contract award. This was some controversy.
Mr. Shivahari	Chairman, Madi	<i>Speaker</i>	<ul style="list-style-type: none"> • The project should focus on River bank

Name of Person	Representative	Attended as	Opinions/Suggestions
Paudel	Mun-9		<i>protection work</i> • <i>Project must be start and complete on time</i>

In conclusion following issues were raised and suggestions were made by the stakeholders during public hearing,

- 1) The initiation of the bridge construction as quickly as possible
- 2) The local materials to be used in the bridge construction like; boulder, sand, aggregate to be collected from prescribed place
- 3) The role of consumer's group to be assured while doing the construction work
- 4) Use of quality material to be assured in the construction and regular monitoring to be done
- 5) Permanent bank protection work to be constructed
- 6) As it is beyond the capacity of Municipality to construct the huge river protection work, the project should itself manage for this.
- 7) As existing width of Ghagar khola is more, the proposed length of bridge 127m seems less. Hence it is advised to increase the bridge span as per the existing width of khola.
- 8) The proper management and protection to be ensured by the project itself.
- 9) Being within the buffer zone of Chitwan National Park, there is frequent movement of wild animals like elephant, rhinoceros through these rivers. Hence, the proposed bridge should be constructed to ensure the easy movement beneath the bridge after its construction.
- 10) The bridge project should take care for the minimization of loss of life and property of local people and workers and should adopt necessary arrangement.
- 11) The use of children in the construction work should strictly be prohibited.

All these issues are categorized, discussed and analyzed in the report. for eg. Environmental issues and demands are two different subjects. The EIA team has analyzed all relevant issue and have been well addressed in this report. Some of them are vague in nature which cannot be fulfilled; For eg. compensation about park people conflict. The proponent and contractor cannot fulfill this demand. Hence, compensation to irrelevant issue is simply not possible.

6 Environmental Impacts Identified

The environmental issues that had been collected during the scoping document preparation were studied in detail to identify the potential impact of this bridge project. This section briefly describes the finding of the study investigation pertaining to the environmental impacts in various aspect of natural as well as artificial environment. The impact were evaluated in terms of the nature of the impacts as direct/indirect were further evaluated into magnitude of the impact (low, medium, high), extent (site specific, local and regional) and duration of the Impacts (short term, medium term and long term). Such predicted impacts assigned with respective numerical weight age as describe in National EIA guidelines, 1993 for evaluated significance value of each predicted impacts. Those impacts which are not identified and if raised during construction and operation shall be covered separately by proponent.

Note: Scoring is done based on following;

Nature of Impact: D = Direct; IN = Indirect;

Magnitude, H = High (60); M = Medium/Moderate (20); and L = Low (10)

Extent, R = Regional (60), L = Local (20); and SS = Site-Specific (10)

Duration, LT = Long-term (20), MT = Medium-term (10); and ST = Short-term (5)

The points/scoring are taken from the National EIA Guidelines, 1993

Significance of Impact

Total Score: > 75 : Very Significant

50-75 : Significant

< 50 : Insignificant

6.1 Adverse Impacts

The project activities during construction and in the operation of the bridge will create a number of adverse impacts on the local environment. These are discussed briefly in the following sections.

6.1.1 Socio-Economic & Cultural Environment

A) Construction Phase

- **Health, Sanitation and Occupational safety**

During construction period, workers will be exposed to various health risks and hazards and may encounter with injuries and accidents during excavation works, working over bridge, equipment handling, and river training etc. Other possible health impacts include respiratory and eye diseases due to exposure to dust and smoke. Similarly, unhygienic sanitary condition may provide places for

endemic diseases like diarrhea, dysentery and cholera. The increased vehicular movement may increase road accident in project area. *The envisaged impact will be direct, local and the long terms having high in magnitude hence will be very significant.*

- **Conflicts between outsider and local people**

Conflict may arise between the local people and outsider labors during the project construction regarding recruitment and procurement for work. Presence of non native people may not be welcomed by the local residents. Additionally, the construction workers may involve in gambling, alcoholism etc and eventually may get into conflict among themselves or with the surrounding people. Similarly, work force from outside may not be familiar with the local culture of the project area and the disagreement may take the form of argument ultimately creating conflict with local people. *The envisaged impact will be direct, site specific and the short terms having moderate in magnitude hence will be insignificant.*

- **Issue of Law and order**

There will be raised the various types of conflicts during construction, such as conflicts between contractor and local people, conflict between contractor and employers, conflicts within employers etc. The construction company may not work as per environmental management protocol and employers may not accept social norms at the project site.

The envisaged impact will be direct, site specific and the long terms having moderate in magnitude hence will be significant.

- **Pressure on local services and Consumption of local resources**

The construction crew will need services like water supply, electricity, telephone, provision shop, health facilities etc. which they will have to utilize from the existing facilities in the area. This may create pressure on the existing common resources; especially health service is already limited.

The envisaged impact will be indirect, site specific and the short terms having moderate in magnitude hence will be insignificant.

- **Gender Discrimination**

There has raised issue on public consultation about discrepancy in wage distribution among male and female labour forces and other opportunities. It is very likely that similar treatment is continued while reimbursing the construction workforce involving the local. *The envisaged impact will be direct, site specific and the short terms having moderate in magnitude hence will be insignificant.*

- **Child Labor Issue**

Nowadays, most of the adolescents have been away from their homeland leaving only females and children. Children have also been involved in productive work in the family. It is most likely that children will be exploited by the contractors in the construction and related works. *The envisaged impact will be indirect, local and the medium-terms having moderate in magnitude hence will be significant.*

- **Obstruction to vehicle crossing across the river**

Presently vehicles cross the river through surface water. The present crossing alignment corresponds with bridge alignment. Therefore there is possibility of obstruction of vehicle during the bridge construction along the alignment of road. Construction activities will hinder the vehicle movement way because of physical construction activities. This will create the possible psychological tension among the passengers, local people, construction employee and pedestrian. *The envisaged impact will be direct, site specific and the short terms having high in magnitude hence will be very significant.*

- **Change in social behaviour of local**

Project activities may change public thought, activities and property. Project can support to improve the livelihood of local. Local employee may not use their earning effectively. At the same time local people may be flow outsiders lifestyle. This will ultimately affect the traditional bonds, norms and functions of the family. This will also cause impact on social and cultural transition. *The envisaged impact will be indirect, local, long term, of medium magnitude, hence will be significant.*

B) Operation Phase:

- **Possible Township/Ribbon settlement and market development/ Encroachment of approach road/ Use of bridge and approach**

The establishment of settlements, shops and food stalls along the road side soon after the construction/upgrading of a road are a common feature along the approach road and this behaviour may also encroach the approach road. Increase in land value adjoining road is important driver for such undesired and uncontrolled development. The negative consequences of such activities are encroachment in the right of way, road blockage, delays in private and public transport, increase in local accidents, hindrance for maintenance works, reduction of the overall road capacity, etc. *Such impacts are indirect, low in magnitude, site specific, and long-term in nature hence will be insignificant.*

- **Bridge Safety Measures/ Operation of bridge and approach road**

There are chances of vehicular accidents on the approach curve and sharp turnings especially on both side of proposed bridge. Inadequate provision of the road safety measures like lack of signals and lack of enforcement of traffic rules during operation period may invite accidents. *The envisaged impact will be direct, local and the long terms having high in magnitude hence will be very significant.*

Table 18: Summary Matrix of impact identification, prediction and evaluation (Adverse Impact- Socio-Economic & Cultural Environment)

Project phase	Potential Adverse Impact	Type of Impact				
		Nature	Magnitude	Extent	Duration	Rating
Construction	Occupational health safety of workers	D	H (60)	L (20)	LT (20)	Very Significant (100)
	Water Supply & Sanitations for workers	D	M (20)	L (20)	LT (20)	Significant (60)
	Pressure on local services, commodities, food supply from external workforce and in-migrants	IN	M (20)	SS (10)	ST (5)	Insignificant (35)
	Possibility of exploitation of women during working condition and possibility of involvement of child labour.	IN	M (20)	SS (10)	ST (5)	Insignificant (35)
	Obstruction to vehicle crossing across the river	D	M (60)	L (20)	ST (5)	Very Significant (85)
Operation	Change in social behaviour of local	IN	M (20)	SS (10)	LT (20)	Significant (50)
	Issue of Law and order	IN	M (20)	L (20)	MT (10)	Significant (50)
	Possible Township/Ribbon settlement and market development	IN	L(10)	SS (10)	LT (20)	Insignificant (40)
	Bridge Safety Measures/ Operation of bridge and approach	IN	H (60)	L (20)	LT (20)	Very Significant (100)

6.1.2 Physical Environment

A) Construction Phase

- **Diversion of river**

River diversion is hydro-engineering processes to divert all or a portion of the flow of river water flow from its natural course. As the river is flat with less quantity of water flowing on it, we may have no more problem of diverting the river while constructing the bridge. The regular moving vehicles can pass through existing river terraces with minimum rework. The diverted river can affect to aquatic species. The diverted river may increase the river bank erosion and may also create the flood. *The envisaged impact will be direct, site specific, short term and of moderate magnitude, hence will be significant.*

