ENVIRONMENTAL IMPACT ASSESSMENT REPORT

for

ELECTRICITY TRANSMISSION PROJECT

Lapsiphedi-Ratmate-New Hetauda, Ratmate-New Damauli-New Butwal-Nepal India Border 400 kV Transmission Line and Ratmate, New Damauli, and New Butwal 400 kV Substations

(Bagmati, Gandaki and Lumbini Province)

VOLUME—I

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GOVERNMENT OF NEPAL

Ministry of Forests and Environment

Singhdurbar, Kathmandu

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Ministry of Energy, Water Resources and Irrigation

Singhdurbar, Kathmandu

and

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Sano Gaucharan, Kathmandu

नेपाल सरकार, वन तथा वातावरण मन्त्रालयको मिति २०७८/१/१६ को मा. मन्त्री स्तरको निर्णय अनुसार स्वीकृत भएको ।

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Millennium Challenge Account Nepal Development Board

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Acronyms and Abbreviations	Definition
ADB	Asian Development Bank
AIS	Air Insulated Switchgear
AJ	Adivasi Janajati
AoA	Area of Analysis
AoI	Area of Influence
a.s.l.	Above Sea Level
ATV	All-terrain Vehicle
BCN	Bird Conservation Nepal
BOQ	Bill of Quantities
CAAN	Civil Aviation Authority of Nepal
CBS	Central Bureau of Statistics
CCA	Chure Conservation Area
CDC	Compensation Determination Committee
CESHSMP	Contractor's Environmental, Social, Health and Safety Management Plan
CF	Community Forest
CFC	Compensation Fixation Committee
CFP	Chance Finds Procedure
CFUG	Community Forest User Groups
CHAL	Chitwan-Annapurna Landscape
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CLO	Community Liaison Officer
CPR	Common Property Resources
CR	Critically Endangered
CSO	Civil Society Organization
CTEVT	Council for Technical Education and Vocational Training
CTIP	Counter Trafficking in Person
D&B	Design and Build
DCC	District Coordinating Committee
DFS	Detailed Feasibility Study
DHS	Department of Health Services
DNPWC	Department of National Parks and Wildlife Conservation

Acronyms and Abbreviations	Definition
DoED	Department of Electricity Development
DFO	Divisional Forest Office
DoFSC	Department of Forests and Soil Conservation
DSO	District Survey Office
DTM	Digital Terrain Model
ED	Executive Director
EIA	Environmental Impact Assessment
ETP	Electricity Transmission Project
EDR	Ecological Development Region
EMF	Electric and Magnetic Field
EN	Endangered
EPA	Environment Protection Act
EPR	Environment Protection Rule
ERM	Environmental Resources Management
ESHS	Environmental, Social, Health and Safety
ESHSMP	Environmental, Social, Health, and Safety Management Plan
ESMS	Environmental and Social Management System
ESP	Environmental and Social Performance
ESP-CA	Environmental and Social Performance On-site Community Assistant
FAO	Food and Agriculture Organization
FECOFUN	Federation of Community Forestry Users Nepal
FGD	Focus Group Discussion
FPIC	Free, Prior and Informed Consent
FRTC	Forest Research and Training Centre
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Gas-Insulated Switchgear
GoN	Government of Nepal
GRC	Grievance Redress Coordinator
GRM	Grievance Redress Mechanism
GPS	Global Positioning System
GSI	Gender and Social Inclusion
Ha	Hectare

Acronyms and Abbreviations	Definition
HDI	Human Development Index
HH	Household
HHS	Household Survey
HIV/AIDS	Human Immune Deficiency Virus or Acquired Immune Deficiency Syndrome
HoH	Head of Household
HPI	Human Poverty Index
IB	Indian Border
IBA	Important Bird Area
ICIMOD	International Centre for Integrated Mountain Development
ICP	Informed Consultation and Participation
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IP	Indigenous Peoples
IUCN	International Union for Conservation of Nature
JTA	Junior Technical Assistant
KBA	Key Biodiversity Area
KII	Key Informant Interview
kV	Kilo-volt
LAHURNIP	Lawyers' Association for Human Rights of Nepalese Indigenous Peoples
LAP	Lapsiphedi
LFUG	Leasehold Forest User Group
LHF	Leasehold Forest
LiDAR	Light Detection and Ranging
LPG	Liquefied Petroleum Gas
LRP	Livelihood Restoration Plan
LRT	Linear Routing Tool
MBT	Main Boundary Thrust
MCA-Nepal	Millennium Challenge Account Nepal Development Board
MCC	Millennium Challenge Corporation
MCT	Main Central Thrust
MFT	Main Frontal Thrust
MoALD	Ministry of Agriculture and Livestock Development

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Acronyms and Abbreviations	Definition
MoEST	Ministry of Education, Science and Technology
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoF	Ministry of Finance
MoFAGA	Ministry of Federal Affairs and General Administration
MoFE	Ministry of Forests and Environment
MPFS	Master Plan for the Forestry Sector
MPI	Multi-dimensional Poverty Index
MSDS	Material Safety Data Sheet
MT	Mahabharat Thrust
NA	Not Applicable
NASA	National Aeronautics and Space Administration
NB	New Butwal
ND	New Damauli
NDHS	Nepal Demographic and Health Survey
NEA	Nepal Electricity Authority
NEFIN	Nepal Federation of Indigenous Nationalities
NFDIN	National Foundation for Development of Indigenous Nationalities
NGO	Non-Governmental Organization
NH	New Hetauda
NLSS	Nepal Living Standards Survey
NPC	National Planning Commission
NPR	Nepalese Rupee
NTFP	Non-Timber Forest Products
NTNC	National Trust for Nature Conservation
O&M	Operation and Maintenance
OMCN	Office of the Millennium Challenge Nepal
OPHI	Oxford Poverty and Human Development Initiative
PAP	Project Affected Persons
PCTMCDB	President Chure-Tarai Madhesh Conservation Development Board
PEI	Power Engineers Inc.
PHCC	Primary Health Care Centers
PPE	Personal Protective Equipment
PPP	Purchasing Power Parity

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Acronyms and Abbreviations	Definition
PPTS	Project Preparation and Technical Supervision Services
RAP	Resettlement Action Plan
RAP-ISP	RAP Implementation Schedule Plan
RM	Rural Municipality
RPF	Resettlement Policy Framework
RoW	Right-of-Way
RTE	Ratmate
SD	Scoping Document
SE	Secondary Education
SEP	Stakeholder Engagement Plan
SGIP	Social and Gender Integration Plan
SHG	Self Help Group
SPAF	Seriously Project Affected People
SSDP	School Sector Development Plan
STDS	South Tibet Detachment System
sq. km.	Square Kilometer
TAL	Terai Arc Landscape
TIP	Trafficking in Persons
TL	Transmission Line
ToR	Terms of Reference
TSP	Total Suspended Particulates
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
VEC	Valued Environmental/Social Components
VU	Vulnerable
WB	World Bank
WHO	World Health Organization
WWF	World Wildlife Fund

STANTEC CONSULTING INTERNATIONAL LLC 2000

नेपाल सरकार
वन तथा वातावरण मन्त्रालय
सिंहदरबार, काठमाडौं

कार्यकारी सारांश

१ भूमिका

नेपाल सरकारको एक निकायका रूपमा रहेको मिलेनियम च्यालेन्ज एकाउण्ट नेपाल (एमसिए-नेपाल) ले विद्युत् प्रसारण आयोजना अन्तर्गत करिब ३१३.९ कि.मि. लामो प्रसारण लाइन निर्माण गर्न लागेको छ। मिलेनियम च्यालेन्ज कर्पोरेशन नामक स्वायत्त अमेरिकी वैदेशिक सहयोग निकायले प्रस्तावित आयोजना निर्माणार्थ झण्डै ३९ करोड ८० लाख अमेरिकी डलर प्रदान गर्ने र नेपाल सरकारले १३ करोड अमेरिकी डलर प्रबन्ध गर्ने गरी नेपाल सरकारसँग एक सम्झौता गरेको छ।

प्रस्तावित आयोजना नेपालको प्रसारण लाइन सञ्जालको एक महत्वपूर्ण अवयवको रूपमा रहेको छ। ऊर्जा, जलस्रोत तथा सिँचाइ मन्त्रालयद्वारा सन् २०१८ मा तयार गरिएको *नेपालको प्रसारण प्रणाली विकास योजनाले* पनि यस प्रसारण आयोजनालाई पहिचान गरेको थियो। यस आयोजनाको समग्र उद्देश्य नेपालमा विद्युत् ग्रिडको उपलब्धता, विश्वसनीयता बढाउनुका साथै ऊर्जा व्यापारलाई सहजीकरण गर्दै विद्युत् खपत वृद्धि गराउनु रहेको छ।

प्रस्तावित आयोजनाबाट कुल ९४३ जना जनसंख्या रहेका १८७ घरपरिवार विस्थापित हुने र प्रस्तावित आयोजना चुरे संरक्षण क्षेत्र भएर जाने हुँदा नेपालको साविक वातावरण संरक्षण ऐन, २०५३ र वातावरण संरक्षण नियमावली, २०५४ ले यसका लागि वातावरणीय प्रभाव मूल्याङ्कन अनिवार्य गरेको थियो। वातावरण संरक्षण नियमावली, २०७७ मा उल्लेख भए अनुसार सबै विद्युत प्रसारण आयोजनालाई प्रारम्भिक वातावरणीय परिक्षण मात्र गर्नुपर्ने व्यवस्था छ। वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ को कार्यान्वयनको प्रकिया सरलीकरण सम्बन्धमा नेपाल सरकार, वन तथा वातावरण मन्त्रालय माननिय मन्त्री स्तरको मिति २०७७।०३।१४ मा भएको निर्णयमा भएको थप २०७७।०८।०४ को निर्णय अनुसार वातावरण संरक्षण नियमावली, २०५४ अनुसार गरेको वातावरणीय प्रभाव मूलयाङ्कन अध्ययन प्रतिवेदन वातावरण संरक्षण नियमावली, २०७७ लागु हुनु भन्दा पहिला सम्बन्धीत मन्त्रालयमा पेश भएको भए आयोजना प्रस्तावकको अनुरोधमा नया नियमावली अनुसार स्वीकृत गर्न सकिने व्यबस्था गरीएको छ।

प्रस्तावित प्रसारण लाइन आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयार गर्न र त्यसको स्वीकृतिका लागि नेपाल सरकार समक्ष पेश गर्न इस्टेन्टेक कन्सल्टिङ्ग इन्टरनेसनल एलएलसी (पावर इन्जिनियर्स आईएनसी तथा इन्भारोन्मेन्टल रिसोर्ससेज मेनेजमेन्टको सहयोगमा र यसलाई समग्रमा कन्सल्टेन्ट समूह भनिएकोछ) लाई जिम्मेवारी दिइएको छ।

एमसिए-नेपाल र यसको पूर्ववर्ती निकाय 'अफिस अफ मिलेनियम च्यालेन्ज नेपाल' ले प्रस्तावित आयोजनाको सन्दर्भमा सन् २०१५ देखि काम थालेका हुन्। सन् २०१७ मा विस्तृत सम्भाव्यता अध्ययन पूरा गरी प्रसारण लाइनको प्रारम्भिक मार्ग पहिचान गरिएको थियो। विस्तृत प्राथमिक अध्ययन, उच्च गुणस्तरीय हवाइचित्र (High- resolution Aerial Imagery) र भौगोलिक अध्ययनका आधारमा प्रसारण लाइनको प्रारम्भिक मार्गमा थप सुधार गरिएको छ। सशक्त र निर्माणयोग्य डिजाइन सहित वातावरणीय तथा सामाजिक प्रभावहरूलाई न्यूनीकरण गर्न पनि यसबाट सहज हुने देखिन्छ।

सन् २०१८ को सेप्टेम्बर/अक्टोबरमा एमसिए-नेपालले प्रभावित हुने सम्भावना भएका सबै स्थानीय तहमा क्षेत्र निर्धारणको क्रममा परामर्श बैठकहरू आयोजना गरी प्रसारण लाइनको प्रारम्भिक मार्ग तथा डिजाइन बारे स्थानीय स्तरबाट सुझाव सङ्कलन गरेको थियो। सन् २०१८ को नोभेम्बरमा एमसिए-नेपालले विद्युत् विकास विभाग मार्फत् वन तथा वातावरण मन्त्रालय समक्ष क्षेत्र निर्धारण प्रतिवेदन (Scoping Document) एवम् कार्यसूची (Terms of Reference) स्वीकृतिको लागि पेश गर्‍यो र सो क्षेत्र निर्धारण प्रतिवेदन र कार्यसूची प्रतिवेदन अप्रिल २०१९मा वन तथा वातावरण मन्त्रालयबाट स्वीकृत भयो।

वातावरणीय तथा सामाजिक क्षेत्रका प्राथमिक अध्ययनहरू तथा इन्जिनियरिङ्ग अध्ययनका जगमा एमसिए-नेपालले मे २०१९ मा प्रसारण लाइनको प्रस्तावित मार्ग पहिचान गर्‍यो। प्रभावित हुने सम्भावना भएका स्थानीय तहबाट प्रसारण लाइनको प्रस्तावित मार्गबारे थप पृष्ठपोषण लिनका निम्ति दोस्रो चरणका परामर्श बैठकहरू पनि सम्पन्न गरियो। प्राप्त टिप्पणीका आधारमा मार्गमा थप सुधार गरियो र आयोजनालाई अगाडि बढाउँदै यस वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयार गरिएको छ। प्रभावित हुने ३० स्थानीय तह र सरोकारवालाहरुको सहभागितामा आयोजनाको वातावरणीय तथा सामाजिक प्रभावहरूबारे छलफल गर्ने उद्देश्यले तेस्रो चरणका परामर्श भेलाहरू (सार्वजनिक सुनुवाई) सन् २०१९ नोभेम्बर र डिसेम्बरमा आयोजना गरिएको थियो। सार्वजनिक सुनुवाईबाट प्राप्त सुझावहरूका आधारमा आयोजनाको मार्गमा थप सुधार गरेर मार्गको अन्तिम स्वरूप यस प्रतिवेदनमा प्रस्तुत गरिएको छ।

२ आयोजनाको परिचय

प्रस्तावित आयोजना ४०० किलोभोल्ट (केभी) डबल सर्किटको ३१३.९ किलोमिटर लामो विद्युत् प्रसारण लाईन निर्माण आयोजना हो। यो प्रसारण लाइन भारतको महेशपुर सीमादेखि उत्तरतर्फ तराईमा पर्ने नवलपरासी (बर्दघाट सुस्ता पश्चिम) जिल्लाको नयाँ बुटवल सब-स्टेशन हुँदै उत्तरपूर्वको चुरे पहाड पार गरेर तनहुँ जिल्लाको नयाँ दमौली सब-स्टेशन एवम् पूर्वी भाग हुँदै

नुवाकोट जिल्लास्थित रातमाटे सबस्टेशनसम्म र यहाँबाट एउटा प्रसारण लाइन मकवानपुर जिल्लाको हेटौंडा तर्फ र अर्को काठमाण्डौ जिल्लाको लप्सेफेदी तर्फ विस्तारित हुनेछ । समग्रमा, प्रस्तावित आयोजना तीन वटा प्रदेश, १० जिल्ला (काठमाण्डौ, सिन्धुपाल्चोक, नुवाकोट, धादिङ्ग, मकवानपुर, चितवन, तनहुँ, पाल्पा, नवलपरासी बर्दघाट सुस्ता पुर्व र नवलपरासी बर्दघाट सुस्ता पश्चिम), एक उप-महानगरपालिका, ११ नगरपालिका र १८ गाउँपालिका भएर जानेछ ।

२.१ प्रस्तावित सुविधाहरू

२.१.१ प्रसारण लाइन र भोगाधिकार क्षेत्र

प्रस्तावित प्रसारण लाइनले विद्युत् उत्पादन क्षेत्रबाट विद्युत् माग क्षेत्रमा उच्च भोल्टेज अर्थात् ४०० केभीको विद्युत् लैजान मद्दत गर्नेछ । यसका लागि ४६ मिटर चौडा भोगाधिकार क्षेत्र (Right of Way) भित्र झण्डै ८५६ वटा प्रसारण टावर निर्माण गरिनेछ । यी टावरको उचाइ ४३ मिटरदेखि ९२.५ मिटर सम्म हुनेछ । बिजुलीको तारका साथै प्रत्येक टावरमा भूमिगत तारहरू (Grounding Wire) पनि हुनेछन्, जसले चट्याङ्गबाट रक्षा गर्नेछ । साथै, ती टावरमा सार्वजनिक सुरक्षा उपायका रूपमा चढ्न नमिल्ने उपकरण र चेतावनी चिन्ह पनि राखिनेछ।

आयोजनाका धेरै टावर कठिन क्षेत्रमा रहनेछन् । एमसिए-नेपालले वन फँडानी, जग्गा अधिग्रहण तथा भौतिक पुनर्वासलाई कम गर्ने अभिप्रायले टावर रहने स्थानसम्म सामान ढुवानी गर्न कुनै पनि नयाँ पहुँच सडक मार्ग निर्माणका लागि प्रस्ताव गरेको छैन । दुर्गम स्थानमा बन्ने टावरहरूको निर्माण सामग्री ढुवानी गर्न हाल भइरहेका बाटा र केही नयाँ गोरेटो बाटा प्रयोग गरी भरिया, पशु र अन्य साना प्रकारका सवारी साधन प्रयोग गरिनेछन् । बाटो नभएको, अत्यन्तै विकट स्थानहरूमा रहने टावरहरू निर्माण गर्न आवश्यक सामग्री तथा भारी सामानहरू ढुवानी गर्न आवश्यकता अनुसार हेलिकप्टर समेत प्रयोग गरिनेछ ।

२.१.२ सब-स्टेशनहरू

उपभोक्ताहरूको प्रयोजनका लागि उच्च भोल्टेजको करेण्ट कम भोल्टेजमा रूपान्तरण गर्न र प्रसारणका लागि कम भोल्टेजको करेण्ट उच्च भोल्टेजमा रूपान्तरण गर्न सबस्टेसन प्रयोग गरिन्छ । यस आयोजनाले नवलपरासी (बर्दघाट सुस्ता पश्चिम), दमौली र रातमाटेमा गरी तीन वटा नयाँ जिआईएस सब-स्टेशन निर्माण गर्नेछ र नेपाल विद्युत् प्राधिकरणले जग्गा अधिग्रहण गर्ने र हेटौंडा र लप्सीफेदीमा निर्माण गर्ने सबस्टेसनमा यो प्रसारण लाइन जोडिनेछ ।