- **Diversion of road**

As there is no permanent stream upstream and downstream of proposed bridge. There is no more disturbance to the physical property and land. As existing river is flat with less quantity of water there is no more problem for the construction of diversion road. *The envisaged impact will be direct, site specific, short term and of high magnitude, hence will be significant.*

- **Soil erosion/Bank Instability**

The soft unconsolidated alluvium at the banks may undergo cutting during high flow situations ultimately affecting the abutments of the bridge. *The envisaged impact will be direct, site specific, long term and of high magnitude, hence will be very significant.*

- **Quarrying/Extraction of construction materials**

More than 21940 cu.m. of materials including fill materials, approach road fillings, base material and sub-base and pavement material will be required for construction. These extraction operations may result in change in river morphology and other associated impacts. Inappropriate operation of quarry sites and over exploitation can adversely impact to adjoining area as well as the river. *The envisaged impact will be direct, short term, site specific, of high magnitude, hence will be significant.*

- **Generation, Spoilage, Leakages of construction chemicals**

Construction work will require oil and fuel, enamel/paints, lubricants, acid, bitumen and other chemical. If these materials are not stored and handled properly, it can reach in the river water and soil, which will deteriorate the ground and surface water quality seriously. *The envisaged impact will be direct, site specific, short term, of high magnitude, hence will be very significant.*

- **Generation of organic, inorganic, sanitary and solid materials**

Construction activities will produce solid wastes such as synthetic materials and some forms of inorganic wastes, whereas, domestic activities will produce mainly food wastes and excretory wastes. 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. *The envisaged impact will be direct, site specific, short term and of high magnitude, hence will be significant.*

- **Stockpiling, Spoil Disposal and Transportation of Material**

The major construction materials are cement, sand and aggregate. Stockpiling of the materials will create a major issue in the area as barren public land. Hence, some environmental implications are envisaged on air, water and land due to stockpiling and storage of the construction materials. Similarly the spoil generated is expected to be used up all. About 987.840 cu.m of spoil is expected to be generated from cutting and excavation of road and drains. All the total spoil generated, will be used in filling road. And there will still be deficit of fill material for approach road. *The envisaged impact will be direct, site specific, short term and of high magnitude, hence will be significant.*

- **Relocation of electric pole**

There are two electric poles near along approach road side. The electric pole may create the electric risk at construction place during bridge construction period. The electric pole may also create problem to vehicular movement along the approach road alignment etc. The envisaged impact will be direct, site specific, short term, of moderate magnitude, hence will be very significant.

- **Impact on Air Quality, Water Quality and Noise Level**

Air Pollution: Diesel generator, machinery equipment, excavators, dozers and transportation vehicles may introduce the fugitive & combustion emissions into atmosphere. Dust emission can be expected to be high in dry weather condition due to construction and transportation activities. Smoke & Dust will also affect the road site, vegetation, local people residing along alignment and workers. *The envisaged direct impact due to air pollution will be site specific and short terms and of moderate magnitude, hence will be insignificant.*

Water pollution: The water quality of stream is in suitable range however construction and personal activities of the labors may introduce several water pollutants into the river. Probable water pollutants are turbidity, suspended & dissolved solids, fecal contamination, oil & grease from vehicles and equipment, etc. The inappropriate use, storage, processing & application of chemicals (i.e. fuel, lubricants, oils & acids and other materials) for the construction may cause soil & ground water pollution. Fluid and solid waste resulting from the construction camp may affect the nearby land and water body. Presence of pollutants in the water may disrupt aquatic environment and dependent lives downstream. *The envisaged direct impact due to air pollution will be site specific and short terms and of moderate magnitude, hence will be insignificant.*

Noise pollution: The present noise level of the area is not offensive. During the construction period, operation of machines, excavators, power tiller, movement of transporting vehicles, trucks and construction equipment will increase the existing noise level. *The envisaged direct impact due to air pollution will be site specific and short terms and of moderate magnitude, hence will be insignificant.*

- **Approach road construction**

The bridge lies on the existing root; hence there is no need of construction of additional approach road. However, as the bridge deck level would be higher than the bank level on both sides, there is need of raising level of approach road near to the bridge abutment on both sides. The approach road will also occupy the public river barren land. There is no problem for land acquisition. The construction of approach road will change physical shape of land at approach road side. *The envisaged impact will be direct, site specific, short term and of high magnitude, hence will be significant.*

- **Land use change**

There will be minimal change in land use from river deposits land into built up area. Around 0.08 ha. land of river area will be converted into built up area. The impact is also minimal. Thus the overall change in land use of the area will be low. *The envisaged impact will be direct, site specific, short term and of high magnitude, hence will be significant.*

B) Operation Phase

- **Narrowing of river channel**

Construction activities can change the structure of river flow mechanism and the river direction of current flow. There will increase the sedimentation material along the bridge amendment and approach road. The construction activities can reduce the widen surface of river at bridge

construction activities. *The envisaged impact will be direct, site specific, long term and of moderate magnitude, hence will be significant.*

- **Erosion of river bed and Change the river course**

The soft unconsolidated alluvium at the banks may undergo cutting during high flow situations ultimately affecting the abutments of the bridge. *The envisaged impact will be direct, site specific, long term and of high magnitude, hence will be very significant.*

- **Increase in intensity of sedimentation around bridge location**

The spoil generated from the excavation may be washed out during rain resulting sediment loading of the river and impact in downstream aquatic life. Similarly, excavation of sand and aggregates from the river flood plain can generate suspended sediment load in the river. Such effects are also envisaged during the excavation of foundations. This could affect the downstream channel. *The envisaged impact will be direct, site specific, long term and of moderate magnitude, hence will be significant.*

Table 19: Summary Matrix of impact identification, prediction and evaluation (Adverse Impact-Physical Environment)

Project phase	Potential Negative Effects	Type of Impacts				
		Nature	Magnitude	Extent	Duration	Rating
Construction Phase	Diversion of river	D	H (60)	SS (10)	ST (5)	Significant (75)
	Diversion of road	D	H (60)	SS (10)	ST (5)	Significant (75)
	Soil erosion	D	H (60)	SS (10)	LT (20)	Very Significant (90)
	Quarrying/ Extraction of construction materials	D	H (60)	SS (10)	ST (5)	Significant (75)
	Generation of organic waste like sanitary waste and inorganic solid waste	D	H (60)	SS (10)	ST (5)	Significant (75)
	Disposing of spoil and solid materials	D	H (60)	SS (10)	ST (5)	Significant (75)
	Stock piling	D	H (60)	SS (10)	ST (5)	Significant (75)
	Relocation of electric pole	D	M (20)	SS (10)	ST (5)	Insignificant (35)
	Impacts on air quality due to operation of equipment and vehicles	IN	M (20)	SS (10)	ST (5)	Insignificant (35)
	Impact on ground water quality and surface water quality	IN	M (20)	SS (10)	ST (5)	Insignificant (35)
	Impact of noise from operation of equipment and vehicles	IN	M (20)	SS (10)	ST (5)	Insignificant (35)
	Spoilage of construction chemicals	D	M (20)	L (20)	ST (5)	Insignificant (45)

Operation Phase	Approach road construction	D	H (60)	SS (10)	ST (5)	Significant (75)
	Land use change	D	M(20)	SS (10)	LT (20)	Significant (50)
	Narrowing of river channel	IN	M (20)	SS (10)	LT (20)	Significant (50)
	Erosion of river bed/Change the river course	IN	H (60)	SS (10)	LT (20)	Very Significant (90)
	Increased in intensity of sedimentation around bridge location	IN	M (20)	SS (10)	LT (20)	Significant (50)

6.1.3 Biological Environment

A) Construction Phase

- **Disturbance to aquatic life**

The commonly found fish species are described under biological environment section of baseline information. Suspension of sediments in the water column is likely to occur as a result of dredging action at the sediment of water interface, transfer of the sediment to a transporting vessel, leakage from the vessel, and disposal of the sediment. Suspension of the sediments causes increased turbidity which may adversely affect the aquatic life by clogging gills, decreasing visibility, and preventing oxygen diffusion. Excavation and river diversion works might affect the aquatic habitat of this river system at project site. Furthermore, accidental spillage and discharge of harmful chemicals could deteriorate the aquatic environment. Disposal of labor generated solid wastes and defecation around the vicinity of the river might as well pollute the river and affect the aquatic life.

The envisaged impact will be direct, site specific, long term and of moderate magnitude, hence will be significant.

- **Disturbance to wildlife migratory route**

Project site is not wildlife habitat, but sometime might be used as migratory route by Elephant. Movement of mega animal like elephant might be obstructed at bridge. *The envisaged impact will be direct, local, long term and of moderate magnitude, hence will be significant.*

- **Effect to ground vegetation such as invasive and weed species and bushy areas**

The project is going to construct at barren land of river flood plain. There was not observed any forest and agro-plant species at the project site. But there was found some sparse vegetation of few weeds and invasive plants species at bank of river channel. The observed invasive and weedy plants were like *Michania micrantha*, *Lantana camera*, *Parthenium histerophorus*, *Eupatorium adinophorum*, *Ageratum conizoids* and *Calotropis gigantean*. Construction of project activities can be disturbed this vegetation. *This impact will be direct, site-specific in nature, short term, having medium magnitude, hence will be insignificant*

- **Disturbance on threatened plants, animals, birds and fishes**

Though this project does not lie within core habitat area. No any threatened plant were observed within the project circumference. There is found some bird species near to project site, though bridge project will not suffer to threatened birds species. However there will be short term negative

effect on fish species at river system. *This impact will be direct, site-specific in nature, short term, having medium magnitude, hence will be insignificant*

B) Operational Phase

• Under bridge wildlife movement

The project site does not lie on core wildlife habitat area. Sometimes there seems movement of elephants. Though, under bridge wildlife movement will be major impact after construction of bridge. Habitual movement elephant will not stop within this corridor and physical structure can be obstruction factors for continuous movement of elephant. *The envisaged impact will be direct, local, long term and of moderate magnitude, hence will be significant.*

Table 20: Summary Matrix of impact identification, prediction and evaluation (Adverse Impact-Biological Environment)

Activity	Potential Negative Effects	Type of Impacts				
		Nature	Magnitude	Extent	Duration	Rating
Construction Phase	Disturbance to aquatic life	D	M(20)	SS (10)	LT(20)	Significant (50)
	Disturbance to wildlife migratory route	D	M(20)	L (20)	LT(20)	Significant (60)
	Effect to ground vegetation such as invasive and weed species and bushy areas	D	M (20)	SS (10)	ST (10)	Insignificant (40)
	Disturbance on threatened plants, animals, birds and fishes	IN	M (20)	SS (10)	ST (10)	Insignificant (40)
Operation Phase	Under bridge wildlife movement	IN	M (20)	L (20)	LT (20)	Significant (60)

7 ALTERNATIVE OF THE PROPOSAL

Alternative analysis involves an examination of alternative ways of achieving objectives of the proposed project. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the adverse impacts. EPR, 1997 provides essential aspects to be considered, as per the nature of the project. The alternative analysis of Tunamuna Khola Bridge Project has been done in the following aspects.

- Design
- Project site
- Alternative design and construction approach
- Alternative schedule and process
- Alternative resource

7.1 Design

There are different preferred types of bridge viz: Pre-stressed Concrete or Suspension, Cable Stayed, Arch or Steel Truss. After the detail study of geological setting of the area, economy, and suitable engineering design Pre-Cast RCC T-Girder was found most suitable. This option was selected to avoid the impact of the river bed constriction and implication of foundation excavation on the water quality and aquatic ecology of the river. The construction approach selected is a labor based approach with minimum utilization of the machine power. This approach is considered beneficial as it provides maximum job opportunity to the local area people.

7.2 Project Site

To minimize the cost, as well as environmental resources (physical as well as socio-economic), locating a bridge in the geologically sound and hydrologically safe area within the road alignment layout of the area is essential. The present location of the bridge as it lies within the existing road network and has geologically sound and hydrological safe properties has been identified as the best site from environmental and socio-economic perspective.

7.3 Process, time schedule

There can be basically two types of construction methods generally adopted in Nepal. These are conventional and labor based approach. Conventional methods needs heavy machineries and equipment, concrete structures, bituminous surfacing, lined side drains, culverts, RCC retaining and breast wall are extensively involved. This method needs high level of skill capabilities. On the other hand, labor based approach is manual, environmental friendly, low cost, participatory, technically

appropriate for fragile and vulnerable geology. The construction approach selected is both conventional and labor based approach with minimum utilization of the machine power. The water diversion work after the construction completion needs use of heavy machines line dozer, vaccue. To construct foundation, machine will be used. This approach is considered to make economical. A construction schedule of 24 months have been proposed taking into consideration of the climatic and hydrological condition of the area. The schedule emphasizes that the active construction of foundation of the bridge is accomplished in the dry periods including collection of sand and aggregates from the river bed during this period only to minimize the impact on the water quality and aquatic ecology.

7.4 Raw Materials to be used

As cement and steel/rod has no alternative resource base within the area, these materials will be sourced from the Nepalese and Indian market to meet the requirements. For aggregates two options were evaluated. The first option opening up a quarry for aggregate was rejected as the option might infringe upon the local land stability and erosion issue apart from the land acquisition issue. The second option of sourcing the required aggregate from the river bed is prioritized as the option does not infringe on the local environmental conditions adversely compared to the first option. Among the construction modality options, maximization of labor based option was preferred as it provides job opportunity to the local area people.

7.5 Others (No Action)

Due to lack of road access, local people of Jiwanpur, Ward no.8 & Karkata, Ward no.8 of Madi, are depriving of many facilities and their daily life are very back and cut off from the transportation facilities even for educational, health services. No action or no project option is maintaining the existing socio-economic situation in the Chitwan district. Such an option is against the government's planning policy. The Tunamuna Khola Bridge is proposed to be constructed across Tunamuna Khola along the Madi-Thori Postal Highway. Therefore no action option is rejected.

8 ENVIRONMENTAL AUGMENTATION/ MITIGATION MEASURES

For the impacts, practical mitigation measures (or actions) have been proposed to mitigate the possible environmental and social impacts that may result due to project implementation (construction and operation). The proponent of the project has prime responsibility in carrying out the indicated mitigation measures. Four categories of environmental and social mitigation measures are generally identified:

- Preventive or Impact avoidance measures are usually implemented at the project planning and design stage, in order to eliminate or minimize from the onset all anticipated adverse impacts.
- Corrective or Reductive measures are those used to eliminate a source of impact or reduce its intensity to an optimal or acceptable extent.
- Compensatory measures seek to compensate for impacts that cannot be mitigated and for residual impacts of the project after implementation of mitigation measures.
- Enhancement or Benefit Augmentation measures are used to improve existing environmental or social conditions, which are not directly affected by the project. Such measures may be implemented outside the study area. To be efficient, these measures must be defined in cooperation with all stakeholders.

8.1 Beneficial Impacts Augmentation Measures

The development efforts particularly the development of transportation network will have multifold beneficial impacts. Bridge projects are generally intended to improve the economic and social welfare of the people. The largest beneficial impacts will be on the socioeconomic environment as given below with their appropriate benefit augmentation measures.

A) Construction Phase

The following beneficial impacts augmentation measures are recommended during the construction stage of the bridge.

- **Employment Opportunities to locals and Increase of Income**

The project will give priority to the socially deprived and excluded, disadvantaged and marginalized people as far as possible as per experience and skill. Promotion of the skill to local manpower through various training programmes which might generate multiplier effect in economy.

- **Enhancement of Technical Skills**

Workers will acquire the additional knowledge through material handling, during occupational safety trainings. Enhancement of technical skills will be an important livelihood enhancement measure for landless and other vulnerable groups whose dependency in agriculture is nominal. As this is the side-effect of above enhancement measure, no additional amount has been allocated.

- **Possible Market Development**

As the municipality will control and promote the development of market in coordination with various other government and non-government organizations, so, proponent itself don't require augmenting this benefit.

- **Enhancement of Community Development Service of project affected area**

No augmentation measure has been suggested for this benefit. Municipality will manage planned growth with required infrastructure facilities.

B) Operation Phase

The following beneficial impacts augmentation measures are recommended during operation stage of the bridge.

- **Promotion of Possible Business, Market Development**

Municipality will manage planned growth with required infrastructure facilities.

- **Tourism Development Opportunity**

Proponent itself donot requir to augment this benefit as various government and non-government organization will promot the tourism of the proposed. Municipality will manage planned growth with required infrastructure facilities.

- **Increase in economic activity**

No augmentation measure has been suggested for this benefit. Municipality will manage planned growth with required infrastructure facilities.

- **Appreciation of land values**

Promotion of land development and land use planning along the road corridor and other local areas are necessary to avoid encroachment.

- **Reduced Traffic Disruption during Rainy Season**

Local government, stakeholder, public aware sustainability of proposed bridge. No augmentation cost have allocated for its management.

- **Improved Transportation Accessibility**

The proponent and local government will make necessary arrangement of regular inspection and maintenance. No mitigation cost allocated for its management on EIA.