२.१.३ अन्य थप सहायक सुविधाहरू

प्रस्तावित आयोजनाका लागि निम्न लिखित सहायक सुविधाहरू आवश्यक पर्नेछ :

- सब-स्टेशनमा कामदार बसोबास र निर्माण सामग्री भण्डारण गर्ने ठाउँ - नयाँ प्रस्तावित तीनवटै सब-स्टेशनमा करिव ५० कामदारहरु बसोबास गर्नेछन् । सब-स्टेशनमा अस्थायी निर्माण औजार र निर्माण समाग्री भण्डार तथा सब-स्टेशनका सामानहरु भण्डार गरिनेछ । नायाँ बनाउने तीनवटै सब-स्टेशनामा व्याचिङ्ग प्लान्टको पनि आवश्यकता पर्न सक्दछ ।
- टावर निर्माण सामग्री भण्डारण गर्ने ठाउँ - टावर निर्माण गर्न आवश्यक उपकरणहरू र निर्माण सामग्री (जस्तै : सिमेन्ट, गिट्टी, स्टील डण्डीहरू) भण्डारण गर्न ११ वटा स्थान पहिचान गरिएको छ । ती स्थानबाट विभिन्न टावर निर्माण स्थलमा निर्माणका लागि उपकरण तथा सामग्री लगिनेछ ।
- टावर निर्माण गर्ने कामदार बस्ने कामदार शिबरिहरु, कार्यस्थलहरू र भण्डार क्षेत्रहरू - टावर निर्माण स्थल दुर्गममा रहेको र विभिन्न चरणमा थोरै कामदार आवश्यक पर्ने भएकाले अस्थायी बसोबास गर्ने कामदार शिविर र निर्माण सामग्री भण्डार टावर निर्माण स्थल नजिक व्यवस्था गरिने छ ।

प्रस्तावित आयोजनाका लागि क्वारी (खानी) वा क्रशर उद्योग आवश्यक पर्ने छैन । यसले विद्यमान स्वीकृत क्वारी क्षेत्रहरू वा नियामक निकायबाट स्वीकृत नदीजन्य गिट्टी, बालुवा आदि जस्ता आवश्यक सामग्री आपूर्तिकर्ताहरूबाट प्राप्त गरिनेछ ।

२.२ निर्माण गतिविधि

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पूर्व निर्माण क्रियाकलाप अन्तर्गत सर्वेक्षण र भौगर्भिक स्थल अनुसन्धान, खाली क्षेत्र कायम, निर्माण व्यवसायीका उपकरण, सामग्री र जनशक्तिको परिचालन, गिट्टी बालुवाको प्राप्ति र भण्डारण आदि कार्य पर्नेछन् । प्रसारण लाइनको एउटा टावरको निर्माण सामान्यतः निम्नलिखित चार चरणमा सम्पन्न गरिनेछ:

- प्रारम्भिक स्थल तयारी - यसका लागि सामान्यतः तीन हप्ता लाग्नेछ ।
- टावरको जग खन्ने र जडान - यसका लागि सामान्यतः दुई महिना लाग्नेछ ।
- टावर खडा गर्ने - यसका लागि सामान्यतः एक महिना लाग्नेछ ।
- कण्डक्टर तार टाँग्ने काम - दुईवटा टावरबीच सामान्यतः एक हप्ता लाग्नेछ ।

निर्माण सम्पन्न भएपछि निर्माण व्यवसायीले प्रत्येक टावर स्थललाई निर्माणपूर्वको अवस्थामा फर्काउनेछ ।

सब-स्टेशन निर्माणको लागि तीनवटै सब-स्टेशनमा भएका रुखबिरुवा लागाएतका हटाउनु पर्ने बस्तुहरु हटाउने, आवश्यक परेमा ब्याचिङ्ग प्लान्ट रख्ने, आवाश्यक्ता अनुसारको जग खन्ने, भवन बनाउने तथा आवश्यक औजारहरु मिलाउने र कन्डक्टर र इलेक्ट्रिकल इक्वीप्टमेन्ट फिट गरिनेछ ।

एमसिए-नेपालले निर्माणका चरणमा निर्माण व्यवसायीले वातावरणीय एवं सामाजिक पक्षसम्बन्धी कार्य ठेक्काको सम्झौतामा उल्लेख गरिए बमोजिम गरेको छ या छैन भनी अनुगमन जारी राख्नेछ ताकी उनीहरूले सबै आवश्यक न्यूनीकरणका उपायहरु लागू गर्दै नेपाल सरकारले तोकेका सबै शर्त बन्देज एवं नियम पालना गरिरहेको तथ्य सुनिश्चित् गर्न सकियोस् ।

२.३ सञ्चालन गतिविधि

आयोजनाको सञ्चालन र सम्भारका लागि नयाँ जमिनको आवश्यकता पर्ने छैन भने कामदार पनि निर्माण चरणमा भन्दा कम मात्र लाग्नेछ । सञ्चालन चरणका क्रियाकलापमा अग्ला रुखहरूको काँटछाँट गर्ने, भोगाधिकार क्षेत्र अतिक्रमण भयो भएन भनेर संरचनाहरूको अनुगमन गर्ने, भू-क्षयलाई स्थिर राख्ने, खिया लागेका टावरको मर्मत गर्ने तथा टावरका हराएका पार्टपुर्जा फेर्ने आदि कार्य पर्दछन् । सब-स्टेशनहरु मोटर बाटोको पहुँचमा हुनेछन् भने प्रसारण लाइनको टावरहरु र भोगाधिकार क्षेत्र भने पैदल मार्गको पहुँचमा हुनेछन् र काहिँ नजिकका जग्गाधनीहरुको अनुमतिको पनि आवश्यकता पर्न सक्नेछ ।

२.४ आयोजनाका लागि जग्गाको आवश्यकता

प्रस्तावित आयोजनाले रातमाटे सब-स्टेशन, रातमाटे तथा नयाँ दमौली सब-स्टेशनको पहुँच मार्ग र प्रसारण टावरको जगका लागि जग्गा प्राप्ति गर्नुपर्नेछ भने नयाँ बुटवल सब-स्टेशनको लागि नेपाल विद्युत् प्राधिकरणले जग्गा प्राप्त गरिसकेको छ र नयाँ दमौली सब-स्टेशनको लागि नेपाल विद्युत प्राधिकरणले अधिग्रहण गर्ने कार्य प्रक्रियारत छ । भोगाधिकार क्षेत्रभित्रको जग्गा प्राप्त गरिने छैन । भोगाधिकार क्षेत्रमा नयाँ आवासीय संरचना निर्माण गर्न नपाइने, अग्ला रुखहरू लगाउन नपाइने आदि जस्ता स्थायी भू-उपयोग बन्देजहरू भने लगाइनेछ । टावरका लागि खाली क्षेत्र र कामदार शिविरका निम्ति अस्थायी ढङ्गले जग्गा प्राप्त गरिनेछ ।

३ प्रतिवेदन तयार गरिएको विधिहरू

वन तथा वातावरण मन्त्रालयले स्वीकृत गरेको कार्यसूची (Terms of Reference) तथा मन्त्रालयले सन् २०१८ मा प्रकाशित गरेको जलविद्युत् वातावरणीय प्रभाव मूल्याङ्कन निर्देशिका (Guideline) बमोजिम प्रस्तुत प्रतिवेदन तयार पारिएको हो । प्रतिवेदन तयार गर्दा साहितिक पुनराबलोकन, भौतिक, जैविक र सामाजिक-आर्थिक तथा साँस्कृतिक वातावरण सम्वन्धि स्थलगत अध्ययन तथा अवलोकन, स्थानीय/सरोकारवाला संग छलफल, सार्वजनिक सुनुवाई, ७ दिने सूचना पत्रिकामा प्रकाशन गरेर सुझाव संकलन र सम्बन्धित निकायहरुबाट सिफारिस पत्र संकलन गरिएको थियो । पूर्व प्रकाशित सन्दर्भ सामग्रीको समीक्षा र विस्तृत भौतिक, जैविक एवम् सामाजिक कार्यक्षेत्र अध्ययनका माध्यमबाट आधारभूत तथ्याङ्क सङ्कलन गरिएको हो । प्रभावहरूलाई तिनीहरूको प्रकार र प्रकृति, सीमा र स्तर तथा अवधिका आधारमा लेखाजोखा गरिएको छ । प्रभाव निर्धारकहरूलाई प्रभावको समग्र अवशिष्ट महत्वको चित्रण गर्न प्रयोग गरिएको छ अर्थात् प्रस्तावित न्यूनीकरणका उपायलाई ध्यानमा राखिएको छ । प्रभावको तीव्रतालाई मुख्य, मध्यम, सामान्य र गौण गरी तह निर्धारण गरिएको छ ।

४ ऐन, नियम, निर्देशिका, दिग्दर्शन र अन्तर्राष्ट्रिय महासन्धीहरूको समिक्षा

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वातावरणीय प्रभाव मूल्याङ्कन गर्नुको औचित्य नेपालको संविधान र नेपाल सरकारका योजना, नीति, ऐन, नियम, निर्देशिका, दिग्दर्शन, मापदण्ड तथा नेपाल सरकार पक्ष रहेका अन्तर्राष्ट्रिय महासन्धी र सम्झौताहरूसँग प्रस्तुत आयोजना अनुकुल छ भन्ने सिद्ध गर्नु हो । यस आयोजनाको निर्माणका लागि एमसिसीले आर्थिक सहयोग दिइरहेको हुँदा एमसिसीका वातावरणीय नीतिहरू, अन्तर्राष्ट्रिय वित्त निगमका वातावरण तथा सामाजिक दिगोपनासम्बन्धी कार्यसम्पादन मापदण्ड तथा लैंगिक एवं मानव तस्करी विषयका नीतिहरू समेत यहाँ लागू हुनेछन् । आयोजना कार्यान्वयनकर्ता आयोजना सञ्चालन गर्ने क्रममा सबै सान्दर्भिक ऐन, नियम, नीति, निर्देशिका तथा अभिसन्धीका प्रावधानहरू पालना गर्न जिम्मेवार रहेको छ । वातावरण संरक्षण ऐन २०७६, वातावरण संरक्षण नियमावली, २०७७, जग्गा प्राप्ति ऐन, २०३४, वन ऐन, २०७६ जस्ता महत्वपूर्ण ऐन, नियमलाई पनि यो प्रतिवेदन तयार पार्दा सूक्ष्मतापूर्वक विवेचना गरिएको छ ।

५ विद्यमान वातावरणीय अवस्था

५.१ भौतिक वातावरण

प्रस्तावित आयोजनाले प्रस्ताव गरेका टावरहरू तराई (९ प्रतिशत), चुरे पनि भनिने शिवालिक (१० प्रतिशत) र मध्य पहाड (८१ प्रतिशत) क्षेत्र भएर जानेछ । तराई क्षेत्र झण्डै समतल छ र यो मुख्यत: कृषि भूमि हो । यस क्षेत्रमा पर्ने आयोजनाको मार्गमा जङ्गली जन्तुको प्राकृतिक वासस्थान छैन भन्दा हुन्छ । चुरे भनेको वातावरणीय रूपमा संवेदनशील भू-भाग हो । यो तराईमा भूमिगत जलसिञ्चन गर्ने महत्वपूर्ण क्षेत्र पनि हो । यसको महत्व बुझेरै चुरे संरक्षण क्षेत्रको घोषणा गरिएको हो । प्रसारण लाइन भोगाधिकार क्षेत्रका रूपमा सबैभन्दा ठूलो क्षेत्रफल ओगट्ने मध्यपहाडमा मिश्रित एवं कठिन भू-भाग रहेको छ । महाभारत क्षेत्र भिरालो छ भने मध्य पहाडमा नदीले बनाएका गहिरा उपत्यका (जस्तै, त्रिशुली, सेती) द्वारा विभाजित हावापानी झेलेको गोलाकार भू-सतह छ । कुल भोगाधिकार क्षेत्र मध्ये करिब ५३ प्रतिशतमा वन (७७७.५ हेक्टर) र ४२ प्रतिशतमा कृषि भूमि (६१२.२ हेक्टर) रहेको छ । बाँकी भू-भागमा विकसित जग्गाका साना भाग, बाँझो, जलक्षेत्र तथा सिमसार रहेका छन् ।

५.२ जैविक वातावरण

प्रस्तावित प्रसारण लाइनको भोगाधिकारमा कुल वनक्षेत्र ७७७.५ हेक्टर (सामुदायिक ३३०.४ हेक्टर, कबुलियती ४.४ हेक्टर र सरकारी तथा अन्य ४४२.७ हेक्टर) पर्दछन् । प्रसारण लाइन ११२ वटा सामुदायिक वन र ८ वटा कबुलियती वन भएर जानेछ । प्रसारण लाइन मार्गमा पर्ने वनमध्ये अधिकांश क्षेत्र उपोष्ण सालको जङ्गल तथा शीतोष्ण चौडापाते वनस्पतिले ढाकेको छ । यी वनले अनेकौं सङ्कटापन्न/लोपोन्मुख जनावरका प्रजातिलाई आश्रय दिएका छन् । जस्तै एसियाली कालो भालु, स्लथ भालु, चिनियाँ सालक, चितुवा, आसामी बाँदर तथा लामो कछुवा आदि । साथै आयोजना क्षेत्रमा कतिपय सङ्कटापन्न/लोपोन्मुख चरा प्रजाति पनि पाइन्छन् । जस्तै, गिद्धका केही प्रजाति, धनेस र काठ पुवा चरा आदि ।

तालिका १: जिल्ला अनुसार वन क्षेत्रमा पर्ने जग्गा र वनको प्रकार

प्रदेश	जिल्ला	सा.व. (हे.)	क.व. (हे)	सरकारद्वारा व्यवस्थित वन (हे.)	जम्मा वन (हे)
वागमती	नुवाकोट	७३.९	०.०	५९.५	१३३.४
	सिन्धुपाल्चोक	०.०	०.०	१७.९	१७.९
	काठमाण्डौ	३.६	०.०	७.०	१०.६
	धादिङ	६८.९	१.६	६७.७	१३८.२
	चितवन	०.०	०.६	२०.६	२१.२
	मकवानपुर	५९.१	०.०	८०.७	१३९.८
लुम्बिनी	पाल्पा	४६.०	२.२	३५.२	८३.४
	नवलपरासी (बर्दघाट सुस्ता पश्चिम)	१९.७	०.०	३९.३	५९.०
गण्डकी	तनहुँ	४४.०	०.०	९९.७	१४३.७
	नवलपरासी (बर्दघाट सुस्ता पूर्व)	१५.२	०.०	१५.१	३०.३
	जम्मा	**३३०.४**	**४.४**	**४४२.७**	**७७७.५**

५.३ सामाजिक, आर्थिक तथा सांस्कृतिक वातावरण

शहर, गाउँ र ठूला बस्तीलाई जोगाउँदै सामाजिक प्रभाव सकेसम्म कम हुने गरी प्रसारण लाइनको मार्ग तय गरिएको छ । प्रसारण लाइन धेरैजसो ग्रामीण क्षेत्र भएर पार हुन्छ तर बाटामा केही साना बस्ती पनि पर्दछन् । आयोजना क्षेत्रमा बसोबास गर्दै आएका मुख्य जातजातिमा ब्राम्हण, क्षेत्री, आदिवासी जनजाति र दलित छन् । चेपाङ, थारु, तामाङ, गुरुङ, मगर र नेवार मुख्य जनजाति हुन् भने मुख्य दलित समुदायहरूका रूपमा कामी, सार्की, दमाई र हरिजन/चमार रहेका छन् । आयोजना क्षेत्रका बासिन्दाका मुख्य सम्पत्ति भनेकै जग्गा हो । बहुसङ्ख्यक मानिसका लागि कृषि नै जीविकाको मुख्य स्रोत हो । कृषिको अभिन्न अङ्गका रूपमा पशुपालन समेत रहेको छ । मुख्य साझा सम्पत्तिका रूपमा सामुदायिक तथा कबुलियति वन, खोलानाला, मसानघाट तथा धार्मिक स्थलहरू रहेका छन् । बत्ती बाल्ने ऊर्जाको मुख्य स्रोत विद्युत् हो । यद्यपि आयोजना क्षेत्रका केही बस्ती अझै राष्ट्रिय ग्रिडमा जोडिन बाँकी छ । स्वास्थ्यका पूर्वाधारका रूपमा जिल्ला अस्पताल, प्राथमिक स्वास्थ्य केन्द्र, स्वास्थ्य चौकी, निजी स्वास्थ्य क्लिनिक तथा आयुर्वेद क्लिनिक रहेका छन् । शैक्षिक पूर्वाधारभित्र सरकारी र निजी दुवै खालका विद्यालय पर्दछन् । आयोजना सञ्चालन गरिने जिल्लाहरूमा साक्षरता दर राष्ट्रिय औसतकै हाराहारीमा छ । आयोजना क्षेत्रका आर्थिक-सामाजिक अवस्था मुलुकको औसत अवस्थासँग मिल्दोजुल्दो छ ।

६ वैकल्पिक विश्लेषण

एमसिए-नेपालले स्थान, डिजाइन, निर्माण, वन तथा प्रविधिका सन्दर्भमा धेरै विकल्पका साथै निर्माण नगर्ने विकल्पको समेत अध्ययन गरेको थियो, जसको सारांश तल प्रस्तुत गरिएको छ :

- **स्थानको विकल्प** : विस्तृत वातावरणीय तथा सामाजिक अध्ययन तथा सरकारी अधिकारी, संरक्षण निकाय, नागरिक समाज एवं प्रभावित समुदायसँग गरिएको परामर्शका आधारमा एमसिए-नेपालले प्रसारण लाइनको प्रस्तावित मार्गलाई सुधार्नका निम्ति झण्डै दुई वर्षको अवधि व्यतित गरेको थियो ।

- **डिजाइनका विकल्प** : यस अन्तर्गत लाइनको क्षमता (४४० वा २२० केभी), भोगाधिकार क्षेत्रको चौडाइ, भूमिगत वा सतही प्रसारण लाइन तथा इन्सुलेटेड सब-स्टेशनको प्रकार (हावा वा ग्यास) आदि कुराको विकल्पवारे अध्ययन गरिएको थियो । टावरहरूलाई खास उचाइमा डिजाइन गरेर पर्नसक्ने प्रभावहरूलाई न्यूनीकरण गरिएको छ ।

- **निर्माण पहुँचमा विकल्प** : यस अन्तर्गत पहुँच मार्गको निर्माण, ढुवानी गर्नका लागि भरिया, हेलिकप्टर तथा जनावरको प्रयोगजस्ता पहुँच विकल्पवारे छलफल गरिएको थियो । एमसिए-नेपालले टावर निर्माण स्थलसम्म पहुँचमार्ग नबनाउने भएकोले यसको सट्टा वन कटानीलाई सकेसम्म कम गर्न र स्थानीय रोजगारी प्रवर्द्धन गर्न, ढुवानी गर्नका लागि भरिया, हेलिकप्टर तथा जनावरको मिश्रित प्रयोग गर्ने विकल्प छनौट गरिएको छ ।

- **वन क्षेत्र प्रयोग नगर्ने वा कम प्रयोग गर्ने विकल्प** : आयोजनाले मार्ग छनौट गर्दा सकेसम्म वन क्षेत्र नपरोस् भनेर विभिन्न विकल्पको अध्ययन गरिएको थियो । वन क्षेत्र प्रयोग नगरी नहुने ठाउँमा मात्र वन क्षेत्रबाट आयोजनाको मार्ग लगिएको छ । प्रसारण लाइनको मार्गले वन क्षेत्रमा कम प्रभाव परोस् भनेर महत्वपूर्ण वन क्षेत्रमा टावरको उचाइ बढाई हटाउनुपर्ने रुखको सङ्ख्या कम गरिएको छ ।

७ आयोजनाका वातावरणीय प्रभावहरू

प्रस्तावित आयोजनाको निर्माणबाट कतिपय सकारात्मक प्रभाव पर्नुका साथै भौतिक, जैविक र सामाजिक-आर्थिक तथा सांस्कृतिक वातावरणमा केही नकारात्मक प्रभाव पनि पर्ने देखिन्छ ।

७.१ सकारात्मक प्रभावहरू

प्रस्तावित आयोजनाको साढे तीन वर्षको निर्माण अवधिमा करिब ७,३०० पूर्णकालीन रोजगारी सिर्जना हुनेछ । यो रोजगारीको करिब ६० प्रतिशत नेपाली कामदारले पाउने अपेक्षा छ । निर्माणको समयमा नियुक्त हुने निर्माण व्यवसायीले कम्तीमा ३३ प्रतिशत महिलालाई सहभागी गराउन प्रोत्साहन गरिनेछ । जनशक्तिको अधिकांश हिस्सा र अदक्ष कामदारहरू सबैजसो आयोजना वरिपरिको क्षेत्रबाटै प्राप्त हुने अपेक्षा गरिएको छ । आयोजना चक्रभरी आवश्यकता पर्ने बस्तु तथा सेवाहरूले गर्दा ती क्षेत्रमा स्थानीय ब्यापार, व्यवसायका लागि अबसर सिर्जना हुनेछ । निर्माण सामग्री, कामदार बस्ने शिविरका लागि खाद्यान्न तथा अन्य सहयोगी सेवाहरू खपत हुनेछन् । मसिनो र खस्रो गिट्टी, बालुवा तथा सिमेन्ट जस्ता निर्माण सामग्री स्थानीय स्तरबाटै जुटाउन सकिनेछ । यसले गर्दा स्थानीय आपूर्तिकर्ता, ढुवानीकर्ता र ठेकेदारका लागि नयाँ अवसर उपलब्ध हुनेछन् । लामो अवधिमा आयोजनामा कार्यरत कामदारहरूले नयाँ वा सुधारिएका सीपहरू प्राप्त गर्नेछन् । यसले गर्दा भविष्यमा रोजगारीका अवसरमा वृद्धि हुनेछ । एमसिए-नेपालले आयोजना खर्चको कम्तीमा ०.७५ प्रतिशत रकम (रु ३४.५ करोड) साझेदारी कार्यक्रम मार्फत् आयोजनाबाट प्रभावित स्थानीय तहमा विद्युत्को पहुँच, विश्वसनीयता र उत्पादनशील प्रयोगमा अभिवृद्धि गर्न खर्च गरिनेछ ।

प्रस्तावित आयोजना सञ्चालनमा आइसकेपछि यसबाट नेपाली कामदारका लागि चार सय वटा नयाँ, स्थायी रोजगारी सिर्जना हुनेछ । साथै, यसबाट राष्ट्रिय विद्युत् प्रणालीमा विश्वसनीयता बढ्ने, धेरै व्यक्तिलाई ऊर्जामा पहुँच दिने, जीवनस्तर सुधार्ने, थप विश्वसनीय विद्युत्शक्तिका कारण आर्थिक लगानीमा वृद्धि हुने, भारततर्फ ऊर्जाको निर्यातबाट राष्ट्रिय राजस्वमा योगदान पुग्ने तथा थप भरपर्दो विद्युत्शक्तिका कारण डिजेल जेनरेटरको प्रयोग कम भई हरितगृह ग्यास उत्सर्जनमा कमी आउने जस्ता लाभ पहिचान गरिएका छन् ।

७.२ नकारात्मक प्रभावहरू

प्रसारण लाइनको होसियारीपूर्ण मार्ग निर्धारण र डिजाइनका माध्यमबाट एमसिए-नेपालले कैयौं सम्भाव्य नकारात्मक प्रभावहरूलाई कम गरेको छ । उदाहरणका लागि प्रसारण लाइनलाई खोला नदीबाट पार गराउँदा टावरबीचको दूरीलाई बढाइएको छ भने पहिरो प्रभावित क्षेत्रभन्दा बाहिरबाट लाने प्रस्ताव गरिएको छ । साथै प्रस्तावित प्रसारण लाइनको मार्ग राष्ट्रिय निकुञ्ज र मध्यवर्ती क्षेत्र भन्दा बाहिरबाट लगिएको छ । महत्वपूर्ण पंक्षी आवागमन मार्गलाई पनि सकेसम्म छल्दै तिनीहरूको परिचित बासस्थानमा पर्न सक्ने प्रभावलाई न्यून गरिएको छ । नेपालको सबैभन्दा ठूलो चराका रूपमा चिनिने हिमाली गिद्ध (हिमालयन ग्रिफन) को पखेटाभन्दा चौडा अन्तरमा कण्डक्टर तारलाई टाँगेर चरालाई विजुलीले समात्ने जोखिम निवारण गरिएको छ । यसका अतिरिक्त आयोजनाले घरपरिवारको विस्थापनलाई यथाशक्य कम गर्दै शहर, ठूला वस्ती, विद्यालय, स्वास्थ्य क्लिनिक तथा परिचित सांस्कृतिक सम्पदालाई सकेसम्म जोगाएको छ ।

आयोजनाका सबैभन्दा उल्लेख्य नकारात्मक प्रभावहरूलाई तलका खण्डमा सङ्क्षेपमा चर्चा गरिएको छ :

७.२.१ भौतिक वातावरण

प्रस्तावित आयोजनाले विद्यमान अधिकांश भौतिक वातावरण तथा संसाधनमा तुलनात्मक रूपमा कम प्रभाव पार्नेछ । आयोजना निर्माणका लागि वन क्षेत्रका रुखहरु हटाउनुका साथै भिरालो जमिनमा समेत निर्माण कार्य गर्नुपर्ने हुन्छ । यसका कारण खासगरी वर्षायाममा भू-क्षय तथा पहिरोको जोखिम बढ्न सक्छ । निर्माण गतिविधिका कारण धुलो उड्ने सम्भावना रहन्छ । निर्माण कार्यसँग जोडिएका सवारी साधन र साना जेनरेटरबाट निस्कने धुवाँबाट वायु प्रदूषण हुने भएकोले हावाको गुणस्तरमा केही मात्रामा प्रभाव पर्नेछ । आयोजना निर्माण गर्दा निर्माणका साधन, यातायातका साधन, हेलिकप्टर र कामदार शिविरबाट ध्वनि पैदा हुनेछ ।

आयोजना निर्माणले जलस्रोतमा पनि विभिन्न ढङ्गले प्रभाव पार्न सक्छ । टावरको जगमा हाल्न कङ्क्रिट बनाउनका लागि पानी र गिट्टी बालुवा निकाल्नुपर्ने हुन्छ । पानी सामान्यतः स्थानीय खोलानालाबाटै निकालिनेछ भने गिट्टी बालुवा स्वीकृतिप्राप्त खानी तथा इजाजतप्राप्त गिट्टी बालुवा आपूर्तिकर्ताबाट मगाइनेछ । आयोजना निर्माणका लागि प्रशस्त जनशक्ति लाग्नेछ, जसले गर्दा घरेलु फोहर र मलमूत्र सिर्जना हुनेछ । यसैगरी गाडी, हेलिकप्टर र जेनरेटरका निम्ति इन्धन, तेल, लुब्रिकेण्ट र पेण्ट पनि प्रयोग हुनेछ ।

केही महत्वपूर्ण मनोरम भू-खण्ड र स्थानको नजिक भएर प्रस्तावित प्रसारण लाइन जानेछ जस्तै तनहुँको बन्दीपुर र नुवाकोटका ऐतिहासिक बस्तीहरू, त्रिशुली र सेती नदीका रमणीय क्षेत्रहरू तथा शिवपुरी-नागार्जुन राष्ट्रिय निकुञ्ज । मनोरम स्थलबाट प्रसारण

लाइनसम्मको दूरी, बीच बीचमा पहाडहरूको उपस्थिति वा दृष्टि-रेखाभन्दा तल वा माथि प्रसारण लाइनको अवस्थितिका कारण यी प्रभाव सापेक्षिक रूपमा नगन्य हुन्छन् ।

७.२.२ जैविक वातावरण

प्रस्तावित आयोजना निर्माण र संचालन कार्यबाट महत्वपूर्ण जैविक वातावरणका स्रोतहरुमा पर्ने प्रभाव बारे तल प्रस्तुत गरिएको छ । प्रभाव न्यूनिकरणका उपायहरुबारे तल दिइएको छ ।

संरक्षित क्षेत्र र जैविक विविधताका मान्यता प्राप्त क्षेत्र

एमसिए-नेपालको प्रस्तावित प्रसारण लाइनको मार्ग सकेसम्म संरक्षित क्षेत्र तथा जैविक विविधताका दृष्टिकोणले अन्तर्राष्ट्रिय मान्यताप्राप्त क्षेत्रहरूभन्दा बाहिरबाट प्रस्ताव गरिएको छ । यसका मुख्य अपवादका रूपमा चुरे संरक्षण क्षेत्र र नवलपरासीस्थित महत्वपूर्ण पंक्षी बासस्थानका रूपमा परिचित जङ्गलक्षेत्र रहेका छन् । नेपालको सिमानाभित्र नै विस्तारित चुरे संरक्षण क्षेत्रलाई नछुने कुनै विकल्प नभएको कारणले आयोजना दक्षिणतिर लाग्ने क्रममा चुरे क्षेत्रको करिब ३२.६ किलोमिटर भएर जानुपर्ने हुन्छ । साथै आयोजना नवलपरासीस्थित महत्वपूर्ण पंक्षी बासस्थानका रूपमा परिचित जङ्गलक्षेत्रको ६ किलोमिटर भू-भाग भएर जानेछ । तथापि एमसिए-नेपालले उक्त क्षेत्रका साथै अन्यत्र पनि सङ्कटापन्न एवं जोखिमग्रस्त चराका प्रजातिमाथि पर्ने प्रभाव कम गर्न उपायहरू पहिल्याएको छ । प्रस्तावित प्रसारण लाइन कुनैपनि संरक्षित क्षेत्र भएर जाँदैन ।

जङ्गलमा प्रभाव

नेपाल सरकारको महत्वपूर्ण कार्यहरुको रूपमा वन संरक्षण पनि रहेको छ । तालिका १ मा देखाइएजस्तै भोगाधिकार क्षेत्रमा करिब ७७७.५ हेक्टर वनक्षेत्र पर्नेछ, जसमा खाली र बुट्यान क्षेत्रलाई समेत सम्भावित वन क्षेत्रका रूपमा समावेश गरिएको छ । टावर निर्माणका लागि र जङ्गलका रुखहरूको उचाइ तथा प्रसारण लाइनबीच भोगाधिकार क्षेत्रको दूरी कायम राख्न केही वन मासिनेछ । यद्यपि एमसिए-नेपालले वन फँडानी सकेसम्म कम गर्न निम्नलिखित कदम चाल्नेछ :

- ९२.५ मिटरसम्म अग्ला टावर प्रयोग गरिने जसको कारण कतिपय जंगलको माथि बाट लाइन जाने ।
- नदी तथा खोला किनारका उपत्यकाहरूको धेरै भू-भागलाई माथिबाटै पार गर्न सकियोस् भनेर ठूला तथा अग्ला टावर निर्माण गर्ने ।
- टावर निर्माणस्थलसम्म नयाँ पहुँच मार्ग निर्माण नगर्ने । यस्ता पहुँच मार्ग वन फँडानीको एक मुख्य कारण हुने गर्दछ । यसको साटो ठेकेदारले विद्यमान र नयाँ पदयात्रा मार्गमा भरिया तथा जनावरमार्फत् निर्माण सामग्री एवं उपकरण ढुवानी गर्नेछ । यस कामका लागि सम्भवतः हेलिकप्टरसमेत प्रयोग गरिनेछ ।
- टावर निर्माण गरिने दुर्गम स्थानसम्म निर्माण सामग्री एवं उपकरण ढुवानी गर्न, टावर ठड्याउन र/वा तार टाँग्नका लागि हेलिकप्टर र सम्भवतः ड्रोनसमेत प्रयोग गरिनेछ ।

आयोजनाका लागि यी विधिको प्रयोगमार्फत् भोगाधिकार क्षेत्रभित्र पर्ने कुल ७७७.५ हेक्टर वनक्षेत्र मध्ये ४५.६ प्रतिशत (३५४.४ हेक्टर) वनक्षेत्र फँडानी गर्नुपर्ने हुन्छ जसबाट वन क्षेत्रमा १,७३,१८३ रुखहरु (तालिका २) र कृषि भूमिमा २८,८३५ रुखहरु हटाउनुपर्ने हुन्छ ।

तालिका २: जिल्ला र वन व्यवस्थापनको प्रकृति अनुसार हटाउनुपर्ने रुखहरुको संख्या

प्रदेश	जिल्ला	सा.व.			क.व.			सरकारद्वारा व्यवस्थित वन			जम्मा वन		
		वनको क्षेत्रफल (हे.)	हटाउनुपर्ने वनको क्षेत्रफल (हे.)	हटाउनुपर्ने रुखको संख्या	वनको क्षेत्रफल (हे.)	हटाउनुपर्ने वनको क्षेत्रफल (हे.)	हटाउनुपर्ने रुखको संख्या	वनको क्षेत्रफल (हे.)	हटाउनुपर्ने वनको क्षेत्रफल (हे.)	हटाउनुपर्ने रुखको संख्या	वनको क्षेत्रफल (हे.)	हटाउनुपर्ने वनको क्षेत्रफल (हे.)	हटाउनुपर्ने रुखको संख्या
बागमती	काठमाडौं	३.६	०.३	१९८	०	०	०	७.०	१.५	१,१८०	१०.६	१.८	१,३७८
	सिन्धुपाल्चोक	०.०	०	०	०	०	०	१७.९	४.८	३,६९६	१७.९	४.८	३,६९६
	नुवाकोट	७३.९	३०	१४,२२७	०	०	०	५९.५	३०.८	३३,६८१	१३३.४	६०.८	४७,९०८
	धादिङ	६८.९	२४	११,९७६	१.६	०.३	११४	६७.७	२४.६	१७,४७१	१३८.२	४८.९	२९,५६१
	मकवानपुर	५९.१	३७.८	१८,९१३	०	०	०	८०.७	३६.९	१६,७०२	१३९.८	७४.७	३५,६१५
	चितवन	०.०	०	०	०.६	०	८	२०.६	७	२,१६५	२१.२	७.०	२,१७३
लुम्बिनी	पाल्पा	४६.०	१८.८	९,४३५	२.२	२.१	१,०७२	३५.२	१३	२,०४१	८३.४	३३.९	१२,५४८
	नवलपरासी (बर्दघाट सुस्ता पश्चिम)	१९.७	८.७	९,६५५	०	०	०	३९.३	३६.७	८,३३४	५९.०	४५.४	१७,९८९
गण्डकी	तनहुँ	४४.०	१९.७	९,८१२	०	०	०	९९.७	३५.७	३५,३०३	१४३.७	५५.४	४५,११५
	नवलपरासी (बर्दघाट सुस्ता पूर्व)	१५.२	१९.४	४,४२६	०	०	०	१५.१	२.३	१,६०९	३०.३	२१.७	६,०३५
जम्मा		३३०.४	१५८.७	७८,६४२	४.४	२.४	१,१९४	४४२.७	१९३.३	१२२,१८२	७७७.५	३५४.४	२०२,०१८

सामुदायिक तथा कबुलियती वनमा पर्ने प्रभाव

प्रस्तावित प्रसारण लाइन कुल ११२ वटा सामुदायिक वन र आठ वटा कबुलियती वनक्षेत्र भएर जानेछ । यसले २०,६१७ सामुदायिक वन उपभोक्ता र ८५ कबुलियती वन उपभोक्ता घरधुरीहरूलाइ प्रभाव पार्नेछ। तर सामुदायिक र कबुलियती वनमा आयोजनाले समग्र रूपमा पार्ने प्रभाव निकै थोरै छ । कुल सामुदायिक तथा कबुलियती वनक्षेत्रका करिब १.३ प्रतिशत क्षेत्र फंडानी गर्नुपर्ने र करिब ०.२ प्रतिशत वन क्षेत्र प्राप्त गर्नुपर्ने छ । केही खास सामुदायिक र कबुलियती वनमा भने योभन्दा बढी नै प्रभाव पुग्ने देखिन्छ ।

महत्वपूर्ण प्रजातिमा पर्ने प्रभाव

नेपालको सङ्कटापन्न प्रजातिको सूची र अन्तर्राष्ट्रिय प्रकृति संरक्षण संस्था (आइयुसिएन) को सूचीमा समाविष्ट संरक्षणको दृष्टिले महत्वपूर्ण कतिपय उल्लेख्य प्रजाति यस आयोजनाको प्रस्तावित मार्गमा पाइन्छन् । जस्तै लामो घाँटी भएको कछुवा, एसियाली कालो भालु, स्लोथ भालु तथा चिनियाँ सालक । आयोजना निर्माण र केही हदसम्म यसको सञ्चालन चरणमा पनि यी र अन्य सामान्य प्रजातिमाथि प्रभाव पर्ने सम्भावना रहेको । वन फंडानीका कारण हुने बासस्थानको नोक्सानीबाट प्रत्यक्ष प्रभावहरू