Assessment of Identified/Predicted Beneficial Environmental Impacts and Recommended Benefit Augmentation Measures

Table 21: Matrix showing Impacts, Enhancement Measures, Enhancement Costs and Responsible Agencies (Beneficial Impacts)

Activities	Potential Beneficial Impact	Benefit Augmentation Measures	Mitigation cost	Responsible Agencies	
				Executing Agency	Supporting Agency
Construction	Employment Opportunities to locals and Increase of Income:	Job preference will be given to local community, disadvantaged and marginalized groups. Employee can saved their earn money and utilized their earned wages for micro and small scaled enterprises, benefit will be durable.	No additional cost is required	Contractor	Proponent
	Enhancement of Technical Skills	Workers will gain technical knowledge during preparation of construction material and its handlings. The labor can use their earned skills to other project. This will be supportive in long term employment generation.	No additional cost is required	Proponent	Proponent
	Enhancement of Community Development Service of project affected area	Project will facilitate to community development service through public hearings and social audits.	No additional cost is required	Contractor & Proponent	Proponent
	Possible Market Development	Priority to local products, local market and local contractors. Local will get opportunities of selling their agro product to project worker on good price. In order to meet the daily demands of the contractors and construction workforce, there will be possibilities of opening of new tea stalls, restaurants, and consumer good shops at the Village. The local community will be benefitted from this new commercial and economic activity.	No additional cost is required	Proponent /Rural Municipality	Proponent /Rural Municipality
Operation	Promotion of Possible Business, Market Development	Municipality and local government will manage planned growth with required infrastructure facilities for the healthy and hygienic environment in the market place.	No additional cost is required	Proponent	Proponent
	Appreciation of land values	Promotion of land development and land use planning along the road corridor and other local areas	No additional cost is required	Proponent	Proponent
	Improved transportation accessibility	The proponent and local government will make necessary arrangement of regular inspection and maintenance. No mitigation cost allocated for its management on EIA.	No additional cost is required	Proponent	Proponent
	Tourism Promotion	The flow of tourist will be increased in all season after construction of project. Municipality and local government will develop tourist attraction plan in their annual plan. Conduct training related to tourism	No additional cost is required	Local Government/Municipality	Local Government/Municipality

		promotion to local people Develop the physical infrastructures such as hotels, recreational and entertaining places etc			
	Reduced Traffic Disruption during Rainy Season	Local government, stakeholder, public aware sustainability of proposed bridge. No mitigation cost allocated for its management.	No additional cost is required	Local Government/Municipality	Local Government/Municipality

8.2 Adverse Impacts Mitigation Measures

8.2.1 Socio-Economic & Cultural Environment

A) Construction Phase

• Health, Sanitation and Occupational safety

Contractor will be responsible for occupational health and safety measures. First Aid kit box must be provided to workers during construction. The provision of providing sign and signal on sensitive and unsafe areas is must so that it could be visible from distance apart. Basic safety tools like helmet, boots, gloves, masks and safety belts should be provided to workers. Facility of drinking water and establishment of temporary pit latrine will be provided to control water pollution and to avoid open defecation. Some other safety guidelines for working on bridges are.

- No-one may gain access to the site unless they are authorized by the Engineer or the contractor. Wherever possible the working area should be isolated from the public.
- All persons engaged in bridge work of any kind must be trained or under training in the precaution to be followed, apart from the detailed training for their particular job.
- No person may work unaccompanied unless they are in a safe area. All personnel must leave the work area to take refreshments, meals.
- During site works, all working areas shall be clearly marked off and personnel informed of the dangers.
- All access equipment, ropes and tackle must be regularly inspected and adequately maintained in a sound condition.
- Where persons could fall over edge of a bridge or embankment, temporary guard rails or ropes should be installed.
- Care must be taken to prevent tool and loose objects falling from the bridge.
- Any scaffolding that is used must be composed of good quality materials. Bamboo should be freshly cut, of strong and flexible nature. Scaffolding must be correctly erected by competent persons and of appropriate capacity.
- Appropriate protective clothing must be used, including, where necessary, shoes with slip resistant soles.

Budget of NRs. 260,000 is allocated for the provision of First Aid Kit, Safety Equipment and sign and signal boards and Orientation to Labours about OSH.

Table 22: Cost Estimation for OSH

S. No.	Activities	Unit	Number	Rate (Rs.)	Amount (Rs.)
1	First Aid Kit, Safety Equipment and sign and signal boards	nos	LS	200,000	200,000
2	Orientation to Labors about OSH	nos	2	30,000	60,000
	Total				260,000

- **Conflicts between outsider and local people**

Construction workers from outside the project area must be well-informed about the general norms and values of society. The construction workforce will be instructed to respect local people, especially the female members and observe/follow the local culture and tradition. Workforce will be discouraged to involve in activities like gambling and alcoholism. Local people will be informed about project activities, requirements and time schedules. Local people will be given maximum priority in employment.

- **Issue of Law and order**

The contractor must develop the protocol as per environmental management guideline. The contractor must comply all environmental management law and order of Nepal government and international conventions. At the same time, contractor must be trained and raised aware to employee about legal binding and legal opportunities to worker. Contractor must be aware about issues about child labour, gender equity. This training can be fruitful for complying the international labor law and national policies

- **Pressure on local services and Consumption of local resources**

Labour camps for construction workers and their daily needed items including services will be arranged by the Contractor. Furthermore, labour camps will be established after receiving approval from the local government. The contractor will manage some utilities like communication, lighting and cooking energy, drinking water supply, etc. within the camp so as to avoid the pressure on local services. Local people will be consulted to build consensus on sharing the community infrastructures such that it will not significantly affect the local people. The contractor will be responsible for reconstruction and rehabilitation of damages infrastructure and physical property due to their activities.

- **Gender Discrimination**

Project will establish agreement with contractors to consider male and female equally for wage distribution for works of similar nature. Male workers will be instructed to respect their female counterparts. There will not be differentiation between local and outsiders.

- **Child Labor Issue**

Child labor will be prohibited totally. Project proponent will establish agreement with contractors to prohibit child labor and the program will monitor the compliance regularly.

- **Obstruction to vehicle crossing across the river**

The approach road must be built up as per bridge standard. At the same time river diversion and road diversion also built up with sufficient consideration. Driver must be well known about situation of

road and bridge. The width of a crossing is limited to that necessary to facilitate the safe access and egress of the driveway. The vehicle access crossing should generally be sited to the side of the frontage, not in the centre. The parking space should not obstruct the main pedestrian access to the property.

- **Change in social behaviour of local**

The mitigation measures recommended will be facilitating awareness raising programs to local community about negative social behaviour like gambling, excess use of alcohol. Contractor must select maximum local person as employee and outsider must be aware to limit the interaction to local community.

B) Operation Phase

Possible Township/Ribbon settlement and market development/ Encroachment of approach road/ Use of bridge and approach

Mitigating the negative impact of the new settlement is to discourage haphazard development of new settlements. Awareness related to the consequences of unplanned settlement is a must. Similarly, enforcement of law, planning of land development for planned settlement should be done. Efforts must be given by concerned agencies for infrastructure facilities like drainage, sewerage etc.

Bridge Safety Measures/ Operation of bridge and approach road

The mitigation measures adopted will be:

- Installation of reflectorized Bridge Sign Board and delineator along the road and bridge;
- Appropriate design of bridge taking into account for the bridge safety measures;
- Speed limit signs shall be used in appropriate areas to reduce accidents and
- Application of appropriate road safety measures with the help of 3-E i.e. Engineering, Enforcement and Education.
- The bridge and the approach road will be repaired and maintained regularly.
- The proponent will allocate budget for the regular inspection and the maintenance of bridge.

NRs. 32,000.00 is allocated for Providing & Installation of reflectorized Bridge Sign Board.

Table 23: Cost for the Bridge Safety

S. No.	Activities	Unit	Number	Rate (Rs.)	Amount (Rs.)
1	Providing & Installation of reflectorized Bridge Sign Board of size 1.5mX0.75m with steel stands including all reinforcement works & formwork complete.(SS-1500)	no.	2.00	20,000.00	32,000.00

Table 24: Matrix showing Impacts, Mitigation Measures, Mitigation Costs and Responsible Agencies (Adverse Impacts - Socio-Economic & Cultural Environment)

Activity	Potential Adverse Impacts	Mitigation Measures	Mitigation cost	Responsible Agencies	
				Executing Agency	Supporting Agency
Construction Phase	Occupational health safety of workers	<ul style="list-style-type: none"> • Safety arrangements like provision of First Aid Kit Box and standby medicine for workforce during working period and emergency. • Provision of helmet, boots, globe, mask and safety belts etc. Public must be isolated from construction sites. • Worker must be trained for their particular job. • During site works, all working areas shall be clearly marked off and personnel informed of the dangers. • Appropriate protective clothing must be used, including, where necessary, shoes with slip resistant soles. 	NRs. 260,000	Contractor	Proponent /Consultant
	Water Supply & Sanitations for workers	<ul style="list-style-type: none"> • Open defecation must be prohibited around project site. • Establishment of temporary pit latrine will be provided to control water pollution and to avoid open defecation. • Contractor must be supplied daily safe drinking water. Awareness to worker about the sanitation must be done • All personnel must leave the work area to take refreshments, meals. 	No additional cost is required	Contractor	Proponent / Consultant/ Local government
	Conflicts between outsider and local people	<ul style="list-style-type: none"> • Local people will be given maximum priority in employment. • Outsider must be well-informed about the general norms and values of society. • Outsider must be respect local culture and tradition. • Workforces will be discouraged to involve in activities like gambling and alcoholism. 	No additional cost is required	Contractor	Proponent / Consultant/ Local government
	Pressure on local services, commodities, food supply from external workforce and in-migrants	<ul style="list-style-type: none"> • Labour camps for construction workers and their daily needed items including services will be arranged by the Contractor. • The contractor will manage some utilities like communication, lighting and cooking energy, drinking water supply, etc. within the camp. • The contractor will be responsible for reconstruction and rehabilitation of damages due to their activities. 	The required cost has included within project and no other additional cost has allocated	Contractor	Proponent / Consultant/ Local government