प्रभावहरू सिर्जना हुन्छन् । यीमध्ये अधिकांश प्रजाति गतिशील छन् र निर्माणका कारण व्यवधान पुगेका स्थानबाट अन्यत्र सर्न सक्छन् । यी प्रत्यक्ष प्रभावका अतिरिक्त आयोजनाका कारण यी सङ्कटापन्न प्रजातिमा परोक्ष प्रभावसमेत पर्नसक्ने देखिन्छ । निर्माण कार्यका कारण हुने भू-परिवर्तन, मानिसको बढ्दो चहलपहल, बासस्थानको खण्डीकरण तथा निर्माणका कारण बिथोलिएका क्षेत्रमा नयाँ, मिचाहा प्रजातिको प्रवेश आदिका कारण अप्रत्यक्ष प्रभाव सिर्जना हुन्छन् ।

पंक्षीहरूमा पर्ने प्रभाव

प्रस्तावित प्रसारण लाइनको सञ्चालनबाट पंक्षीहरूमा मुख्यत: करेण्ट लाग्ने र टावर वा प्रसारण लाइनमा ठोक्किएर घाइते हुने जस्ता प्रभाव पर्न सक्दछ । विशेषगरी गिद्ध, चिल, मलेवा र सारसजस्ता ठूला पंक्षीहरूका लागि यो जोखिम उच्च छ । माथि उल्लेख भएजस्तै पंक्षीहरूलाई करेन्ट लाग्ने जोखिम न्यूनीकरण हुने गरी टावरको डिजाइन गरिएको छ । चराहरूको आधारभूत अध्ययनबाट यी ठूला पंक्षीहरूले गुँड लगाउने, खाना खोज्ने, खाने तथा उड्ने कतिपय क्षेत्र पत्ता लागेका छन् ।

७.२.३ सामाजिक, आर्थिक तथा सांस्कृतिक वातावरण

प्रस्तावित प्रसारण लाइनको प्रस्तावित मार्ग सबै शहर, खासगरी ठूला मानव बस्ती तथा परिचित सांस्कृतिक सम्पदास्थल भन्दा टाढाबाट प्रस्ताव गरिएको छ । यसबाट सम्भाव्य नकरात्मक प्रभावहरूमा कमी आएको छ । तथापि आयोजनाका कारण केही ठाउँमा भू-उपयोग गर्न नपाउने, आर्थिक तथा भौतिक विस्थापन हुने तथा सामुदायिक स्वास्थ्य र सुरक्षामा प्रभाव पर्ने देखिन्छ ।

जग्गा प्राप्ति र प्रतिबन्धहरू

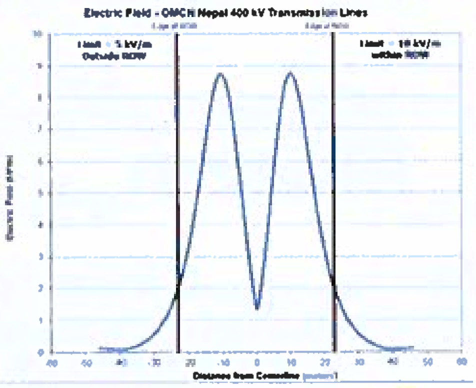
प्रस्तावित आयोजनाले रातमाटे सब-स्टेशन र त्यसको पहुँच मार्ग तथा नयाँ दमौली सब-स्टेशनका लागि पहुँचमार्ग र प्रसारण टावरका लागि कुल १२४ हेक्टर जति जग्गा प्राप्त गर्नेछ । प्राप्त गरिने जग्गामा ४९.८ हेक्टर जङ्गल र ६८.७ हेक्टर कृषि भूमि रहेको छ र बाँकी अन्य उपयोगका जग्गा ५.५ हेक्टर (खाली र घर भएको जग्गा) रहेका छन् । एमसिए-नेपालले प्रभाव तीव्रतालाई कम गर्नका निम्ति शुरुको विस्तृत सम्भाव्यता अध्ययनमा तोकिएका प्रसारण टावरमा २० प्रतिशतले कटौती गरेको छ साथै टावरको औसत उचाइ र प्रसारण लाइनको औसत लम्बाइलाई समेत वढाएको छ ।

साथै, आयोजनाले भोगाधिकार क्षेत्रभित्रको झण्डै १३४७ .१ हेक्टर जग्गाको प्रयोगमा स्थायी प्रतिबन्ध पनि लगाउनेछ । सुरक्षा कारणले नयाँ घर, आवासीय बस्ती बनाउन तथा अग्ला रुख रोप्नमा प्रतिबन्ध लगाइनेछ । स्थायी रूपमा प्रतिबन्ध लगाइने क्षेत्रमा ७२६.४ हेक्टर जङ्गल, ५४२.७ हेक्टर कृषि भूमि, र बाँकी अन्य उपयोगका जग्गा ७८ हेक्टर (खाली, नदी तथा तिनीहरुको बाढ क्षेत्र र घर भएको जग्गा) रहेका छन् । भोगाधिकार क्षेत्रमा पर्ने १,३४७ हेक्टर जग्गा मध्ये १६९.४ हेक्टर जग्गा निर्माणको समायमा टावर निर्माणका लागि अस्थायी कामदर शिविर तथा निर्माण सामाग्री भण्डारणको लागि प्रयोग गरिने छ । साथै प्रस्तावित आयोजनाका लागि १३.२ हेक्टर जग्गा प्रसारण लाइन र त्यसको भोगाधिकार क्षेत्र बाहिर कामदार शिविर र निर्माण सामाग्री भण्डारन तथा जडान गर्नको लागि निर्माण समायबधि भर अस्थायी आवश्यकता पर्नेछ ।

घरपरिवारको विस्थापन

घरपरिवारको विस्थापनलाई सकेसम्म न्यूनीकरण गर्ने गरी प्रसारण लाइनको मार्ग निर्धारण गरिए पनि आयोजनाका कारण करिब १८७ घरपरिवार विस्थापित हुनेछन् । यीमध्ये ३७ घरधुरी रातमाटे सब-स्टेशनमा र बाँकी १५० घरधुरी भोगाधिकार क्षेत्रको करिब ३१३.९ कि.मि. भू-भागबाट विस्थापित हुनेछन् । शुरुको विस्तृत सम्भाव्यता अध्ययनमा पाँच सयभन्दा बढी घरधुरी विस्थापित हुने भनिएकोमा विस्थापनलाई सकेसम्म कम गरिएको छ । सब-स्टेशन बनाउँदा र टावरको जग राख्दा कृषियोग्य भूमिमा समेत प्रभाव पर्नेछ ।

सामुदायिक स्वास्थ्य र सुरक्षामा पर्ने प्रभाव



प्रस्तावित आयोजना जस्ता ठूला निर्माण आयो जनाका कारण मानव बेचबिखन र बालश्रमको समस्या सिर्जना हुनु नेपालका सन्दर्भमा आम समस्या हो। आयोजनाको निर्माणबाट ध्वनि, धुलो तथा सवारीसाधनको चाप सिर्जना हुन्छ। यी असरबाट निर्माणस्थल निकट रहेका घरधुरीहरू प्रभावित हुन्छन् । कामदार र कहिलेकाहीँ उनीहरूका परिवारका सदस्यको आगमनले समुदायका सुविधा तथा पूर्वाधारमा थप बोझ पर्न सक्छ । तथापि, यस आयोजनाका लागि यो त्यति ठूलो समस्या हुने देखिँदैन किनकी कामदारहरूको ठूलो अंश स्थानीय स्तरबाटै आपूर्ति गरिनेछ । साथै, टावर निर्माण कर्मीहरू पनि लामो समयसम्म एकै ठाउँमा नबसी एक टावरबाट अर्कोमा सरिरहनेछन् ।

आयोजनाका परामर्श वैठकहरूका क्रममा स्थानीयहरू प्रसारण लाइनबाट सिर्जना हुने विद्युतीय र चुम्बकीय फिल्ड (इलेक्ट्रीक म्याग्नेटीक फिल्ड - ईएमएफ) का कारण स्वास्थ्यमा पर्ने जोखिम बारे चिन्तित रहेको पाइएको छ । अध्ययनहरूले प्रसारण लाइन आसपासका क्षेत्रमा बसोबास गर्दा स्वास्थ्यमा हुने जोखिम बारे कुनै प्रमाणित तथ्याङ्क उल्लेख गरेको पाइँदैन । विश्व स्वास्थ्य सङ्गठनले भने ईएमएफको एक्स्पोजरको मापदण्ड बनाएको छ । एमसिए- नेपालको अध्ययन अनुसार प्रस्तावित आयोजनाको ईएमएफको प्रभाव विश्व स्वास्थ्य सङ्गठनको मापदण्डको आधाभन्दा कम रहेको छ । यस अध्ययनबाट भोगाधिकार क्षेत्रमा खेती गर्न सकिने र भोगाधिकार बाहिरको क्षेत्रमा बसोबास गर्दा सुरक्षित हुने देखिएको छ ।

आदिवासी, सीमान्तीकृत र विपन्न जनसङ्ख्यामा पर्ने प्रभाव

सम्भाव्य प्रतिकूल प्रभाव न्यूनीकरण गर्न नसकिएमा तिनको प्रभाव सीमान्तीकृत तथा अति सीमान्तीकृत आदिवासी, जनजाति तथा दलित समुदायमा बढी पर्न सक्छ । साथै, प्रस्तावित आयोजना कार्यान्वयनका क्रममा मानव ओसारपसारका कारण महिला तथा सीमान्तीकृत समुदायमाथि अतिरिक्त जोखिम सिर्जना हुनसक्दछ । यस जोखिमभित्र धोकापूर्ण वा बाध्यकारी यौन तस्करीसमेत पर्न सक्छन् । यसका अतिरिक्त रोजगारीमा विभेद र महिला श्रमको अवमूल्यन तथा पुरुषसरह समान काम गर्दा पनि असमान पारिश्रमिक अवस्था रहनसक्छ । यौनजन्य उत्पीडन र लैङ्गिक हिंसाका घटना पनि हुन सक्छन् ।

पेशागत स्वास्थ्य र सुरक्षा

आयोजना निर्माणका क्रममा उचाइमा रहेर काम गर्ने, गह्रौं सामान ओसारपरसार गर्ने, कठिन भू-क्षेत्रमा काम गर्ने र बदलिँदो मौसममा खटिने कामदारहरूमा सुरक्षा जोखिम सिर्जना हुनसक्छ ।

८ सकारात्मक प्रभाव अभिवृद्धि र नकारात्मक प्रभाव न्यूनिकरणका उपायहरू

एमसिए-नेपालले आयोजनाबाट प्राप्त हुने लाभलाई अधिकतम गर्नका लागि सकारात्मक प्रभाव अभिवृद्धिका उपाय र आयोजनाका नकारात्मक प्रभावलाई कम गर्न न्यूनिकरणका उपाय अगाडि बढाउने दिशामा निम्न लिखित उपाय प्रस्ताव गरेको छ।

८.१ सकारात्मक प्रभाव अभिवृद्धिका उपायहरू

एमसिए-नेपालले देहायका सकारात्मक प्रभाव अभिवृद्धिका उपायहरू प्रस्ताव गरेको छ :

- एमसिए-नेपाल साझेदारी कार्यक्रम : एमसिए-नेपालले आयोजना लागतको कम्तिमा ०.७५ प्रतिशत रकम साझेदारी कार्यक्रममार्फत् आयोजना प्रभावित स्थानीय तहमा विद्युत्को पहुँच, भरपर्दो आपूर्ति र उत्पादनशीलताको लागि प्रयोग गर्नेछ।
- ठेकेदारलाई स्थानीय र महिलालाई काममा अधिकतम भर्ना गर्न प्रोत्साहन गर्नका निम्ति निर्माण बोलपत्रमा सान्दर्भिक व्यवस्थाहरू राखी स्थानीय रोजगारीका अवसरलाई अभिवृद्धि गर्ने। रोजगारीको अवसरमा ३३ प्रतिशत महिला प्रतिनिधित्व गराउने र सीमान्तकृत तथा आदिवासी समुदायलाई प्राथमिकता दिने प्रयास गरिनेछ।

- ठेकेदारलाई स्थानीय वस्तु र सेवा अधिकतम खरिद गर्न प्रोत्साहन गर्नका निम्ति निर्माण बोलपत्रमा सान्दर्भिक व्यवस्था राखी स्थानीय व्यापारको अवसरलाई अभिवृद्धि गर्ने ।
- नयाँ बुटवल, नयाँ दमौली र रातमाटे सब-स्टेशनको डिजाइनमा भविष्यमा क्षमता थप गर्न सकिने गरी स्थान छोडेर नेपालको विद्युत् वितरण प्रणालीको कार्यदक्षता एवं विश्वसनीयता अभिवृद्धि गर्ने ।

८.२ नकारात्मक प्रभाव न्यूनीकरणका उपायहरू

प्रस्तावित आयोजनाका नकारात्मक प्रभाव न्यूनीकरणका लागि मुख्य उपायहरू तल तालिकामा प्रस्तुत गरिएको छ ।

तालिका ३ : आयोजनाका नकारात्मक प्रभाव निराकरणका मुख्य उपायहरूको सारांश

पक्ष/स्रोत	प्रभाव	प्रस्तावित न्यूनीकरणका उपाय
निर्माण चरण		
सामान्यतया पर्ने प्रभावहरु	सामाजिक वातावरणको विभिन्न क्षेत्रमा	कामदार आचारसंहिता लागू गर्दै चोरीशिकारी, दाउरा सङ्कलन, वनस्पतिको अवैध फडानी, विरुवा तथा जनावरको व्यापार वा सङ्कलन, अवैध सामग्रीको धारणा, मदिरा तथा लागूपदार्थ दुर्व्यसन, मानव तस्करी, वेश्यागमन, स्थानीय परम्परा र प्रथाको अवमूल्यन जस्ता कार्यमा संलग्न आयोजनाका कर्मचारी तथा कामदारलाई दण्डित गर्ने व्यवस्था कार्यान्वयन गर्ने ।
	समाजमा	समुदायको गुनासो सम्वोधन प्रक्रिया लागू गर्ने । यसबाट ठेकेदारको वातावरणीय र सामाजिक कार्य सम्पादन बारे चासो व्यक्त गर्न सरोकारवालालाई सहज हुनेछ ।
	आयोजना क्षेत्रमा	सरोकारवालालाई आयोजनाको गतिविधिबारे सुसूचित गर्न आयोजना सरोकारवालासंगको परामर्श योजना (Stakeholder Engagement Plan) लागू गर्ने ।
भौतिक वातावरण		
भू-धरातल/भू-गर्भ/माटो	भू-क्षय र थिग्रान	भू-क्षय निवारण मापदण्ड पूर्ण पालना गर्ने । टावरमा पुग्न पहुँच मार्गका रूपमा पूर्ण नयाँ सडक निर्माण नगर्ने । वनस्पतिको कटानी सीमित गर्ने । माथिको सतहको माटो पुनःप्रयोगको लागि थुपार्ने ।
हावाको गुणस्तर	धुलो र जेनरेटरबाट हुने उत्सर्जन	निर्माण क्षेत्रलाई पुनस्थापना गर्ने । निकालिएको माटोलाई छोप्ने । गुनासो आएमा निर्माण क्षेत्रमा पानी छर्किने । जेनरेटर, निर्माण वाहन/उपकरणको उचित सम्भार गर्ने ।
जलस्रोत	पानीको प्रयोग	पानी निकाल्ने काम प्रवाहको २० प्रतिशतभित्रै सीमित राख्ने ।

पक्ष/स्रोत	प्रभाव	प्रस्तावित न्यूनीकरणका उपाय
	गिट्टी बालुवाको निकासी	स्वीकृत नदीजन्य गिट्टी बालुवा आपूर्तिकर्ता वा खानीबाट सामान लिने ।
	नदी पार र तटिय क्षेत्र	नदी तटिय क्षेत्रमा प्रस्तावित टावरहरूको उचाइ र फाउन्डेसन विशेष किसिमको प्रस्ताव गरिएको छ ।
	ढल निकास र फोहर पानीको विसर्जन	उपयुक्त ढल निकास र फोहर पानीको उपचार र विसर्जन सेवा उपलब्ध गराउने ।
	निश्चित फोहर व्यवस्थापन	फोहर घटाउने, पुन: प्रयोग गर्ने र प्रसोधन गर्ने पद्धति अपनाइनेछ ।
	हानिकारक सामग्री	खोलानालाबाट कम्तीमा १०० मिटर परै इन्धन ट्याङ्की राख्ने र भण्डारणको अर्को तह थप गर्ने ।
ध्वनिको तह	निर्माणबाट हुनेध्वनि प्रदूषण	• ध्वनि उत्पन्न गर्ने क्रियाकलापलाई दिनको समयमा सीमित गर्ने । • ब्लास्टिङ्ग गर्नुपरेमा नजिकका संरचनाहरूको पहिलेनै लेखाजोखा गर्ने • हेलिकप्टर प्रयोग, ब्लास्टिङ्ग र विस्फोटकको सम्बन्धमा नजिककमा छरछिमेकहरूलाइ पुर्व सूचित गर्ने ।
दृष्य वातावरण, सुविधा र मूल्य	दृष्य प्रदूषण	प्रसारण लाइनलाई सकेसम्म पर्यटकीय क्षेत्रबाट नदेखिने ठाउँबाट लैजाने ।
जैविक वातावरण		
जैविक विविधता संरक्षणका लागि अन्तर्राष्ट्रिय मान्यता प्राप्त क्षेत्र र संरक्षित क्षेत्र	चुरे संरक्षणक्षेत्रमा प्रभाव	• राष्ट्रपति चुरे तराई मधेश संरक्षण विकास समितिको शर्तहरूको पालना गर्ने । • चुरे संरक्षण क्षेत्रबाट गिट्टी बालुवा निकाल्न वन्देज लगाउने । • चुरे संरक्षण क्षेत्रमा वनको नोक्सानी नहोस् भन्नका लागि वृक्षारोपणमा जोड दिने ।
वन र रुखहरू	वनकटानी	▪ वन क्षेत्रको सफाइ र रुखहरुमा परेको प्रभावको क्षतिपूर्ति वापत २०,२०,१८० बिरुवाहरु लागाउने । (एउटा हटाइएको रुख वापत १० वटा रुख रोप्ने) ▪ क्षतिग्रस्त ठाउँहरुमा स्थानीय प्रजातिका बिरुवा रोप्ने । ▪ वृक्षरोपणका समयमा सामूदायिक वनहरुलाई सहभागिता गराउने ।