	Possibility of exploitation of women during working condition and possibility of involvement of child labour.	<ul style="list-style-type: none"> Enforcement labor policy. Prohibition of use of child labor in the force. Must implement the gender equity protocol 	No additional cost is required	Contractor	Proponent /Consultant
	Obstruction to vehicle crossing across the river	<ul style="list-style-type: none"> The approach road must be built up as per bridge standard. Driver must be known about situation of road and bridge. The vehicle access crossing should generally be sited to the side of the frontage, not in the centre. The parking space should not obstruct the main pedestrian access to the property. 	Cost included in project document	Contractor	Proponent / Consultant/ Local government
	Change in social behaviour of local	<ul style="list-style-type: none"> The mitigation measures recommended will be facilitating awareness raising programs to the communities about negative social behaviour like gambling, excess use of alcohol. Contractor must be select local person as employee and outside must be aware to limit the interaction to local communities. 	No additional cost is required	Contractor	Proponent / Consultant/ Local government
	Issue of Law and order	<ul style="list-style-type: none"> The contractor must develop the protocol as per environmental management guideline. The contractor must comply all environmental management law and order of Nepal government and international conventions. 	No additional cost is required	Contractor	Proponent / Consultant/ Local government
	Possible Township/Ri bbon settlement and market development/ Operation of bridge and approach	<ul style="list-style-type: none"> Discourage haphazard development of new settlements. Awareness related to the consequences of unplanned settlement is a must. Efforts must be given by concerned agencies for infrastructure facilities like drainage, sewerage etc. 	No additional cost is required	Contractor	Proponent / Consultant/ Local government
Operation Phase	Bridge Safety Measures	<ul style="list-style-type: none"> Installation of reflectorized Bridge Sign Board and delineator along the road and bridge. Application of appropriate road safety measures with the help of 3-E i.e. Engineering, Enforcement and Education. The bridge and the approach road will be repaired and maintained regularly. The proponent will allocate budget 	NRs. 32,000	Contractor	Proponent / Consultant/ Local government

		for the regular inspection and the maintenance of bridge.			
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8.2.2 Physical Environment

A) Construction Phase

- **Diversion of river**

Contractor will built and maintain the river diversion as recommended on the detail bridge design report. The Contractor is advised to construct the bridge off season storm events. Diverted part of water flow can erode bedding of river so that contactor must compact soil and cover by crown vegetation. Bridge construction should be completed on proposed schedule. After construction of bridge the diversion access will be dismantled and reclaimed.

- **Diversion of road**

Contractor will built and maintain the river diversion as recommended on the detail bridge design report. A diversion road must be constructed with hume pipe in the water course. Pedestrians, cyclists will use corner of diverted road for minimizing the traffic congestion. At the same time contractor will try to provide to Pedestrians, cyclists with appropriate safe and attractive routes. After construction of bridge the diversion access will be dismantled and reclaimed.

- **Soil erosion/River bank soil instability**

The bank will be stabilized by appropriate engineering and bioengineering structure. River training works such as bio-engineering with hardwood retaining structure, gabion basket, and plantation of local species at upstream and downstream of the project on both banks extending up to 500 m on both sides and banks of the bridge will protect the soil erosion of river bank. The necessary river training works will be identified. Bridge User Committee will be formed to enforce the protective provisions and Local government and proponent will monitor on such activities In Lump Sum about NRs 480, 0000 has been recommended for river bank protection.

- **Quarrying/Extraction of construction materials**

Quarry operation and collection of aggregates will be carried out from the suitable area as recommended in the IEE approved by DCC. Road and bridge sides, cattle grazing area will be avoided for quarry site. The erosion prone areas and nearby sites of community structures will be avoided for quarry operation. The quarry sites will be rehabilitated after extraction is completed.

- **Generation, Spoilage, Leakages of construction chemicals**

The chemicals used during construction will be handled properly. Similarly, proper barricades will be established to isolate the construction material. Chemicals, oils and fuels will be stored in the impervious floor/ secure weather -proof buildings in such a way that no leakage or spillage will occur to drainage system. The hazardous chemicals will not be stored within 100 meters periphery of permanent water course or spring. Instruction will be done to the construction workforce not to dispose the bitumen contaminated aggregate haphazardly and store the unused bitumen contaminated materials in a safe site for later disposal as to the instruction of engineer. Prohibit bitumen heating from tradition methods in an open environment and limit bitumen spreading as per only requirement. Project will manage impact mitigation cost of spoil, and leakage of construction chemicals.

- **Generation of organic, inorganic, sanitary and solid materials**

The solid waste generated from the construction/labor camp will be segregated at source and degradable waste will be used for composting. All the camp wastes and construction wastes will be placed in the designated waste collection pits away from the water path. The separate storage areas will be established for all punctured containers (drums, carboys, flasks etc) and will be processed for selling to scavengers. Similarly, the offsite activities of the workforce that are potential to cause pollution of surface and subsurface waters will be prohibited. Project will manage impact mitigation cost of organic, inorganic and sanitary management such as separation bins and compost pits, from project cost.

- **Stockpiling, Spoil Disposal and Transportation of Material**

Limited quantity of material will be used for construction, and all the spoil will be used up for filling up the approach road. Proper drainage will be arranged around the stockpile area. Only required aggregates will be collected from approved quarry site sustainably whenever required. Floodways, natural drainage paths, water bodies, farmlands will be avoided. Stockpiling of the construction aggregates will be done above the high flood level of the river. Stockpiling of the cement and other materials in shaded structures within the construction camp will be made. Spoil generated from excavation of the abutment and foundations will be used for land filling or reclamation for approach road construction and river training works.

- **Relocation of electric pole**

Electric pole must be relocated taking permission from local government electric office and community people. The proper management of electric pole must do and awareness about electric pole will be done by contractor. About NRs 5000 has been allocated for the relocation and compensation, if any pole has been damaged.

- **Impact on Air Quality, Water Quality and Noise Level**

Air Pollution:

To mitigate the air pollution and its effect the following measures will be carried out:

- Construction equipment and vehicles will be regularly examined and maintained in proper condition.
- Water will be sprinkled along access road at least two times a day to reduce the dust emission.
- Proper protection works like fencing by GCI sheets or walls will be done at excavation and disposal site.
- Construction materials will be properly covered during conveyance.
- Speed limit will be enforced for service vehicles.
- Workers will be encouraged to use masks.

All the required impact mitigation cost for air pollution reduction due to project activities, will bear project from project cost.

Water pollution: The proponent will adopt the following mitigation measures in order to minimize the impact on the surface and ground water quality;

- Disposal of the soil, sludge and the other wastes directly into the water body will be avoided;
- Prevention of the soil slippage at the toe of stockpile areas by installing barriers at the perimeter;
- Prohibition of the open urination and defecation by workers. Pit toilets will be provided at the work sites;
- Restriction of the vehicle washing in the river; and
- Safe storage and the wise use of the chemicals.

All the required impact mitigation cost for water pollution reduction due to project activities, will bear project from project cost.

Noise pollution: Concrete mixer, vibrator, etc. will be maintained in proper condition by applying grease and lubricants.

- Sound producing equipment will be preferred to use only in day time.
- Earplug will be provided to the worker involved in equipment operations.
- Crusher plant will be kept at area away from settlement.

All the required impact mitigation cost for noise pollution reduction due to project activities, will bear project from project cost.

- **Approach road construction**

Contactor is responsible for construction of approach road. The contactor must be build approach roach as recommended on the detail report about bridge design and construction of the bridge deck, abutment, and foundation, as well as by the roadway pavement system, embankment, and embankment foundation. The contactor will can use the dry waste material for filling up approach road. At the sometime, contactor will compact soil and planted crown vegetation on this side of approach road. The proponent, road department, community people and local government will maintain it regularly.

- **Land use change**

Appropriate site will be selected from bridge construction spoils disposal and precaution will be taken for other land will not be changed. Applying additional protective measures that the remaining land will not be lost due to erosion will be given more emphasis. The sites will also be stabilized with bio-engineering technologies

B) Operation Phase

- **Narrowing of river channel**

Contactor can use the flooded waste particles and stone with sedimentation, hence sedimentation must be revoked from bridge span.

- **Erosion of river bed and Change the river course**

The bank will be stabilized by appropriate engineering structure. Project infrastructure will be protected by river training works upstream and downstream of the project and on both banks extending up to 500 m on both sides and banks of the bridge. The necessary river training works has been already recommended as river bank protect during construction and project will regularly maintained will be done by Department of Road. Bridge User Committee will be formed to enforce the protective provisions and DCC will monitor on such activities.

- **Increased in intensity of sedimentation around bridge location**

Foundation works will be avoided in rainy season. Blockage of river flow will be cleared immediately. Foundation work in river will be done by constructing the bund around the work so that mud slurry will be accumulated. Adopting the method of pumping mud slurry to avoid sediment load discharge in the river while working on abutment and piers seems to be important.

Table 25: Matrix showing Impacts, Mitigation Measures, Mitigation Costs and Responsible Agencies (Adverse Impacts - Physical Environment)

Activity	Potential Negative Effects	Mitigation Measure	Mitigation cost	Responsible Agencies	
				Executing Agency	Supporting Agency
Construction Phase	Diversion of river	<ul style="list-style-type: none"> • Water diversion will be implemented by the Contractor to maintain the work site as water-free. • The Contractor is advised to construct the bridge off season storm events. • Diverted part of water flow can erode bedding of river so that contractor must compact soil and cover by crown vegetation. • Bridge construction should be completed on proposed schedule. • After construction of bridge the diversion access will be dismantled and reclaimed 	Cost included in project document	Contractor	Proponent /Consultant
	Diversion of road	<ul style="list-style-type: none"> • To adopt appropriate diversions, including use of normal bus diversion routes, and minimizes the impact on businesses and resident. • Contractor will built and maintain the river diversion as recommended on the detail bridge design report. • A diversion accesses will be constructed with hume pipe in the water course. After construction of bridge the diversion access will be dismantled and reclaimed. • Pedestrians, cyclists will use corner of diverted road for minimizing the traffic congestion. 	Cost included in project document	Contractor	Proponent /Consultant
	Approach	<ul style="list-style-type: none"> • The contractor must be build approach 	Cost	Contractor	Proponent

road construction	<p>roach as recommended on the detail report about bridge design.</p> <ul style="list-style-type: none"> The contractor will use the dry waste material for filling up approach road. The proponent, road department, community people and local government will maintain it regularly. 	included in project document		/Consultant
Soil erosion/River bank soil instability	<ul style="list-style-type: none"> Bio-engineering such as hardwood retaining structure, gabion basket, and local species plantation like bio-physical structure will be developed at upstream and downstream of the project on both banks extending up to 500 m. The necessary river training works will be identified. Bridge User Committee will be formed to protect plantation and structure 	NRs 48,00,000	Contractor	Proponent /Consultant
Quarrying/ Extraction of construction materials	<ul style="list-style-type: none"> Quarry operation and collection of aggregates will be carried out from approved site of DCC. Road and bridge sides, cattle grazing area will be avoided for quarry site. The erosion prone areas and nearby sites of community structures will be avoided for quarry operation. The quarry sites will be rehabilitated after extraction is completed. 	No Cost required	Contractor	Proponent /Consultant
Stockpiling, Spoil Disposal and Transportation of Material	<ul style="list-style-type: none"> Limited quantity of material will be used for construction, and all the spoil will be used up for filling up the approach road. Proper drainage will be arranged around the stockpile area. Only required aggregates will be collected from approved quarry site sustainably whenever required. Floodways, natural drainage paths, water bodies, farmlands will be avoided. Stockpiling of the construction aggregates will be done above the high flood level of the river. Stockpiling of the cement and other materials in shaded structures within the construction camp will be made. 	No cost required	Contractor	Proponent /Consultant
Generation, Spoilage, Leakages of construction chemicals	<ul style="list-style-type: none"> The chemicals used during construction will be handled properly. Similarly, proper barricades will be established to isolate the construction material. Chemicals, oils and fuels will be stored in the impervious floor/ secure weather-proof buildings in such a way that no leakage or spillage will occur to drainage system. The hazardous chemicals will not be stored within 100 meters periphery of permanent water course or spring. Prohibit bitumen heating from traditional methods in an open environment and 	Impact mitigation cost will bear project from project cost, so no additional separate cost has recommended	Contractor	Proponent /Consultant

		limit bitumen spreading as per only requirement.			
	Generation of organic, inorganic, sanitary and solid materials	<ul style="list-style-type: none"> The solid waste generated from the construction/labor camp will be segregated at source and degradable waste will be used for composting. All the camp wastes and construction wastes will be placed in the designated waste collection pits away from the water path. The separate storage areas will be established for all punctured containers (drums, carboys, flasks etc) and will be processed for selling to scavengers. Bins and compost pits has been placed for separation of various wastes. 	Impact mitigation cost will bear project from project cost, so no additional separate cost has recommended	Contractor	Proponent /Consultant
	Relocation of electric pole	<ul style="list-style-type: none"> Permission for relocation of electrical pole from local government electric office and community people will be taken. Contactor will responsible for proper management of electric pole and contactor will replace new if damaged during its relocation. 	NR 5000	Contractor	Proponent /Consultant
	Air pollution	<ul style="list-style-type: none"> Construction equipment and vehicles will be regularly examined and maintained in proper condition. Proper protection works like fencing by GCI sheets or walls will be done at excavation and disposal site. Construction materials will be properly covered during conveyance. Speed limit will be enforced for service vehicles. Workers will be encouraged to use masks. 	Impact mitigation cost will bear project from project cost, so no additional separate cost has recommended	Contractor	Proponent /Consultant
	Water pollution quality	<ul style="list-style-type: none"> Disposal of the soil, sludge and the other wastes directly into the water body will be avoided; Prevention of the soil slippage at the toe of stockpile areas by installing barriers at the perimeter; Prohibition of the open urination and defecation by workers. Pit toilets will be provided at the work sites; Restriction of the vehicle washing in the river; and Safe storage and the wise use of the chemicals. 	Impact mitigation cost will bear project from project cost, so no additional separate cost has recommended	Contractor	Proponent /Consultant
	Noise pollution	<ul style="list-style-type: none"> Concrete mixer, vibrator, etc. will be maintained in proper condition by applying grease and lubricants. Sound producing equipment will be preferred to use only in day time. Earplug will be provided to the worker involved in equipment operations. Crusher plant will be kept at area away from settlement. 	Impact mitigation cost will bear project from project cost, so no additional	Contractor	Proponent /Consultant

			separate cost has recommended		
	Land use change	<ul style="list-style-type: none"> • Appropriate site will be selected from bridge construction spoils disposal and precaution will be taken for other land will not be changed. • Applying additional protective measures that the remaining land will not be lost due to erosion will be given more emphasis. • The sites will also be stabilized with bio-engineering technologies 	No Cost	Contractor	Proponent /Consultant
Operation Phase	Narrowing of river channel	<ul style="list-style-type: none"> • Contactor can use the flooded sediment waste particles and stone with, hence sedimentation must be revoked from bridge span. 	No cost	Proponent	Local government
	Erosion of river bed/Change the river course	<ul style="list-style-type: none"> • The bank will be stabilized by appropriate bio-engineering structure. Project infrastructure will be protected by river training works at upstream and downstream of the project and which is extending up to 50 m on both sides and banks of the bridge. 	Cost included in project document	Proponent	Local government
	Increased in intensity of sedimentation around bridge location	<ul style="list-style-type: none"> • Foundation works will be avoided in rainy season. • Blockage of river flow will be cleared immediately. • Foundation work in river will be done by constructing the bund around the work so that mud slurry will be accumulated. • Pumping mud slurry will carry out to avoid sediment load discharge in the river while working on abutment and piers seems to be important. 	No cost	Proponent	Local government

8.2.3 Biological Environment

A) Construction Phase

• Disturbance to aquatic life

The mitigation measures will be:

- Restriction of haphazard disposal of garbage and open defecation within the river course.
- Proper handling of chemicals and other petroleum products.
- The river channel will be disturbed only in required extent
- Spoil will be safely managed soon after generated
- Chemical used in construction will be properly handled
- Illegal fishing activities by the construction crews will be regulated.

About NRs 350000 mitigation cost has been proposed for minimizing the disturbance of aquatic life.

- **Disturbance to wildlife migratory route**

Restriction of bridge construction activities during the night time. The construction activity will be managed so as to minimize disturbance to wildlife; speed limit will be enforced for transporting vehicles. The impact can be minimized by employing the local labors. Hunting and poaching by the construction crew will be strictly prohibited. Restriction will be put on the use of wildlife meat in the construction camps. A hoarding board will be placed at bridge site and locals alike on importance of wildlife and conservation. Project will support local organization to organize awareness program and training activities to manpower of project and local people about importance of wildlife for communities and environment. These activities will support to protect biodiversity of Chitwan National Park and Buffer zone. About NRs 300000 mitigation cost has been proposed for minimizing the disturbance of migratory route.

- **Effect to ground vegetation such as invasive and weed species and bushy areas**

The mitigation measures will be:

Bio-engineering works will be done in the surrounding area of bridge site at both banks of the river. The maximum cost has been included on project document though some awareness and prevention related cost will be need so NRs 200000 mitigation cost has been proposed for minimizing the effect to ground vegetation such as invasive and weed species and bushy areas

- **Disturbance on threatened plants, animals, birds and fishes**

The mitigation measures will be:

Construction activities will be carried out at day time. Construction chemicals will be restricting to contact to water bodies. Construction materials will not be exposed to river system. Awareness programmes will be organized to educate local people on the conservation of threatened biodiversity. Encourage and support local communities and authorities by responsible agencies in controlling illegal activity. About NRs 500000 mitigation cost has been proposed for minimizing the disturbance of threatened plants, animals, birds and fishes

B) Operation Phase

- **Under bridge wildlife movement**

Tallest wildlife (Elephant) in Asian context is found to be 2.7 meter in average height and length ranges from 5.5-6.5 meter. The proposed bridge height is 4.92 meter from river bed level to the bottom of superstructure (beam). This is sufficient bridge height for mega wildlife (Elephant) so that under bridge movement of wildlife will not be disturbed. After construction of bridge the under bridge landscape will be converted to natural site with plantation of local plant species. Road safety measure must be implicated with sufficient preparedness. Proponent and relevant government agency will bear required impact mitigation cost due to disturbance of wildlife to communities and vise-versa due to under bridge wildlife movement.