पक्ष/स्रोत	प्रभाव	प्रस्तावित न्यूनीकरणका उपाय
		▪ क्षतिपूर्ति वापत रोप्ने रुखहरु रोप्ने समयमा राष्ट्रिय प्राथमिकता प्राप्त योजनाको लागि राष्ट्रिय वन क्षेत्र प्रयोग गर्ने सम्बन्धी मापदण्ड सहितको कार्यविधि, २०७६ अनुसार डिभिजन वन कार्यालय र सामुदायिक वन संग समन्वय गर्ने ।
वन्यजन्तु	सङ्कटापन्न प्रजातिमा प्रभाव	▪ वन कटानी र वासस्थानको नोक्सानीलाई सीमित गर्ने । ▪ मिचाहा प्रजातिको अतिक्रमण पत्ता लगाई उन्मुलन गर्ने । ▪ निर्माण क्षेत्रबाट कम गतिशील प्रजातिहरुलाई अन्यत्र सार्न चरिचरणका मापदण्ड लागू गर्ने ।
सामाजिक, आर्थिक तथा सांस्कृतिक वातावरण		
भू-स्वामित्व र प्रयोगमा परिवर्तन	घरपरिवार विस्थापन	▪ पुनर्वास नीति ढाँचा र पुनर्वास कार्ययोजना तयार गरी लागू गर्ने जसमा जग्गाको स्वामित्व नभएका तर भोगचलन गरी राखेकाको समेत सम्बोधन हुनेछ । यसमा प्रतिस्थापन मूल्य सहितको जग्गा र त्यसमा भएका अन्य सम्पत्तिको मूल्याङ्कन गरिनेछ र जोखिम समुदायको लागि संक्रमणकालिन भत्ताको व्यवस्था गरिनेछ । ▪ अस्थायी जग्गा उपयोग नीति प्रयोग गरिनेछ । ▪ एमसीए-नेपालले जग्गा प्राप्ति ऐन २०३४ अनुसार जग्गा अधिग्रहण गर्नेछ र भोगाधिकार क्षेत्रको जग्गा विद्युत ऐन तथा नियमावली अनुसार क्षतिपूर्ति निर्धाण समितिले तोकेवमोजिम गर्नेछ । अस्थायी आवश्यक जग्गा भाडामा लिनेछ ।
	आर्थिक विस्थापन	▪ विस्थापित परिवार वा कामदारका लागि जीविकोपार्जन पुनर्स्थापना योजना लागू गर्ने ।
महिला, आदिवासी, जोखिमग्रस्त तथा विपन्न जनसङ्ख्या	मानव ओसारपसार र नाबालिगहरूलाई काममा लगाउने जोखिम	▪ मानव ओसारपसार जोखिम व्यवस्थापन योजना लागू गर्ने ।
	नाबालिगहरू	▪ सबै कर्मचारीको उमेर खुल्ने प्रमाण माग गर्ने ।
	यौनजन्य उत्पीडन तथा लैंगिक हिंसा	▪ कामदारहरुको आचारसंहिता लागू गर्ने । ▪ यौनजन्य उत्पीडन विरुद्ध नीति लागू गर्ने।
सामुदायिक स्वास्थ्य र सुरक्षा	रोजगारी सम्बन्धी विभेदको जोखिम	▪ कामदार व्यवस्थापन योजना लागू गर्ने ।
	कामदार-समुदायद्वन्द्वको सम्भावना	▪ कामदारहरूको आचारसंहिता लागू गर्ने ।

पक्ष/स्रोत	प्रभाव	प्रस्तावित न्यूनीकरणका उपाय
		▪ ट्राफिक व्यवस्थापन योजना लागू गर्ने । ▪ कामदार पहुँच व्यवस्थापन मापदण्ड लागू गर्ने । ▪ समुदाय गुनासो सम्बोधन संयन्त्र लागू गर्ने । ▪ आवागमन व्यवस्थापन योजना लागू गर्ने ।
पेशागत स्वास्थ्य र सुरक्षा	कामदार चोटपटकको सम्भावना	▪ पेशागत स्वास्थ्य र सुरक्षा योजना बनाई लागू गर्ने । ▪ कामदार गुनासो सम्बोधन संयन्त्र लागू गर्ने ।
कार्यसञ्चालन चरण		
जलस्रोत	ढल र फोहरपानी उपचार	▪ सेप्टिक प्रणाली वा फोहर पानी उपचार संयन्त्र उपयुक्त ढङ्गले खडा गर्ने ।
	हानिकारक सामग्री पोखिने	▪ हानिकारक सामग्रीलाई निर्धारित स्थानमा राख्ने र भण्डारणको अर्को तह थप गर्ने ।
ध्वनि वातावरण	सब-स्टेशनको सञ्चालन	▪ ठूलो आवाज निकाल्ने क्रियाकलापलाई विहान ६ देखि राति ▪ १० बजेसम्म सीमित गर्ने ।
वन र रुखहरू	भोगाधिकारक्षेत्रको सम्भार	▪ सुरक्षा मापदण्डका लागि आवश्यक जति मात्र रुख हटाउने ।
पंक्षीहरू	ठोक्किने जोखिम	▪ पंक्षीको ठक्करको जोखिम कम गर्न तारहरूमा सदृष्य वस्तुहरू जडान गर्ने । जस्तै : पंक्षी विकर्षक र सूचक वलहरू । ▪ सङ्कटापन्न र लोपोन्मुख चराका प्रजातिहरूलाई प्रसारण लाइनको ठक्करको जोखिमबाट जोगाउन जैविक विविधता अफसेट प्रदान गर्ने ।

जग्गा अधिग्रहण वाहेक आयोजनाको प्रस्तावित न्यूनीकरणका उपायहरू कार्यान्वयनकालागि करिब ३ अर्ब रुपैयाँ (करिब २७.५ मिलियन अमेरिकी डलर) खर्च अनुमान गरिएको छ । यी न्यूनीकरण एवं निराकरणका उपायहरूको उद्देश्य आयोजनाका सबै नकारात्मक प्रभावहरूलाई कम गर्न रहेको छ । यसका लागि पहिले यी प्रभावहरूको प्रकृति, किसिम, तीव्रता, विस्तार र अवधि तथा प्रस्तावित न्यूनीकरण एवं निराकरणका उपायहरूको अनुमानित प्रभावकारितालाई ध्यानमा राखिएको छ । प्रस्तावित न्यूनीकरण एवं निराकरणका उपायहरूले आयोजनाका सबै प्रभावहरूको भूमिकालाई नगण्य बनाइ दिएको छ । यसबाट आयोजना वातावरणीय एवं सामाजिक दृष्टिले स्वीकार्य बन्न पुगेको छ । अंग्रेजी संग तुलना गर्नु पर्ने ।

९ वातावरणीय व्यवस्थापन योजना

एमसिए-नेपालले एक प्रभावकारी वातावरणीय, सामाजिक, स्वास्थ्य र सुरक्षा व्यवस्थापन योजना तयार गरेको छ । यसबाट यस वातावरणीय प्रभाव मूल्याङ्कनमा पहिचान गरिएका न्यूनीकरण एवं निराकरणका उपायहरूलाई पूर्णतः लागू गर्ने कुराको सुनिश्चितता कायम गरिएको छ । यो व्यवस्थापन योजनालाई २ चरणमा बाँडिएको छ । प्रत्येकले फरक फरक आयोजना चरण एवं फरक फरक कार्यान्वयन निकायसँग सम्बन्ध राख्दछ । यसबाट उनीहरूको भूमिका र जिम्मेवारीका बारेमा कुनै अन्यौल

बाँकी रहँदैन । यी २ चरण हुन् : १) निर्माणपूर्व र निर्माण चरण, तथा २) सञ्चालन चरण । पहिलो चरणमा आयोजना निर्माणका समयमा एमसिए-नेपाल र ठेकेदारका सामाजिक तथा वातावरणीय व्यवस्थापन जिम्मेवारीको पहिचान गरिन्छ । यसका अतिरिक्त, एमसिए-नेपालले जैविक विविधता व्यवस्थापन, पुनर्वास, वृक्षारोपण र एमसिए साझेदारी कार्यक्रमसँग सम्बन्धित न्यूनीकरणका दायित्वसमेत निर्वाह गरिरहनेछ । दोस्रो चरणमा ती प्रभावहरूको लेखाजोखा र सम्बोधन गरिन्छ जुन आयोजना सञ्चालन अवधिसम्म कायम रहन्छन् वा आयोजना सञ्चालन नहुँदासम्म ती देखिँदैनन्, यद्यपि आयोजनाका अधिकांश प्रभावहरू निर्माण चरणमै देखिने छन् । वातावरणीय व्यवस्थापन योजनाको अनुगमनका समयमा एमसीए-नेपाल, एमसीसी, निर्माणव्यवसायी, आयोजनाको इन्जिनियर, वन तथा वातावरण मन्त्रालय, राष्ट्रपति चुरे संरक्षण बोर्ड, नागरिक उड्डयन प्राधिकरण आदिलाई समावेस गरिनेछ ।

१० वातावरणीय अनुगमन

वातावरणीय अनुगमनको उद्देश्य नियमनकारी आवश्यकताहरूको परिपालन गर्नु तथा समग्र वातावरणीय तथा सामाजिक कार्यसम्पादनसँग आयोजनाको तादात्मय पत्ता लगाउनु हो । एमसिए-नेपालले ३ किसिमका अनुगमन गर्ने प्रस्ताव गरेको छ : १) समयसँगै हुने परिवर्तन मापन गर्न गरिने आधारभूत अनुगमन २) नेपालका प्रचलित नियामक मापदण्डसँग आयोजनाको अनुकूलता जाँच्न गरिने अनुपालन (Compliance) अनुगमन, र ३) नियामक मापदण्ड नरहेको अवस्थामा विभिन्न पक्षमाथि आयोजनाले पारेको असर पत्ता लगाउन प्रभाव अनुगमन । यो अनुगमन निर्माणपूर्व, निर्माण, निर्माणोत्तर र सञ्चालनको चरणसम्म बहाल रहनेछ ।

११ वातावरणीय परीक्षण

प्रस्तावित आयोजनाको वातावरणीय परीक्षण ३ किसिमले गरिनेछ : १) समापन परीक्षण जसमा एमसिए-नेपालले निर्माण सकिएको अवस्थामा ठेकेदार तथा आयोजना कार्यान्वयनमा संलग्न अन्य पक्षले वातावरणीय प्रभाव मूल्याङ्कन तथा वातावरणीय, सामाजिक, स्वास्थ्य र सुरक्षा व्यवस्थापन योजनाको अनुपालन गरेको सुनिश्चित गर्नका लागि गर्दछ । २) वातावरणीय प्रभाव मूल्याङ्कन परीक्षण जसलाई आयोजना सञ्चालन भएको २ वर्षपछिको ६ महिना भित्र वन तथा वातावरण मन्त्रालयले गर्दछ । यसको उद्देश्य आयोजनाले वातावरणीय प्रभाव मूल्याङ्कनका मापदण्ड अनुशरण गऱ्यो वा गरेन भन्ने तय गर्नु हो । ३) आयोजना प्रभाव परीक्षण जसलाई अन्तिम आयोजना सञ्चालकले अन्दाजी हरेक २ वर्षमा गर्दछ । यसको उद्देश्य समयक्रमसँगै देखिने आयोजना सम्बन्धी वातावरणीय एवं सामाजिक प्रभावहरूको मापन गर्दै निरन्तर सुधारको संस्कृति बसाउनु हो ।

१२ निष्कर्ष र प्रतिबद्धता

यस वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा प्रस्तावित निराकरण/न्यूनीकरणका उपायलाई ध्यानमा राख्दा आयोजना निर्माण, सञ्चालनको चरणमा पर्ने सबै नकारात्मक प्रभावहरू नगण्य रहनेछन् । तल तालिकामा देखाए अनुसार प्रस्तावित न्यूनीकरणका उपायहरू अपनाउँदा सङ्कटापन्न र लोपोन्मुख चराका प्रजातिहरू (हिमालयन ग्रिफन्, गिद्धका प्रजातिहरू, स्टिप इगल, र सारस केन) मा पर्ने तारमा ठोकाईको प्रभाव बाहेक अन्य प्रभावहरू नगण्य देखिएका छन् । एमसिए-नेपालले यस प्रभावलाई न्यूनीकरण गर्न विभिन्न उपायहरू अपनाएको छ र यो विकल्प विनाको प्रभावका बारे अन्य थप कार्यहरू समेत गर्नेछ । साथै, एमसिए-नेपालले तयार गरेको वातावरणीय, सामाजिक, स्वास्थ्य र सुरक्षा व्यवस्थापन योजना कार्यान्वयन गरिनेछ । वातावरणीय अनुगमन प्रणाली कार्यान्वयन गरी सबै आवश्यक न्यूनीकरण तथा निराकरणका विधिहरू लागू भएको कुरा सुनिश्चित गर्नेछ । यस वातावरणीय प्रभाव मूल्याङ्कनको निष्कर्षमा यस आयोजनाको कार्यान्वयनबाट देशको अर्थतन्त्र एवं नेपाली जनताका लागि यस आयोजनाको सारभूत लाभहरू यसका अवशिष्ट प्रभावहरूभन्दा बढी छन् ।

तालिका ४: आयोजना निर्माण चरणका नकारात्मक प्रभाव र अवशिष्ट भूमिकाको सारसंक्षेप

पक्ष/स्रोत	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
भौतिक वातावरण			
भू-बनोट/भू-गर्भ/माटो	भू-क्षय र पहिरो	मध्यम	मामूली
हावाको गुणस्तर	धुलो उत्सर्जन	मामूली	नगण्य
	प्रसारण लाइनबाट उत्सर्जन	नगण्य	नगण्य
	सब-स्टेशनबाट उत्सर्जन	नगण्य	नगण्य
	पानीको प्राप्ति	मामूली	नगण्य
	गिट्टी बालुवा प्राप्ति	मामूली	नगण्य
	नदी तर्ने र बाढी मैदान	नगण्य	नगण्य
जलस्रोत	थिग्रान	मध्यम	मामूली
	फोहरपानीको विसर्जन	मामुली	नगण्य
	हानिकारक सामग्री पोखिने	मामूली	नगण्य
	ठोस फोहरको अनुचित विसर्जन	मामूली	नगण्य
ध्वनि वातावरण	प्रसारण लाइन निर्माण कार्यबाट हुने कोलाहल	मामूली	नगण्य
	नयाँ सब-स्टेशन निर्माण कार्यबाट हुने कोलाहल	मामूली	नगण्य
	मौजुद सब-स्टेशन निर्माणबाट हुने कोलाहल	नगण्य	नगण्य
	हेलिकप्टरको प्रयोगबाट हुने हल्ला	मध्यम	मामूली
	विष्फोटक पदार्थको प्रयोगबाट हुने ध्वनि र कम्पन	मध्यम	नगण्य
दृश्यावलोकन	मनोरम दृश्यको क्षय	मामूली	मामूली
जैविक वातावरण			
संरक्षित क्षेत्र र जैविक विविधताका लागि अन्तर्राष्ट्रिय मान्यता प्राप्त क्षेत्र	चुरे संरक्षण क्षेत्र	मध्यम	मामूली
	तराई भू-परिधि क्षेत्र	नगण्य	नगण्य
	चितवन अन्नपूर्ण क्षेत्र	नगण्य	नगण्य
	शिवपुरी-नागार्जुन राष्ट्रिय निकुञ्ज	नगण्य	नगण्य

पक्ष/स्रोत	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
	पर्सा राष्ट्रिय निकुञ्ज र महत्वपूर्ण पंक्षी बासस्थान	नगण्य	नगण्य
	नवलपरासी महत्वपूर्ण पंक्षी बासस्थान	मामूली	नगण्य
बासस्थान	वनमा हुने प्रभाव	मुख्य	मामूली
	मिचाहा प्रजातिको प्रवेश	मामूली	मामूली
	अग्नि जोखिममा वृद्धि	मध्यम	मामूली
	सीमान्त प्रभावहरू	मामूली	मामूली
	गैरकाष्ठ वनपैदावरको थप नोक्सानी	मामूली	मामूली
वन्यजन्तु प्रजाति	वन्यजन्तुमा व्यवधान	मध्यम	मामूली
	वन्यजन्तुको अवैध चोरीसिकार	मध्यम	मामूली
	सवारी साधन दुर्घटनाबाट हुने मृत्यु	नगण्य	नगण्य
	मानव-वन्यजन्तु द्वन्द्वको बढ्दो जोखिम	नगण्य	नगण्य
	बासस्थानको बढ्दो खण्डीकरण	मध्यम	मामूली
सामाजिक वातावरण			
भू-स्वामित्व र प्रयोगमा फेरबदल	भौतिक विस्थापन	मुख्य	मामूली
	आर्थिक विस्थापन/जीविकाको नोक्सानी	मुख्य	मामूली
	पहुँचसम्बन्धी अस्थायी प्रभाव	मुख्य	मामूली
सामुदायिक स्वास्थ्य र सुरक्षा	मानव ओसारपसार र बालश्रम सम्बन्धी जोखिम	मध्यम	मामूली
	स्थानीय समुदायमा हैरानीको जोखिम	मामूली	नगण्य
	सरुवा रोग र जीवाणुबाट सर्ने रोगको जोखिम	मामूली	नगण्य
	सम्भावित सामुदायिक द्वन्द्व	मध्यम	नगण्य
	सुरक्षासम्बन्धी सम्भाव्य प्रभाव	मामूली	नगण्य
सामुदायिक संसाधन	प्राकृतिक स्रोतमा पर्ने प्रभाव	मध्यम	मामूली
	अन्य प्राकृतिक स्रोतमा पर्ने प्रभाव (जलस्रोत)	मामूली	नगण्य
	पूर्वाधारमा दबाव	मामूली	नगण्य

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पक्ष/स्रोत	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
स्थानीय अर्थतन्त्र र रोजगारी	स्थानीय अर्थतन्त्र र रोजगारीमा पर्ने प्रभाव	मामूली	सकारात्मक
जोखिमशील व्यक्तिहरू	आदिवासी र विपन्न वर्गमा पर्ने प्रभाव	मध्यम	मामूली
लैङ्गिक	महिलामा पर्ने जोखिम	मध्यम	मामूली
सांस्कृतिक सम्पदा	मूर्त (tangible) संसाधन	नगण्य	नगण्य
	अमूर्त (intangible) संसाधन	मध्यम	नगण्य

तालिका ५ : आयोजना सञ्चालन चरणका नकारात्मक प्रभाव र अवशिष्ट भूमिकाको सारसङ्क्षेप

पक्ष	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
भौतिक वातावरण			
भू-बनोट/भू-गर्भ/माटो	भू-क्षय र पहिरो	मध्यम	नगण्य
हावाको गुणस्तर	सब-स्टेशनको उत्सर्जन	नगण्य	नगण्य
जलस्रोत	नदीपार तथा बाढीक्षेत्र	मामूली	नगण्य
	थिग्रान	मध्यम	नगण्य
	फोहरपानीको विसर्जन	नगण्य	नगण्य
	हानिकारक सामग्री पोखिने	मामूली	नगण्य
	अव्यवस्थित फोहर विस्थापन	नगण्य	नगण्य
ध्वनि वातावरण	प्रसारण लाइन सञ्चालनबाट निस्कने ध्वनि	मामूली	नगण्य
	नयाँ सब-स्टेशन सञ्चालनबाट निस्कने ध्वनि	मामूली	नगण्य
दृश्य मूल्य	मनोरम दृश्यको क्षय	मामूली	मामूली
जैविक वातवरण			
संरक्षित क्षेत्र र जैविक विविधताका लागि अन्तर्राष्ट्रिय मान्यता प्राप्त क्षेत्र	चुरे संरक्षण क्षेत्र	मामूली	नगण्य
	तराई भू-परिधि क्षेत्र	नगण्य	नगण्य
	चितवन अन्नपूर्ण क्षेत्र	नगण्य	नगण्य
	शिवपुरी-नागार्जुन राष्ट्रिय निकुञ्ज	नगण्य	नगण्य
	पर्सा राष्ट्रिय निकुञ्ज र महत्वपूर्ण पंक्षी वासस्थान	नगण्य	नगण्य

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सिंहदरबार, काठमाडौं

पक्ष	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
	नवलपरासी महत्वपूर्ण पंक्षी वासस्थान	मामूली	नगण्य
वन र वनस्पति	वनमा पर्ने प्रभाव	मामूली	नगण्य
	घुसपैठिया प्रजातिको प्रवेश	मामूली	नगण्य
	अग्नि जोखिममा वृद्धि	मामूली	नगण्य
	सीमान्त प्रभावहरू	नगण्य	नगण्य
	गैरकाष्ठ वनपैदावरको थप नोक्सानी	नगण्य	नगण्य
जङ्गली जनावर प्रजातिहरू	जङ्गली जनावरमा हुने खलल र विस्थापन	नगण्य	नगण्य
	वन्यजन्तुको अवैध चोरीशिकार	मामूली	मामूली
	सवारी साधनबाट हुने दुर्घटना	नगण्य	नगण्य
	मानव-वन्यजन्तु द्वन्द्वको बढ्दो	नगण्य	नगण्य
	जोखिम		
	वासस्थानको बढ्दो खण्डीकरण	नगण्य	नगण्य
	ठोक्किने जोखिम	मुख्य	मध्यम
सामाजिक वातावरण			
भू-स्वामित्व र प्रयोगमा फेरबदल	व्यक्तिको जग्गामा पहुँच सम्बन्धी अस्थायी प्रभाव	नगण्य	नगण्य
सामुदायिक स्वास्थ्य र सुरक्षा	विद्युतीय चुम्बकीय फिल्ड	नगण्य	नगण्य
सामुदायिक स्रोत र साधन	प्राकृतिक संसाधनमा प्रभाव	नगण्य	नगण्य
	पूर्वाधारमा दबाब	नगण्य	नगण्य
जोखिमशील व्यक्ति	आदिवासी तथा जोखिममा परेका व्यक्तिहरू	मामूली	नगण्य
लैङ्गिक	महिलामा पर्ने प्रभाव	मामूली	नगण्य

एमसिए-नेपालले चराका विभिन्न प्रजातिमा पर्नसक्ने अन्य जोखिमलाई कम गर्न विभिन्न थप न्यूनीकरणका उपायअपनाउनेछ ।

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तालिका ६ : निर्माण र सञ्चालन अवधिको समग्र अवशिष्ट महत्व

पक्ष	प्रभाव	न्यूनीकरण पूर्वको महत्व	अवशिष्ट महत्व
भौतिक वातावरण			
जलवायु परिवर्तन	हरितगृह ग्यास उत्सर्जन	सकारात्मक	सकारात्मक

अर्थतन्त्र र नेपालका जनताका निम्ति यस आयोजनाका सारभूत लाभहरू यसका अवशिष्ट नकारात्मक प्रभावहरू भन्दा धेरै वढी छन् र आयोजनाको नकारात्मक प्रभावहरू नगण्य रहने समग्र निष्कर्ष यस वातावरणीय प्रभाव मूल्याङ्कनले निकालेको छ ।

EXECUTIVE SUMMARY

1. BACKGROUND

The Millennium Challenge Account Nepal (MCA-Nepal), which is a Government of Nepal (GoN) agency, is proposing to construct an approximately 313.9-kilometer-long 400 kV double circuit transmission line project, referred to as the Electricity Transmission Project (ETP or Project). The Millennium Challenge Corporation (MCC), an independent United States Government foreign aid agency, entered into an agreement with the GoN to provide approximately $398 million to fund construction of the ETP, with the GoN contributing an additional $130 million.

The ETP is intended to be a significant component of Nepal's electricity transmission network, as identified in the *Transmission System Development Plan of Nepal* (MoEWRI 2018). The overall objective of this Project is to increase electricity consumption by improving the availability and reliability of electricity supply in Nepal's electricity grid and by facilitating power trade.

Since the ETP is expected to displace 187 households (approximately 943 people) and passes through the Chure Conservation Area, Nepal's *Environment Protection Act* (EPA 1997) and *Environment Protection Rules* (EPR 1997) require an Environmental Impact Assessment (EIA) for the Project. EPR (2020) requires transmission line projects to do only IEE irrespective of whether it passes through protected areas and their capacities. The Ministry of Forests and Environment (MoFE) made Minister Level Decisions on Simplification of Implementation Procedure of Environment Protection Act, 2019 (2076) and Environment Protection Rule, 2020 (2077) on June 28, 2020 (Ashad 14, 2077) and November 19, 2020 (Mansir 04, 2077) that allowed EIA reports conducted as per EPR (1997) which were submitted to concerned agency prior to the publication of EPR (2020) to go through approval process as per EPR (2020) upon request from the project proponent (Decision #2 made on November 19, 2020).

Stantec Consulting International LLC (assisted by subcontract partners Power Engineers Inc. and Environmental Resources Management, and collectively referred to as the "Consultant Team" in this EIA) was commissioned to undertake the consulting services for the ETP, which include the preparation of this EIA for submission to the GoN for approval.

MCA-Nepal (and its predecessor Office of Millennium Challenge Nepal) began working on this Project in 2015, and completed a Detailed Feasibility Study (DFS) in 2017 that identified an initial transmission line alignment. This initial alignment has been optimized over the last two years, based on detailed baseline studies and the acquisition of high-resolution aerial imagery and topography, to avoid and minimize environmental and social impacts, while still providing a robust and constructible design.

In September/October 2018, MCA-Nepal held EIA Scoping meetings in each of the potentially affected municipalities to obtain local input to a preliminary project alignment and design. In November 2018, MCA-Nepal submitted a Scoping Document (SD) and Terms of Reference (ToR) for approval to conduct an EIA of the Project to the Ministry of Forests and Environment (MoFE) through the Department of Electricity Development (DoED). The SD and ToR were approved in April 2019.

Based on additional environmental and social baseline studies and engineering studies, MCA-Nepal identified a recommended transmission line alignment in May 2019. A second round of consultation meetings were held to share the recommended alignment with potentially affected municipalities and to obtain their feedback. Based on the comments received, the alignment was further refined. EIA public hearing were conducted during November and December 2019 to disclose the environmental and social impacts and benefits of the Project with the 30 affected municipalities and various stakeholders. Based on comments received, the Project alignment and design were further refined, resulting in the transmission line alignment proposed in this document.

2. PROJECT INTRODUCTION

The proposed project is a 313.9 km long 400 kilovolt (kV) electric transmission project, which extends north from the Nepal border with India through the Terai to the New Butwal substation in the Nawalparasi district, then northeast across the Chure Hills to the New Damauli substation in the Tanahu district, and then east to the Ratmate substation in the Nuwakot district, where one segment goes southeast to the New Hetauda substation in the Makwanpur district and another goes east to the Lapsiphedi substation in the Kathmandu district. Overall, the Project traverses three provinces, including 10 districts (Kathmandu, Sindupalchowk, Nuwakot, Dhading, Makawanpur, Chitawan, Tanahu, Palpa, Nawalparasi (East of Bardaghat Susta), and Nawalparasi (West of Bardaghat Susta), one sub-metropolitis, 11 municipalities, and 18 rural municipalities.

2.1 Proposed Facilities

2.1.1 Transmission Line and RoW

The transmission line will help carry high voltage (400 kV) electricity from areas of electricity generation to areas of electricity demand. It will involve the construction of approximately 856 transmission towers within a 46-meter-wide Right-of-Way (RoW). The transmission towers range in height from approximately 43 meters to 92.5 meters. As well as carrying cables, each tower will have grounding wires to protect them from lightning strikes, anti-climbing devices, and warning signage as public safety measures.

Many of the tower sites are in remote areas. In order to reduce forest clearing, land acquisition, and physical displacement, and to maximize local employment opportunities, MCA-Nepal has decided not to construct any new access roads to tower locations. Porters, pack animals, and small motorized vehicles (e.g., motorcycles, all-terrain vehicles) will access remote tower sites following existing and new trails. Helicopters may be used to transport construction materials and equipment and to assist with tower erection in at least some remote locations.

2.1.2 Substations

Substations are used to transform high voltages for transmission networks and to step down to lower distribution voltages for use by consumers. The ETP will involve constructing three new gas-insulated substations (GIS) at Nawalparasi (West of Bardaghat Susta), Damauli, and Ratmate, and connecting with two existing substations at Hetauda and Lapsiphedi.

2.1.3 Ancillary Facilities

Project construction will require the following ancillary facilities:

- Substation workers camps and laydown areas—worker housing to accommodate approximately 50 construction workers at each of the three new substations. The substation laydown areas provide for temporary construction equipment and materials storage and will be within the substation property. Construction of the three new substations may also require concrete batch plants.
- Tower laydown areas—eleven sites have been identified where tower construction equipment and materials (e.g., cement, aggregate, and rebar for foundation construction and steel for tower construction) will be stored for distribution to the tower construction sites. The construction contractors may require different or additional laydown areas.
- Tower work camps, work areas, and storage areas—because of their generally more remote locations, fewer construction workers, and intermittent use (see Section 2.3), worker housing will not be provided; rather, construction workers will camp near each tower construction site and establish temporary work and material storage areas.

The Project will not require a dedicated quarry or crusher plant, but rather will obtain aggregate from existing permitted quarry sites or river aggregate suppliers approved by regulatory authorities.

2.2 Project Construction Activities

Pre-construction activities will include surveying and geotechnical site investigations, establishing laydown areas; mobilizing construction contractor's equipment, materials, and workforce; and sourcing and stockpiling aggregate.

Transmission line construction typically occurs in four work crew mobilizations, as follows:

- Initial Site Preparation—typically requires about 3 weeks.
- Tower Foundation Excavation and Installation—typically requires about 2 months.
- Tower Erection—typically requires about 1 month.
- Conductor Stringing—typically requires about one week between towers.

After completion of construction, the contractors will restore each tower site to pre-construction conditions.

Substation construction will involve clearing the three new substation sites, installing a concrete batch plant (if required), digging and laying building and equipment foundations, installing grounding grids, constructing buildings and installing equipment, and connecting conductors to substation electrical equipment.

MCA-Nepal will also provide environmental and social monitoring of the contractors during construction to ensure the contractors are implementing all required mitigation measures and complying with all GoN conditions and regulations.

2.3 Project Operation Activities

Project operation and maintenance requires no new land disturbance and fewer workers than the construction phase. The operation phase activities will include trimming overgrown trees, monitoring for structure encroachment into the RoWs, detecting and replacing displaced vibration damps/spacers/and other components, conducting thermos-vision scanning, stabilizing soil erosion, repairing rusting towers, and replacing missing tower accessories. The substation sites will have vehicular access, while the transmission towers and RoW will be accessed through land access agreements with affected property owners.

2.4 Project Land Requirements

The Project will require acquisition of land for the Ratmate substation (land for the other two new substations, New Butwal and New Damauli, has been acquired or is being acquired by the Nepal Electricity Authority), the New Damauli and Ratmate substation access roads, and the transmission tower foundations. Land within the RoW will not be acquired, but will incur some permanent land use restrictions (e.g., prohibition of new residential structures, planting of tall trees). Other land will be leased for temporary use as tower laydown areas and work camps.

3. METHODS FOR PREPARING THE REPORT

This EIA was prepared in accordance with the Project's ToR approved by MoFE, and the *Hydropower Environmental Impact Assessment Manual* (MoFE 2018). Baseline data were collected using a literature review, detailed physical, biological, and social field studies, consultations with local communities and other stakeholders, public hearings, solicitation of comments from public through a 7-day newspaper notice, and collection of recommendation letters. Impacts were evaluated in terms of nature and type of impact, and the magnitude, extent, and duration of the impact. These impact criteria were used to characterize the overall residual significance of the impact (i.e., taking into consideration recommended mitigation measures), which could range from Major, Moderate, Minor, to Negligible.

4. REVIEW OF PLANS, POLICIES, ACTS, REGULATIONS, GUIDELINES, STANDARDS, AND CONVENTIONS

This EIA was undertaken to document the Project's conformance with the provisions of the Constitution of Nepal and applicable GoN plans, policies, acts, rules/regulations, manuals, guidelines, standards, and international conventions and agreements to which the Government of Nepal is a signatory. Since the MCC is providing funding to support construction of the ETP, its environmental policies, including conformance with the International Finance Corporation's Performance Standards on Environmental and Social Sustainability, and Gender and Counter-trafficking in Persons Policies also apply. MCA-Nepal will be responsible for fulfilling the provisions of all relevant acts, rules/ regulations policies, guidelines and conventions while implementing the Project. Important acts and regulations like the *EPA* (2019), *EPR* (2020), *Land Acquisition Act* (1977), and *Forest Act* (2019) were also extensively reviewed while preparing the report.

5. EXISTING ENVIRONMENTAL CONDITION

5.1 Physical Environment

The Project traverses the following physiographic zones: the Terai (9 percent), Siwalik (also known as the Chure) (10 percent), and Middle Mountains (81 percent). The Terai is nearly flat and primarily agricultural land, with almost no remaining natural habitat. The Chure is an environmentally sensitive area and an important groundwater recharge area for the Terai, whose importance has been recognized by its designation as the Chure Conservation Area. The Middle Mountains, which represents the largest portion of the transmission line RoW, is a mixture of rugged terrain with steep slopes in the Mahabharat Range, and more weathered and rounded terrain in the mid-hills, dissected by steep river valleys (e.g., Trishuli, Seti). The overall RoW is about 53 percent forest (777.5 hectares) and 42 percent agriculture (612.2 hectares), with the remainder being small areas of developed land, barren land, and water/wetlands.

5.2 Biological Environment

The substations and transmission line RoW encompass 330.4 hectare of community forests, 4.4 hectare of leasehold forests, and 442.7 hectare of government/other forests (Table 1). The transmission line passes through 112 community forests and 8 leasehold forests. The forests along the transmission line alignment primarily consist of subtropical sal forest, and warm temperate broadleaf schima-castanopsis and conifer forests. These forests provide habitat for a number of endangered and critically endangered species, including the Asiatic black bear, Sloth bear, Chinese pangolin, Leopard cat, Assamese monkey, and Elongated tortoise. There are also a number of endangered/critically endangered bird species that occur in the Project area, including several vulture species, cranes, storks, the Great Hornbill, and the Great Slaty Woodpecker.

Table 1: Total Forest Land by Forest Management Type and District

Province	Districts	CF (ha)	LHF (ha)	Government and Other Forest (ha)	Total Forest (ha)
Bagmati	Nuwakot	73.9	0.0	59.5	133.4
	Sindhupalchok	0.0	0.0	17.9	17.9
	Kathmandu	3.6	0.0	7.0	10.6
	Dhading	68.9	1.6	67.7	138.2
	Chitwan	0.0	0.6	20.6	21.2
	Makawanpur	59.1	0.0	80.7	139.8
Lumbini	Palpa	46.0	2.2	35.2	83.4
	Nawalparasi (West of Bardaghat Susta)	19.7	0.0	39.3	59.0
Gandaki	Tanahu	44.0	0.0	99.7	143.7
	Nawalparasi (East of Bardaghat Susta)	15.2	0.0	15.1	30.3
Total		330.4	4.4	442.7	777.5

5.3 Socioeconomic and Cultural Environment

The transmission line alignment was selected to minimize socioeconomic impacts by avoiding towns and larger villages and settlements, so much of the route goes through rural areas, but does pass near some small villages. Major caste/ethnic groups in the Project area include Brahmin, Chhetri, Adivasi Janajati (indigenous people), and Dalit. Chepang, Tharu, Tamang, Gurung, Magar, and Newar are major Janajati Adivasi groups. Kami, Sarki, Damai, and Chamar/Harijan are major Dalit groups. Land is a main asset owned by households in the Project area. Agriculture is the main source of livelihood for the majority of the people. Livestock is an integral part of farming. Community forests, rivers/springs, cremation/burial sites, and religious places are main common property resources. Electricity is the main source of energy for lighting, although some households in the Project area are yet to be connected to the national grid. Health infrastructure includes district hospitals, primary health centers, health posts, private health clinics, private hospitals, and Ayurvedic clinics. Educational infrastructure includes both government and private schools and colledges/campuses. Literacy rates in Project districts are close to the national average.

6. ALTERNATIVE ANALYSIS

MCA-Nepal considered a range of location, design, construction, forest, and technology alternatives, as well as the non-implementation alternative, which are summarized below:

- Location Alternatives—MCA-Nepal spent approximately two years optimizing the proposed transmission line alignment based on detailed environmental and social baseline studies and consultations with government officials, conservation organizations, civil society groups, and affected communities. MCA-Nepal's avoidance efforts are identified above in Section ES.5.

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- Design Alternatives—which included alternatives relating to line capacity (400 kV versus 220 kV), RoW width (either a standard 46 meter width, wider or narrower), underground or above ground transmission lines, and type of insulated substations (air versus gas). Impacts were reduced by designing towers to specific heights, which included high towers that allow the transmission lines to span over much of the potentially affected forest, and creating a tower type that allows for long spans across valleys to further reduce forest clearance and disturbance of steep slopes.
- Construction Access Alternatives—which included consideration of access alternatives such as construction of access roads, use of porters and pack animals, and use of helicopters. MCA-Nepal decided to not build any new roads to access tower sites, but rather to use a combination of porters, pack animals, and possibly helicopters to minimize forest clearing and maximize local employment benefits.No Forest or Less Forest Alternatives – The Project had examined various alternatives while selecting transmission line routes to avoid forests as far as possible. Transmission lines were routed through forests only when no other alternatives were available. The Project has minimized impact on forests and tree clearing by increasing heights of transmission towers.

7. ENVIRONMENTAL IMPACTS OF THE PROJECT

Construction of the ETP will provide benefits as well as various adverse impact on the physical, biological, and socio-economic and cultural environments.