Table 26: Matrix showing Impacts, Mitigation Measures, Mitigation Costs and Responsible Agencies (Adverse Impacts - Biological Environment)

Activity	Potential Negative Effects	Mitigation Measures	Mitigation cost (NRs)	Responsible Agencies	
				Executing Agency	Supporting Agency
Construction Phase	Disturbance to aquatic life	<ul style="list-style-type: none"> • Restriction of haphazard disposal of garbage and open defecation within the river course. • Proper handling of chemicals and other petroleum products. • Spoil will be safely managed soon after generated • Chemical used in construction will be properly handled • Illegal fishing activities by the construction of crews will be regulated. 	350000	Proponent	Local Government
	Disturbance to wildlife migratory route	<ul style="list-style-type: none"> • Restriction of bridge construction activities at the night time. • Hunting and poaching by the construction crew will be strictly prohibited. • Awareness program will be organized about the importance of wildlife and wildlife habitat to worker. 	300000	Proponent	Local Government
	Effect to ground vegetation such as invasive and weed species and bushy areas	<ul style="list-style-type: none"> • Bio-engineering works will be done in the surrounding area of bridge site at both banks of the river. 	200000	Proponent	Local Government
	Disturbance on threatened plants, animals, birds and fishes	<ul style="list-style-type: none"> • Construction chemicals will be restricting to contact to water bodies. • Construction materials will not be exposed to river system. • Awareness programmes will be organized about the conservation of threatened biodiversity and controlling illegal activity. 	500000	Proponent	Local Government
Operation Phase	Under bridge wildlife movement	<ul style="list-style-type: none"> • The proposed bridge height is sufficient so that under bridge movement of wildlife will not be disturbed. • After construction of bridge the under bridge landscape will be converted to like natural site with plantation of local plant species. • Road safety measure must be implicated with sufficient preparedness. 	Proponent and relevant government agency will bear cost for impact mitigation of under bridge wildlife movement	Proponent	Local Government

Table 27: Summary of Project Enhancement and Mitigation Cost

Impact Parameter/Potential environmental Impact	Proposed Mitigation Cost
Occupational health safety of workers	260,000
Installation of reflectorized Bridge Sign Board and delineator along the road and bridge.	32,000
Soil erosion/Bank Instability	4,800,000

Relocation of electric pole	5000
Disturbance to aquatic life	350000
Disturbance to wildlife migratory route	300000
Effect to ground vegetation such as invasive and weed species and bushy	200000
Disturbance on threatened plants, animals, birds and fishes	500000
Total	6,447,000

9 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is to prepare guide implementation of mitigation measures and monitoring requirements. It includes institution and their roles in environmental management activities, organizational structure of institution for environmental management and budget for mitigation measures. There are mainly two components of an EMP - 1) Environmental Monitoring, and 2) Environmental Auditing.

9.1 Project Management responsibility

The construction contractor should implement the recommend mitigation measures in this EIA report during construction period. Construction Company, proponent, local government, and community people should implement the recommend mitigation measures in this EIA report during operation period. Department of Road (DoR), Geo-Environment and Social Unit (GESU) and local government will be monitoring agency of the project activities, environmental impacts of project and its management during construction and operation period.

9.2 Monitoring Indicators

Monitoring will be carried out in a transparent and credible manner by using established indicators. To ensure that the monitored parameters are replicable, i.e. do not depend on the person or specific methodology used, the selected indicators are easy to be verified and controlled by the agencies where the final monitoring and supervision responsibility remains.

9.3 Environmental Monitoring Plan

A monitoring program is essential in order to collect up-to-date baseline conditions and for evaluating environmental impacts and the effectiveness of the mitigation measures adopted. The EIA monitoring process should generate meaningful information and improve the implementation of mitigation measures. According to the *EPR 54*, the concerned body shall monitor and evaluate the implementation of the project on the environment. However, the project proponent will be primarily responsible for carrying out different activities as mentioned in the EMP, as a part of the EIA, with the help of local people, local government and concerned parties. The following sections identify the types of monitoring required, monitoring schedule, and the parameters to be monitored.

Baseline Monitoring

A Baseline Study is required to compile and maintain a database on environmental conditions prior to the implementation of the project. This is especially important if the Project Implementation is delayed due to unforeseen circumstances and information given in the EIA needs to be updated. The baseline data recorded before the Project Implementation will facilitate the comparison of the information obtained during the monitoring activities and in auditing of the project.

Compliance Monitoring

The following activities should be conducted to ensure compliance with the recommendations of the EIA Study: Following the completion of the detailed design and the tender documents,

confirm that all the mitigation, compensation and rehabilitation measures recommended by the EIA Study have been incorporated. The mitigation measure, responsible agency, and mitigation cost has been presented in below table

Table 28: Proposed Compliance Monitoring Indicators and Verification technique and schedule for monitoring

Parameter/Impacts	Verifiable Indicators	Verification Methods	Implementation Phase/frequency
Compliance to occupational safety and hazards	Number and type of accidents, adequacy of occupational safety measured provided, compensation provided in case of fatal accidents or invalidity.	Spot checks at work sites, photos, accidents records, health records, interviews	During construction/three times
Health and sanitation due to disease transmission, air pollution, water pollution and noise pollution	Record cases of infection or health problem, first aid medical arrangement	Discuss with local people and health workers, records of health post	during construction phase / three times
Pressure on local services and Consumption of local resources	Availability of toilet, drinking water supply, electricity, vegetables etc.	Spot checks at work sites, photos	During construction/three times
Conflict between local and outside workers	Registered records at local level & police station	Local observers and witnesses of quarrel and conflict	During construction/ three times
Skill training to local people	Training programs for skill development, occupational safety and environmental protection	Specifications; Training records, check training program reports,	During construction/once
Discrimination and labor law	Specification of marginalized & vulnerable group as quota	Record of laborers' at work, interviews	Beginning construction and during const. phase/twice
Property acquisition and compensation	Preparation of inventory of infrastructures likely to be affected	Public consultation	Before construction/once
Impact on aquatic life	Distribution of fishes and other aquatic life	Interviews with local people and observation	During construction/twice
Disturbance on wildlife movement under bridge	List about migratory species, Events of hunting and killing of wildlife	Interviews with local people and concern stakeholders	During construction phase/ twice
Impact on invasive vegetation	List of invasive disturbance species	spot observation and consultation with local	During construction phase/ twice
Slope and bank instability and erosion	Inclination, bank/slope failures, causes	Observation and interview	during construction period/ once
Management of construction of camps	Solid waste, Sanitary waste management	Disposal site, Dumping site, Sanitation (toilet)	During construction phase/ twice
Stockpiling of construction materials and disposal of waste	Changes in landscape, affected soil productivity	Site observation, photos	during construction/ twice
Quarrying of construction materials	Changes in landscape, water logging	Site observation, photos	during construction/three times
Measure to protect environment from air, noise and water pollution	Dust level and noise level at work site, near settlements, visual observation	Inspection, testing of sample of water if necessary	During construction/ once

Parameter/Impacts	Verifiable Indicators	Verification Methods	Implementation Phase/frequency
Channelization of river course	bank/slope failures, river bed scouring measurement	Site inspection, discussion with project management,	During construction/once

Impact Monitoring

The actual impacts caused by Project Implementation should be closely monitored during the construction and operation of the project to examine the effectiveness of the mitigation measures. The following activities need to be conducted for impact monitoring:

Table 29: Proposed Impact Monitoring Indicators and Verification technique and schedule for monitoring

Parameters/Issues	Verifiable Indicators	Verification Methods	Schedule/Frequency
Socio-economic and Cultural Environment			
Population pressure around the site of bridge construction/approach road	Demographic, economic and education data of project affected ward	Observation, Interview with local people	During operation/once
Trade and Commerce	Nos. of shops increased & decreased, rental of houses	Observation, interviews, photos, Municipality records	During operation/twice
Change in socio-economic structure	No. and extent of new settlement /types and ethnic groups/No. and extent of new business, new services	Observations, interview, Municipality records	During operation/twice
Urination and defecations	Whether urination and defecation practice at the bridge foundations, pier are present or not	Observation and use of public toilets	During operation
Impact on aquatic life	Fishing, disturbance to aquatic life, trade of fishes	Interview with local people/ observations on local markets	routine during operation/once
Physical Environment			
Impact on land use pattern	Status of road side land;	Observation, data collection and analysis and interview	operation phase/once
Bank/Slope stability and erosion	Inclination, Bank/Slope failures, causes; Drainage facilities such as catch drain, side drains and functionality of cross drainage structures ; Fresh gullies and erosion; Success/failure of bio-engineering/river training solutions	Site observation, photos Discussion with technicians	Continuously during operation/once
Water quality	Observation of defecation and waste disposal around water sources near construction sites.	Visual observation,	During operation/once
Noise quality	Traffic level Noise generating activities	Assessment of noise level on site by measurement by decibel meter and interview with stakeholders	During operation/once
Air Quality	Dust level in ambient air	Visual inspection measurement of total suspended solid,	During operation/once