7.1 Beneficial Impacts

In terms of Project benefits, construction of the ETP will create over 7,300 full-time jobs over the 3.5-year construction period with Nepalese workers predicted to fill about 60 percent of these jobs. The construction contractor's will be encouraged to have women represent at least 33 person of the overall Project workforce. Much of the Project workforce is expected to come from the immediate Project area, including nearly all of the unskilled labor. Goods and services requirements throughout the Project lifecycle will provide opportunities for local businesses in areas such as construction equipment, food for the worker camps, and support services. Construction materials, such as fine and coarse aggregates and cement, will likely be sourced locally, creating further opportunities for local suppliers, transporters, and contractors. Over the longer term, some of those employed by the Project are likely to have new or improved skills, which should result in increased future employment opportunities. MCA-Nepal will also be contributing at least 0.75 percent of Project costs (approximately 345 million NPR) through their MCA Partnership program to increase access, reliability, and productive use of electricity within Project-affected municipalities.

Once the Project is operational, it will create about 400 new permanent jobs for Nepali workers, improve the national electricity system reliability, enable more people to access power and achieve better living conditions, increase economic investment as a result of more reliable electricity, increase national government revenues from the export of power to India, and reduce greenhouse gas emissions as more reliable electricity will reduce the use of diesel generators.

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7.2 Adverse Impacts

MCA-Nepal has worked to avoid and minimize many potential impacts through careful routing and design of the transmission line. For example, the Project has spanned all rivers and streams, avoided or spanned landslide prone areas, avoided all national parks and buffers, reduced the number of important bird flyway crossings, minimized impacts to important known bird habitat, eliminated bird electrocution risk by separating conductors by more than the wingspan of the largest bird in Nepal (Himalayan Griffon), minimized physical displacement of households, and avoided towns, large villages/settlements, schools, health clinics, and all known cultural heritage sites.

The sections below briefly describe the most significant adverse impacts of Project.

7.2.1 Physical Environment

The Project will have relatively minor impacts on most physical resources. Project construction will require clearing forest and disturbing steep slopes, which can result in erosion and increased risks of slope failure and landslides, especially during the monsoon season. These construction activities and land disturbance can generate fugitive dust and there will be some emissions from construction vehicles and small power generators. Project construction will generate noise from construction vehicles/equipment, helicopters, and from the worker camps.

Project construction may affect water resources in several ways. The construction contractors will need to obtain water and aggregate to make concrete for the tower foundations. The water will usually be withdrawn from local streams and the aggregate sourced from already permitted sources, such as permitted quarries and district approved river aggregate suppliers. Project construction will require a large workforce that will generate domestic sewage and wastewater. The Project will not require much hazardous materials other than fuel for vehicles, helicopters, and generators, and small quantities of oils, lubricants, and paints.

The Project will pass near a few important visual landscapes and sites, including the historic towns of Bandipur and Nuwakot, the Trishuli and Seti River recreation areas, and the Shivapuri-Nagarjun National Park. These impacts are relatively minor because of the distance of the transmission line from those sites, presence of intervening hills, or the location of the transmission line either below or above the typical line of sight.

7.2.2 Biological Environment

Important biological resources affected by Project construction and operation are summarized below.

Protected Areas and Recognized Areas for Biodiversity

MCA-Nepal's proposed transmission line alignment has avoided all protected areas and most internationally recognized areas for biodiversity, with the primary exceptions being the Chure Conservation Area and the Nawalparasi Forest Important Bird Area (IBA). The Project crosses approximately 32.6 kilometers of the Chure Conservation Area (CCA), which is an unavoidable impact as the CCA extends across essentially the entire length of Nepal. The Project will also unavoidably cross approximately 6 kilometers of the Nawalparasi Forest IBA, as the New Butwal Substation, which is an essential Project connection, is within the IBA. MCA-Nepal has worked to find ways to minimize impacts to the several critically endangered and endangered bird species found within the IBA and elsewhere along the alignment. The transmission line does not pass through protected areas.

Forests

Protecting forests is an important GoN policy mandate. As indicated in Table 1, the RoW traverses about 777.5 hectares of forest, which is defined herein to include shrub/scrub as potential forest. Some forest will be cleared because of tower construction and in order to meet the safety requirement for clearance between the transmission line and the forest canopy. However, MCA-Nepal has minimized the need for forest clearance by:

- Using towers up to 92.5 meters high, which allows the transmission lines to span over some of the forest;
- Developing special tower types that allow the transmission lines to span longer distances over river and stream valleys;
- Committing to build no new roads to access tower construction sites, which is typically one of the major causes of forest clearance. The Contractors will instead use porters and pack animals following existing and some new foot trails, and possibly helicopters to transport construction equipment and materials; and
- Potentially using helicopters and possibly drones to deliver construction equipment and materials to remote tower locations and to help with tower erection and/or line stringing.

Through the use of these techniques, the Project will only require clearing of 354.4 hectares of forest (45.6 percent of the forest within the RoW) which will lead to clearing of 173,183 trees in forest land (Table 2) and 28, 835 trees in agricultural land.

Table 2: Forest and Tree Clearing by District and Forest Management Types

	Districts	Community Forest			Leasehold Forest			Govt and Other Forest			Total		
		Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)
Bagmati	Kathmandu	3.6	0.3	198	0	0	0	7.0	1.5	1,180	10.6	1.8	1,378
	Sindhupalchok	0.0	0	0	0	0	0	17.9	4.8	3,696	17.9	4.8	3,696
	Nuwakot	73.9	30	14,227	0	0	0	59.5	30.8	33,681	133.4	60.8	47,908
	Dhading	68.9	24	11,976	1.6	0.3	114	67.7	24.6	17,471	138.2	48.9	29,561
	Makawanpur	59.1	37.8	18,913	0	0	0	80.7	36.9	16,702	139.8	74.7	35,615
	Chitwan	0.0	0	0	0.6	0	8	20.6	7	2,165	21.2	7.0	2,173
Lumbini	Palpa	46.0	18.8	9,435	2.2	2.1	1,072	35.2	13	2,041	83.4	33.9	12,548
	Nawalparasi W	19.7	8.7	9,655	0	0	0	39.3	36.7	8,334	59.0	45.4	17,989
Gandaki	Nawalparasi E	15.2	19.4	4,426	0	0	0	15.1	2.3	1,609	30.3	21.7	6,035
	Tanahu	44.0	19.7	9,812	0	0	0	99.7	35.7	35,303	143.7	55.4	45,115
	Total	**330.4**	**158.7**	**78,642**	**4.4**	**2.4**	**1,194**	**442.7**	**193.3**	**122,182**	**777.5**	**354.4**	**202,018**

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Community and Leasehold Forest

This will affect 20,617 community forestry user households and 85 leasehold forests user households. However, the overall Project impacts on affected CFs and LHFs is quite small, with only 1.3 percent of forest to be cleared and only 0.2 percent to be acquired although there are some individual CFs and LHFs that are more significantly impacted.

Important Terrestrial Species

There are several conservation significant species that are listed on the International Union for Conservation of Nature and/or the Nepal lists of endangered species that may occur along the ETP route, including the Elongated Tortoise, Asiatic Black Bear, Sloth Bear, and Chinese Pangolin. Project construction, and to a lesser extent operations, has the potential to impact these and other more common species. Direct impacts are due to forest clearance and the associated loss of habitat. Most of these species are mobile and will move from areas disturbed by construction. In addition to the direct impacts, the Project may also indirectly affect these endangered species as a result of disturbance by construction activities, improved human access, habitat fragmentation, and the potential introduction of invasive species in areas disturbed by construction.

Birds

Transmission line operation impacts on birds are primarily related to the potential for birds to be injured or killed by electrocution and collision with the towers or transmission lines. This risk is greatest for large birds, such as vultures, eagles, storks, and cranes. As stated above, the tower design has eliminated the electrocution risk to birds. Avian baseline studies identified several areas where these large birds were found to nest, roost, feed, and soar near the transmission line route, especially in the New Butwal to New Damauli Segment.

7.2.3 Socioeconomic and Cultural Environment

The proposed transmission line alignment avoids all towns, villages, and larger settlements and all tangible cultural heritage sites, thereby reducing potential adverse impacts. The Project will still require, however, some land acquisition/restrictions, physical and economic displacement, and have impacts on community and leasehold forests, and community health and safety. These impacts are discussed below.

Land Acquisition and Restrictions

The Project will acquire 124 hectares of land for the Ratmate Substation, access roads to the Ratmate and New Damauli substations, and the transmission towers. This land acquisition will include 49.8 hectares of forest and 68.7 hectares of agricultural land, and 5.5 hectare of other (barren and built-up/residential) land cover categories. MCA-Nepal has reduced the magnitude of this impact by reducing the number of transmission towers by 20 percent from the original

DFS alignment, and by increasing average tower height and average transmission line span length.

The Project will also place permanent restrictions on future development of approximately 1,347.1 hectares of land within the RoW (i.e., prohibition on new residential dwellings and restrictions on the height of any structures) for safety reasons. These permanent land use restrictions includes 727.7 hectares of forest and 542.7 hectares of agricultural land, and 76.7 hectares of other (river/flood plains, and built-up/residential) land cover categories. Of the 1,347 hectare land within the RoW, about 169.4 hectare will be used temporarily for workers camps/laydown areas during construction period. In addition, the Project will also require 13.2 hectares of land (outside of the transmission line RoW and substation) for temporary use including the land required for laydown areas and tower workers camps during construction phase.

Land Loss and Physical Displacement

Although the transmission line alignment was developed to reduce physical displacement to the extent possible, the Project will displace approximately 187 households, of which 37 households are at the site of the Ratmate Substation, and 150 households are along the approximately 313.9 kilometer RoW. As evidence of the effort put into reducing physical displacement, the original DFS estimated displacement of over 500 residences. There will also be some impacts associated with the loss of agricultural land for substations and tower foundations.

Community Health, Safety, and Security

Large construction projects can often attract trafficking in persons (TIP) and the hiring of underage children, both of which are common problems in Nepal and represent community safety and security risks. Project construction will generate noise, dust, and traffic, which can affect community health and safety. These impacts will only affect households located very close to the construction sites. Labor influx (in-migration of workers and sometimes their families) can place extra stress on community facilities and infrastructure. It is expected, however, to be less of a problem for the ETP because a large proportion of the workers are expected to be hired locally and the tower construction crews typically move from one tower to the next, so are not based in any one area for a long period of time.

Project consultations have found that local residents are concerned about potential health risks from electric and magnetic fields (EMF) associated with transmission lines. Research has not documented any health impacts associated with living near transmission lines anywhere, but the World Health Organization has developed recommended exposure standards to EMF. MCA-Nepal has evaluated EMF from the Project's transmission lines and found that it will be less than half of the World Health Organization's recommended exposure standard at the edge of the RoW. This indicates that it is safe to live immediately adjacent to the RoW and to work or farm within the RoW.

Indigenous, Vulnerable, and Disadvantaged People

Potential adverse impacts, unless mitigated, may be disproportionately greater on vulnerable groups like marginalized and highly marginalized Adivasi Janajati and Dalit groups, and women. The Project may also create additional risks for women and marginalized groups in TIP, which includes fraudulent or forced sex trafficking as well as coercive labor practices., women and marginalized groups may be subject to employment discrimination and women's labor may be undervalued and underpaid (relative to men for the same job). Incidences of sexual harassment and gender-based violence may occur.

Occupational Health and Safety

Project construction inherently presents safety risks for workers, as they will be working from heights, hauling heavy materials, and working in difficult terrain and potentially adverse weather conditions.

8. ENHANCEMENT AND MITIGATION MEASURES

MCA-Nepal proposes a series of enhancement measures to maximize Project benefits and mitigation measures to minimize negative Project impacts, as described below.

8.1 Enhancements Measures

MCA-Nepal proposes the following enhancement measures:

- MCA Partnership program—MCA-Nepal will set aside at least 0.75 percent of the Project cost for improving access, reliability, and productive use of electricity in Project affected municipalities.
- Increase local employment opportunities by including language within the construction bid documents encouraging the Contractors to maximize local hiring, targeting women representing 33 percent of the Contractor's workforce, and hiring disadvantaged groups/individuals to the extent they are qualified.
- Increase local business opportunities by including language in the construction bid documents encouraging the Contractors to maximize purchasing of local goods and services.
- Improve Nepal's electricity system reliability and efficiency by including space for future expansion of the New Butwal, New Damauli, and Ratmate substations.

8.2 Mitigation Measures

The Project impacts and key mitigation measures are summarized in Table ES-3.

Table 3: Summary of Project Impacts and Key Mitigation Measures

Aspect/Resource	Impact	Proposed Mitigation Measures
Construction Phase		
General	Multiple	• Implement a Workers Code of Conduct that lays out the penalties for Project staff and workers found to be involved in hunting, collection of firewood, unauthorized clearing of vegetation, the collection of/trade in plants and animals, possession of illegal substances, abuse of drugs and alcohol, gambling, carrying of firearms, TIP, involvement with prostitutes, and disrespecting local customs and practices.
	Multiple	• Implement a Community Grievance Redress process that allows stakeholders to raise concerns about the Contractor's environmental and social performance.
	Multiple	• Implement the Project Stakeholder Engagement Plan to keep stakeholders informed of Project activities.
Physical Environment		
Topography/Geology/ Soils	Erosion and Sedimentation	• Follow strict erosion prevention protocols. • No construction of new tower access roads. • Limit clearing of vegetation. • Remove and stockpile topsoil for reuse.
Air Quality	Fugitive Dust and Generator Emissions	• Stabilize disturbed areas. • Cover excavated soils. • Spray water on disturbed areas upon complaints. • Properly maintain generators, construction vehicles/equipment to minimize emissions.
Water Resources	Water Sourcing	• Limit water withdrawals to no more than 20% of flow.
	Aggregate Sourcing	• Use approved river aggregate suppliers/quarries.
	River Crossings and Floodplains	• Use special towers and/or foundations for towers located in floodplains.
	Sewage and Wastewater Discharges	• Require appropriate sewage and wastewater treatment and disposal for all workers. • Prohibit discharges of any untreated wastewater.
	Improper Solid Waste Disposal	• Reduce, reuse, and recycle wastes to the extent possible.
	Hazardous Materials	• Locate fuel tanks at least 100 meters from any streams and have secondary containment.

Aspect/Resource	Impact	Proposed Mitigation Measures
Acoustic Environment	Construction Noise	• Limit noise generating activities to daylight hours. • Assess nearby structures for damage prior to any blasting. • Notify nearby households of planned use of helicopters and explosives and implosives
Landscape Values and Visual Amenity	Degradation of Viewsheds	• Locate transmission line such that it is above or below the typical line of sight.
Biological Environment		
Protected Areas and Internationally Recognized Areas for Biodiversity Conservation	Chure Conservation Area Impacts	• Comply with President Chure-Tarai Madhesh Conservation Development Board conditions. • Prohibit sourcing of aggregate within the Chure Conservation Area. • Target afforestation so as to result in no net loss of forest within the Chure Conservation Area.
Forest and Trees	Forest clearing	• Plant 2,020,180 saplings (plant10 saplings for each tree cleared) to provide compensatory plantation for forest clearing and tree impacts as per Working Procedure with Standards for the Use of Forest Lands for National Priority Infrastructures in Nepal, 2076, and Government Forest Land Transfer Protocol for Electricity Transmission Project (ETP) approved by MoFE (Minister Level Decision) on Poush 03, 2077(December 18, 2020).. • Replant disturbed areas with native species. • Involve CFUGs in reforestation program. • Coordinate with Division Forest Offices and CFUGs/LFUGs in selecting area for compensatory plantation as per Working Procedure with Standards for the Use of Forest Lands for National Priority Infrastructures in Nepal, 2076.
Wildlife	Impacts to endangered species	• Monitor for and remove any invasive species. • Implement shepherding protocol to relocate less-mobile species from construction areas.
Social Environment		

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Aspect/Resource	Impact	Proposed Mitigation Measures
Change in Land Ownership and Use	Physical Displacement	• Prepare and implement Resettlement Policy Framework and Resettlement Action Plan, which include provisions for compensating those who have informal arrangements for use of buildings or land. This also includes payment of compensation for the loss of land and assets at replacement cost, land use restriction, and displacement and providing other allowances to cover the transition period and temporary livelihoods restoration support for the more vulnerable persons or groups. • Implement temporary land use policy. • MCA-Nepal will acquire and compensate for land in accordance with the provisions of the *Land Acquisition Act* (1977) and procure land within the RoW subject to permanent restrictions in accordance with the provisions of the *Nepal Electricity Act* and its Rules, in coordination with the District Compensation Fixation Committees. Temporary use of land will also be compensated at officially determined rates.
	Economic Displacement	• Implement a Livelihood Restoration Plan for displaced families or workers.
Women, Indigenous, Vulnerable, and Disadvantaged People	Risk of TIP and Employment of Under-age Children	• Implement TIP Risk Management Plan. • Require proof of age for all employees.
	Risk of sexual harassment/gender based violence	• Implement Workers Code of Conduct. • Implement Anti-sexual harassment policy.
Community Health, Safety, and Security	Risk of employment discrimination	• Implement Workforce Management Plan.
	Potential for Worker–Community Conflict	• Implement a Workers Code of Conduct. • Implement a Worker Access Management Protocol. • Implement a Community Grievance Procedure. • Implement Traffic Management Plan.
Occupational Health and Safety	Potential for worker injury	• Develop and Implement an Occupational Health and Safety Plan. • Implement a Worker Grievance Procedure.
Operation Phase		

Aspect/Resource	Impact	Proposed Mitigation Measures
Water Resources	Sewage and Wastewater Treatment	• Properly operate and maintain septic systems or wastewater package plants.
Water Resources	Hazardous material spills	• Store hazardous materials in designated areas with impervious liners and secondary containment.
Acoustic Environment	Substation operations	• Restrict loud noise–generating maintenance activities to between 6 am and 10 pm.
Forest and Trees	RoW Maintenance	• Limit tree clearing to that required to meet safety clearance requirements.
Birds	Collision Risk	• Install and maintain visibility enhancement objects on the shield wire to minimize bird collisions (e.g., bird diverters and marker balls). • Provide biodiversity offset for risk of increased mortality from collisions with transmission lines for several species of critically endangered and endangered birds

The overall cost of these mitigation measures, excluding land acquisition, is approximately 3 billion Nepalese rupees (approximately US$27.5 million). The intent of these mitigation measures is to reduce the residual significance of all Project impacts, after taking into account the nature, type, magnitude, extent, and duration of the impacts, and the predicted effectiveness of the proposed mitigation measures.