Parameters/ Issues	Verifiable Indicators	Verification Methods	Schedule/ Frequency
Socio-economic and Cultural Environment			
		particulate matter	
Possible Quarry site operation	Quarry sites operated near to the bridge foundations both upstream and downstream at least 500 m	Observation, Interview with locals	During operation phase/
Bridge maintenance & emergency work	Whether bridge foundations, piers are cracked or not or any damages	Observation	During operation phase/
Road Safety and Bridge safety signs	Erection of signboards	Observations	During operation phase/
Congestions around the bridge approached road affecting visibility	Whether haphazard parking has been avoided or not? Whether no parking signs are erected or not?	Observations/ Interview with local	Operation of road and bridge
Construction of drainage along the approach road, access road and diversion of river	Construction of those structure	Observations	During construction
Biological Environment			
Disturbance at Under bridge Movement	Disturbance to elephant movement	Interview with local people/ observations on local markets	routine during operation/once
Impact on vegetation	Disturbance to herbs	Interview with local people/ observations on local markets	routine during operation/once
Impact on aquatic life	Fishing, disturbance to aquatic life, trade of fishes	Interview with local people/ observations on local markets	routine during operation/once

9.4 Responsible Monitoring Agencies

The Project Proponent, being the Department of Roads under the Ministry of Physical Infrastructure and Transport (MoPIT), is the main responsible implementing agency for managing the construction and maintenance of the proposed bridge. In most cases where monitoring refer to the proponent as the principal responsible implementing agency, the specific tasks refer to the direct involvement of the GESU of the DoR. Buffer zone community forest plays an important role in the protection of flora and fauna. Local government and Ministry of Home Affairs are main responsible organization for the road safety and enforcement of traffic regulations.

9.5 Grievance Redress Mechanism

To demonstrate compliance with the environmental management, the proponent will instruct the construction contractors through environmental expert to maintain daily records of his mitigation implementation works in retrievable forms at its office during the construction phase. Contractors will keep records of the employment of the local area people, Nepali and foreigner and will submit such records to the environmental expert every three month. Similarly records of occupational health will also be documented in retrievable forms and submitted to environmental expert every three month. Besides, records of instructions, trainings, and land area rented with agreements will also be submitted to the environmental expert regularly or when it is demanded by the environmental expert. The geo-environmental section of the Department of Road will carryout monitoring works of the construction contractors and prepares monitoring reports quarterly during construction phase. The quarterly reports produced by the geo-environmental section will be

distributed to the concerned stakeholders for their comments and suggestions. Any comments and suggestions in the form of corrective actions of the stakeholders will be taken into account in the subsequent environmental management to enhance the project performance during construction by contractor. In the operation phase, the sector road operation and management office will keep records of the mitigation and monitoring as required in the retrievable forms. Every year, the sector road operation and management office will prepare a compiled report and pass it to the concerned stakeholder for comments and suggestions. The sector road operation and management office will carry out any recommendations and suggestion in the form of corrective actions of the concerned stakeholders.

9.6 Environmental Auditing

Environmental auditing assesses the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures and the functioning of monitoring mechanisms. An environmental impact audit of the bridge shall be performed after two years following the operation of the power plant as per EPR provision. The responsibility of the environmental audit lies with Ministry of Forestry and Environment. As stated in the national EIA Guidelines, the types of auditing that may be carried out as follows:

Decision Point Auditing: Which examine the effectiveness of the environmental impact assessment as decision making tool?

Implementation Auditing: Which ensures that conditions of consent have been met?

Performance Auditing: Which studies the work of agencies associated with the project management?

Predictive Technique Auditing: Which critically examine the methods and approach assessment procedure adopted during the environmental Impact Assessment?

The implementation auditing and predictive Technique Auditing will be mainly used for this bridge. The following checklist may be used while conducting the audit.

How have the environmental conditions (physical, biotic ad Socio-economic) changed from baseline conditions prior to the implementation of the project. Predicted impacts were the actual impacts observed during the project construction. Have mitigation measures have been effective in the avoidance, minimization and compensation of the predicted impacts. Any additional mitigation and monitoring required for the project

9.7 Environmental Auditing and Monitoring Costs

Monitoring cost will be provided by bridge project, DoR. Impact monitoring is essential, which shall be carried out by the proponent or GESU. The monitoring and auditing cost is presented in given below table . Total monitoring cost for the project construction and operation phase is NRs. 780,000. Similarly total auditing costs is NRs. 400,000.00.

Table 30: Summary of Monitoring Cost

Specifications	Months	Rate	Amount (NRs)
Expert Team Monitoring Cost			
Environmental Expert	2	80,000	160,000
Sociologist	2	60,000	120,000
Biologist	2	60,000	120,000
Logistics			100,000
Preparation of Report			200,000
Cost for Monitoring by GESU			800,00
Total Monitoring Cost			780,000
Auditing after 2 years			400000
Total monitoring and auditing			11,80,000

10 CONCLUSION

The EIA exercise for proposed Tunamuna Khola Bridge Project has been carried out as per EPR. The project has various types of beneficial impacts but also has adverse impacts. The EIA study has predicted and outlined the beneficial impacts and the adverse impacts as well as. The adverse impacts are considered to be nominal as compared to the beneficial impacts. The benefit augmentation measures for beneficial impacts and mitigation measures for adverse have been proposed along with the possible exploration of alternatives. Therefore, it is recommended to operate the proposal with due consideration and implementation of all the recommended mitigation measures. Environmental Management Plan and Environmental Auditing has also been prepared and will be implemented for sustainability of project. The project will implement all these so that the proposal will more benefits to the environment as well as social wellbeings. Any Activity will not effective without proper monitoring. The proponent has generously committed the monitoring cost within project cost.

REFERENCES

- ADB, 2003. *Environmental Assessment Guidelines*. Asian Development Bank; Kathmandu Nepal.
- Central Bureau of Statistics, 2011. National Population and Housing Census 2011. Thapathali, Kathmandu, Nepal.
- Constitution of Nepal. 2015. Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board, Kathmandu
- Department of Roads. 2000. Policy document, *Environmental Assessment in the Road Sector of Nepal*. Geo-Environment Unit, Ministry of Physical Planning and Works, Nepal.
- DCC, 2015(2072). *District Profile of Chitwan*. District Development Office (Now District Coordination Committee Office), Chitwan.
- DOR, 2007. *A guide to the Environmental and Social Management Framework*, Ministry of Physical Planning and Works. Department of Roads, Kathmandu
- DoR 2003. *Reference Manual for Environmental and Social Aspects of Integrated Road Development*, Ministry of Physical Planning and Works. Department of Roads, Kathmandu.
- MOFE, 1997. *Environment Protection Act, 1997*. Ministry of Science, Technology and Environment Kathmandu
- MOFE, 1997. *Environment Protection Rules, 1997*, Ministry of Science, Technology and Environment, Kathmandu
- CBS, 2014 *Environment Statistics of Nepal*. Thapathali, Kathmandu, Nepal.
- National Planning Commission, 1993. *Environmental Impact Assessment Guidelines, (1993)*. National Conservation Strategy Implementation Project, National Planning Commission, Kathmandu Nepal
- ESMF, 2007. *Department of Road; Road & Bridge Unit, amendment 2013*. Kathmandu, Nepal.
- DoR, 2017. *Feasibility Study of Tunamuna Khola Bridge Project*
- Nepal Law Commission, 2007. *Policy plan, acts, rule regulation, guideline and standard of Nepal government*. Constituent Assembly of Nepal, Supreme Court Of Nepal, Commission for the Investigation of Abuse of Authority, Ministry of Law and Justice and Office of the Attorney General of Nepal
- GoN, 1993. *Forest Act, 1993*. Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board, Kathmandu
- GoN, 1991. *Labor Act, 1991.*, Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board, Kathmandu
- GoN, 1999. *Local Self-Governance Act, 1999*. Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board, Kathmandu
- GoN, 1999. *Local Self-Governance Rules 1999*, Ministry of Law, Justice and Parliamentary Affairs, Law Books Management Board, Kathmandu.
- GoN, 1999, Ministry of Population and Environment, 1999. *Environmental Protection Act, 1997 and Environment Protection Rules, 1999. (Amendment, 1999)*. Ministry of Law, Justice and Parliament Affairs, Nepal
- GoN, 2016. *Municipality profile. Madi Municipality Profile, 2073/74*
- GoN, 2012. *National Population and Housing 2011*, CBS, 2012

GoN, 2011. *Solid Waste Management Act (2011)*. Ministry of Science and Technology and Environment, Kathmandu

Shrestha K 1998. *Dictionary of Nepalese Plant names*. Mandala Book Point, Kathmandu, Nepal.

Shrestha, J. 1994. *Fishes, Fishing Implements, and Methods of Nepal*. Kathmandu, Nepal.

ICIMOD, 2016. Winter Study on Outdoor/Indoor Air Quality Measurements in Chitwan. <http://www.icimod.org/?q=21611>.

Malla R and Karki K, 2016, Groundwater_Environment_in_Chitwan_Nepal <https://www.researchgate.net/application.ClientValidation.html?origPath=%2Fpublication%2F303414786>.

<http://www.seismonepal.gov.np/files/listings/145.jpg>

<https://www.google.com.np/search?q=seismic+map+after+earthquake+nepal>