9. ENVIRONMENTAL MANAGEMENT PLAN

MCA-Nepal has developed a robust Environmental Management Plan (EMP) what it refers to as an Environmental, Social, Health, and Safety Management Plan (ESHSMP) to help ensure that the mitigation measures identified in this EIA are fully implemented. The ESHSMP is divided into two plans, each targeting different Project phases with different implementation entities, so there is no confusion about roles and responsibilities: (1) Pre-construction and Construction Phases ESHSMP—this plan identifies MCA-Nepal's and the Contractor's environmental and social management responsibilities during Project construction. In addition, there are other mitigation responsibilities that MCA-Nepal will retain relating to biodiversity management, resettlement, afforestation, and the MCA Partnership program; and (2) Operation Phase ESHSMP—although most Project impacts occur during construction, there are certain impacts that continue into Project operations and some that do not really begin until the Project begins operations. Several agencies including MCA-Nepal, MCC, Contractors, Project Engineer, MoFE, DoED, PCTMCDB, and CAAN will be involved in the implementation and monitoring of ESHSMP.

10. ENVIRONMENTAL MONITORING

The purpose of environmental monitoring is to assess the Project's conformance with regulatory requirements and overall environmental and social performance. MCA-Nepal proposes to conduct three types of monitoring: (1) Baseline monitoring to establish a baseline for measuring change over time; (2) Compliance monitoring to document compliance with applicable Nepali regulatory standards; and (3) Impact monitoring to monitor Project effects on aspects for which there are no regulatory standards. This monitoring will extend from pre-construction, through construction, and into operation.

11. ENVIRONMENTAL AUDITS

The ETP will be subject to three types of environmental audits: (1) Completion audit, which will be conducted by MCA-Nepal at the completion of construction to ensure that the Contractors and others involved in the implementation of the Project have complied with the terms of the EIA and the ESHSMP; (2) EIA audit, which will be conducted once by MoFE after 2 years of Project operations to determine whether the Project has complied with EIA conditions; and (3) Project Impact Audit, which will be conducted by the ultimate Project operator approximately every 2 years to identify and assess Project-related ESHS impacts over time to enable a culture of continual improvement.

12. CONCLUSIONS AND COMMITMENT

Tables ES-4, ES-5, and ES-6 show that the predicted residual (post-mitigation) significance of the Project impacts during the Project's construction, operation, and, for greenhouse gases, the combined construction and operation phases, respectively. As these tables show, the proposed mitigation measures reduce the residual significance of all of the Project impacts to Negligible or Minor with the exception of the risk of increased mortality for critically endangered and endangered birds (e.g., Himalayan griffon, several species of vultures, Steppe eagle, and Sarus crane) from colliding with the transmission lines. MCA-Nepal is proposing mitigation measures to reduce threats to these species and additional actions to offset this unavoidable moderate residual impact. MCA-Nepal will also implement a formal Environmental and Social Management System and a robust environmental and social monitoring program, which will help confirm that all required mitigation measures are implemented and that actual Project impacts are consistent with those predicted in this EIA.

Table 4: Summary of Project Construction Phase Impacts and Residual Significance

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Topography/Geology/ Soils	Erosion and Landslides	Moderate	Minor
Air Quality	Fugitive Dust Emissions	Minor	Negligible
	Transmission Line Emissions	Negligible	Negligible
	Substation Emissions	Negligible	Negligible
Water Resources	Water Sourcing	Minor	Negligible
	Aggregate Sourcing	Minor	Negligible
	River Crossing and Floodplains	Negligible	Negligible
	Sedimentation	Moderate	Minor

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
	Wastewater Discharges	Minor	Negligible
	Hazardous Materials Spills	Minor	Negligible
	Improper Solid Waste Disposal	Minor	Negligible
Acoustic Environment	Transmission Line Construction Noise	Minor	Negligible
	New Substation Construction Noise	Minor	Negligible
	Existing Substation Construction Noise	Negligible	Negligible
	Noise from Helicopter Use	Moderate	Minor
	Noise/Vibration from Explosives/Implosives Use	Moderate	Negligible
Landscape Values	Degradation of Scenic Viewsheds	Minor	Minor
Biological Environment			
Protected Areas and Internationally Recognized Areas for Biodiversity	Chure Conservation Area	Moderate	Minor
	Terai Arc Landscape	Negligible	Negligible
	Chitwan Annapurna Landscape	Negligible	Negligible
	Shivapuri-Nagarun National Park	Negligible	Negligible
	Parsa National Park and IBA	Negligible	Negligible
	Nawalparasi Forest IBA	Minor	Negligible
Forests and Vegetation	Impacts to Forests	Major	Minor
	Introduction of Invasive Species	Minor	Minor
	Increase in Fire Hazard	Moderate	Minor
	Edge Effects	Minor	Minor
	Induced Clearing and NTFP Collection	Minor	Minor
Wildlife Species	Fauna Disturbance and Displacement	Moderate	Minor
	Hunting and Poaching of Fauna	Moderate	Minor
	Increased Mortality from Vehicles	Negligible	Negligible
	Enhanced Risk of Wildlife-Human Conflict	Negligible	Negligible
	Increased Habitat Fragmentation	Moderate	Minor
Social Environment			
Change in Land Ownership and Use	Physical Displacement	Major	Minor
	Economic Displacement/Loss of Livelihood	Major	Minor
	Temporary Access Related Impacts	Minor	Negligible
Community Health, Safety and Security	Risk of TIP and Child Labor	Moderate	Minor
	Nuisance Impacts on Local Communities	Minor	Negligible
	Risk of Communicable and Vector Borne Diseases	Minor	Negligible
	Potential Community Conflict	Moderate	Minor

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
	Potential Safety and Security Impacts	Minor	Negligible
Community Resources and Infrastructure	Effect on Natural Resources (Forests)	Moderate	Minor
	Effect on Natural Resources (Water Resources)	Minor	Negligible
	Stress on Physical Infrastructure	Minor	Negligible
Local Economy and Employment	Effects on Local Economy and Employment	Minor	Positive
Vulnerable People	Impacts on Indigenous People and Vulnerable Groups	Moderate	Minor
Gender	Impacts on women	Moderate	Minor
Cultural Heritage	Impacts on Tangible Resources	Negligible	Negligible
	Impacts on Intangible Resources	Moderate	Negligible

Table 5: Summary of Project Operation Phase Impacts and Residual Significance

Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Topography/Geology/ Soils	Erosion and Landslides	Moderate	Negligible
Air Quality	Substation Emissions	Negligible	Negligible
Water Resources	River Crossings and Floodplains	Minor	Negligible
	Sedimentation	Moderate	Negligible
	Wastewater Discharges	Minor	Negligible
	Hazardous Material Spills	Minor	Negligible
	Improper Solid Waste Disposal	Negligible	Negligible
Acoustic Environment	Transmission Line Operation Noise	Minor	Negligible
	Substation Operation Noise	Minor	Negligible
Landscape Values	Degradation of Viewsheds	Minor	Minor
Biological Environment			
Protected Areas and Internationally Recognized Areas for Biodiversity	Chure Conservation Area	Minor	Negligible
	Terai Arc Landscape	Negligible	Negligible
	Chitwan Annapurna Landscape	Negligible	Negligible
	Shivapuri-Nagarjun National Park	Negligible	Negligible
	Parsa National Park and IBA	Negligible	Negligible
	Nawalparasi Forest IBA	Minor	Negligible
Forests and Vegetation	Impacts to Forests	Minor	Negligible
	Introduction of Invasive Species	Minor	Negligible
	Increase in Fire Hazard	Minor	Negligible

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Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
	Edge Effects	Negligible	Negligible
	Induced Clearing and NTFP Collection	Negligible	Negligible
Wildlife Species	Fauna Disturbance and Displacement	Negligible	Negligible
	Hunting and Poaching of Fauna	Minor	Negligible
	Increased Mortality from Vehicles	Negligible	Negligible
	Enhanced Risk of Wildlife-Human Conflict	Negligible	Negligible
	Increased Habitat Fragmentation	Negligible	Negligible
	Bird Collision Risk	Major	Moderate[1]
Social Environment			
Change in Land Ownership/Use	Temporary Access Related Impacts on private land	Negligible	Negligible
Community Health, Safety and Security	Electromagnetic Fields Effects	Negligible	Negligible
Community Resources	Impact of Natural Resources	Negligible	Negligible
	Stress on Physical Infrastructure	Negligible	Negligible
Vulnerable People	Impacts on Indigenous/ Vulnerable Peoples	Minor	Negligible
Gender	Impacts on women	Minor	Negligible

[1] MCA-Nepal proposes mitigation measures to reduce threats to these bird species and additional actions to offset this unavoidable moderate residual impact.

Table 6: Summary of Combined Construction & Operation Phases and Residual Significance

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Climate Change	Greenhouse Gas Emissions	Positive	Positive

The overall conclusion of this EIA is that the substantial benefits of this Project to the economy and people of Nepal outweigh the Project's relatively insignificant residual impacts.

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सिंहदरबार, काठमाडौं

CHAPTER ONE
NAME AND ADDRESS OF THE AGENCY PREPARING THE REPORT

1.1 NAME AND ADDRESS OF PROJECT PROPONENT

The Proponent of the Electricity Transmission Project (ETP or Project) is the Millennium Challenge Account Nepal Development Board (MCA-Nepal), which is a Government of Nepal (GoN) agency. MCA--Nepal was formed by a cabinet level executive order (Order 2018) under Section 3 of *Development Board Act* 2013 BS (1956 AD) in order to manage the compact program developed by the Office of the Millennium Challenge Nepal (OMCN),[1] in coordination with the Millennium Challenge Corporation (MCC). The MCC is an independent United States government foreign aid agency. The MCA-Nepal is the Nepal agency responsible for implementing the Project.

Contact details of the Project Proponent are as follows:

Government of Nepal
Ministry of Finance
Millennium Challenge Account Nepal Development Board (MCA-Nepal)
Formerly the Office of Millennium Challenge Nepal
Contact: Shyam Upadhyaya, Quality Assurance Manager—Environment, Health, & Safety
Hotel Yak & Yeti Complex Kathmandu, Nepal
Tel No.: +977-1-4238353, 4238392
Email: shyam.upadhyaya@mcanp.org
info@mcanp.org
Website: https://mcanp.org

1.2 NAME AND ADDRESS OF CONSULTANT

Stantec Consulting International LLC (assisted by subcontract partners Power Engineers Inc. and Environmental Resources Management [ERM]—collectively referred to as the "Consultant Team") was commissioned to undertake the Consulting Services for Project Preparation and Technical Supervision Services (PPTS) for the ETP: Transmission and Substation Activities, which includes the preparation of this Environmental Impact Assessment (EIA) for submission to the GoN. Curricula Vitae for the EIA team are provided in Annex A.

[1] OMCN is the predecessor organization of the MCA-Nepal.

Contact details of the Consultant are as follows:

PPTS Consultant Team (Stantec, with subcontract partners Environmental Resources Management (ERM) and Power Engineers Inc (PEI)
(with contribution from TMS/NESS)
Contact: David Blaha, EIA Team Lead
House 736/68 Narayan Gopal Sadak Lazimpat
Kathmandu, Nepal (Opposite to Machhapuchhre Bank)
Tel No.: +977-1-4415861
Email: david.blaha@erm.com
Website: https://www.erm.com

1.3 RATIONALITY OF ENVIRONMENTAL IMPACT ASSESSMENT

The ETP is a 400-kilovolt double circuit transmission line (TL) spanning 313.9 kilometers. Chapter 2 presents a detailed Project description. The GoN required preparation of either an EIA or an Initial Environmental Examination (IEE) by the Project proponent in order to obtain environmental authorization prior to Project development, in accordance with the *Environment Protection Act*, 1997 AD/2053 BS and the Environment Protection Rules, 1997 AD/2054 BS, as amended (EPR). For TL Projects with a capacity of more than 132 kilovolts, the EPR (1997) required only an Initial Environmental Examination (second amendment gazette 2065-11-26/09-03-2009). However, an EIA was required for the ETP based upon two provisions in the EPR (1997):

- Per Schedule 2 (E-6) of the EPR (1997), any water resource development Project displacing more than 100 people required an EIA study and transmission line is a critical component of hydropower development. The ETP is predicted to physically displace 187 households with 943 persons (see Section 7.4 for additional details).

- Per Schedule 2 (K-3) of the EPR (1997), if any Project is constructed within a national park, wildlife sanctuary, or conservation area, an EIA is required. The proposed TL will pass through the Chure Conservation Area affecting 81.5 hectare of forest, and the President Chure Terai Madesh Conservation Development Board (PCTMCDB), in its letter to MCA-Nepal, had made it clear that an EIA was required for ETP.

MCA-Nepal conducted EIA study for ETP project based on above provisions of EPR (1997) as per Scoping Document (SD) and Terms of Reference (ToR) approved by the Ministry of Forests and Environment on May 24, 2019 (Jestha 10, 2076). EIA report was submitted to Department of Electricity Development (DoED) prior to the enactment of new Environment Protection Rule (2020). EPR (2020) requires transmission line projects to do only IEE irrespective of whether it passes through protected areas and their capacities. The Ministry of Forests and Environment (MoFE) made Minister Level Decisions on Simplification of Implementation Procedure of Environment Protection Act, 2019 (2076) and Environment Protection Rule, 2020 (2077) on June 28, 2020 (Ashad 14, 2077) and November 19, 2020 (Mansir 04, 2077) that allowed EIA reports conducted as per EPR (1997) which were

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submitted to concerned agency prior to the publication of EPR (2020) to go through approval process as per EPR (2020) upon request from the project proponent (Decision #2 made on November 19, 2020). Consequently, MCA-Nepal requested MoFE to move EIA report for approval on November 24, 2020 (Mansir 09, 2077).

1.4 SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENT

In compliance with the EPR (1997), a Scoping Document and a Terms of Reference were prepared for the Project to describe the scope for the EIA study. These documents were approved by Ministry of Forests and Environment (MoFE) on May 24, 2019 (see Annex C).

This EIA has been prepared in accordance with the Terms of Reference and is generally consistent with the format and content for an EIA as described in the Hydropower Environmental Impact Assessment Manual (July 2018) which has been endorsed by the MoFE. The EIA study covers transmission line towers, Right-of-Way (RoW), sub-station areas (Ratmate, New Damauli, and New Butwal substations), access roads to Ratmate and New Damauli Substations, and ancillary facilities such as laydown and storage areas. This study identifies project footprints and provides a detail description of the project. It establishes physical, biological, and socio-economic and cultural baseline conditions; identifies, assesses, and predicts beneficial and adverse impacts along with cumulative impacts; and proposes practical enhancement, mitigation, management, monitoring, and auditing measures for the Project.

1.5 OBJECTIVES OF ENVIRONMENTAL IMPACT ASSESSMENT

The overall objectives of the EIA study are:

- To identify, assess, and predict the environmental and social impacts and opportunities associated with the different phases of the Project;
- To propose practical enhancement and mitigation measures; and
- To incorporate these into the Project planning to optimize the Project environmental and social outcomes.

The specific objectives are to:

- Conduct the EIA process and prepare the EIA report in conformance with Nepali regulations and laws, and MCC Environmental Guidelines.
- Introduce the Project and provide an opportunity for stakeholders to provide suggestions and concerns about the Project.
- Establish the existing status of the physical, biological, socio-economic, and cultural environments of the Project-affected areas.
- Examine the activities of the Project to identify the potential environmental issues and impacts.

- Identify and evaluate various alternatives to avoid or minimize impacts to the extent possible.
- Evaluate and identify potential beneficial and adverse impacts of the Project and propose mitigating measures to avoid, minimize, or mitigate/manage these impacts.
- Reduce the overall environmental, social, and economic impacts of the Project as far as practicable as well as optimizing Project benefits.
- Prepare an Environmental Management Plan that will include environmental, social, health, and safety management plans (ESHSMP) based on management and mitigation measures identified in the EIA.
- Develop appropriate environmental monitoring and auditing frameworks.

1.6 LIMITATIONS OF THE STUDY

The following limitations are applicable to this EIA study:

- Baseline Studies—The ETP has been developed differently than other TL Projects in Nepal, in that the baseline studies were conducted before the final selection of the TL alignment to help inform and guide the alignment to minimize environmental and social impacts. As a result, some of the baseline studies initially conducted (i.e., before the confirmation/freezing of the alignment) are located near, but not within, the final proposed right-of-way. Where alignment re-routes and minor deviations happened as part of refining the alignment, both the field survey and desktop study were conducted within the revised alignment areas. See Chapters 3 (Methods for Preparing the Report) and 5 (Existing Environmental Condition) for more details. However, this is a better approach in the sense that it has led to the broad acceptance of the Project among affected communities.
- Tree Count—Given the large scale of this Project, the estimated tree count included in the EIA was determined using actual tree counts from an MoFE-approved one percent (1%) field-based tree inventory. A very high resolution Light Detection and Ranging (LiDAR) remote sensing technology was used to identify sample plots for 1% survey. LiDAR was also used to identify individual trees or small clusters of trees in locations such as agricultural plots, developed landscapes, or mostly barren environments. See Section 7.3 (Biological Environment Impact Assessment) for more details. A complete 100 percent tree inventory will be conducted for the *Forest Clearance Permit* application.
- Cadastral Mapping—There are limitations with geo-referencing the available Nepal cadastral maps. These maps have been adjusted to the extent possible, but the exact ownership of affected land parcels cannot be confirmed until the Resettlement Action Plan and associated cadastral verification survey are completed, both of which are underway.

- Community and Leasehold Forests—Most of the community and leasehold forests have not had their boundaries surveyed, so, for purposes of this EIA, the boundaries of these forests were mapped in consultation with the associated forest user groups.
- LiDAR was used to obtain high definition aerial imagery and topography, which provided for detailed and up-to date information on the terrain, land cover, and potential obstacles. However, LiDAR data are not always as accurate in very steep or vertical slopes.

CHAPTER TWO
PROJECT INTRODUCTION

2.1 BACKGROUND

An underlying cause of Nepal's constraints to economic growth has been identified as the inadequate supply of electricity. Historically, Nepal has suffered from the worst electricity shortages in South Asia, and new investment in Nepal's electricity sector is critical to achieve significant and sustainable economic growth. The availability of electricity is further reduced by Nepal's limited ability to import power when needed and the significant losses in transmission and distribution.[1]

The ETP is funded by the Millennium Challenge Corporation (MCC), a U.S. Government agency, and the Government of Nepal (GoN). Since it is a government undertaking, a survey license was not required for this Project. However, MCA-Nepal has received a Letter of Authorization from the Department of Electricity Development (DoED) in lieu of a survey license, to proceed with the necessary project surveys and studies. Consent letters from government agencies (DoED), the President Chure-Terai Madhesh Conservation Development Board (PCTMCDB), and Civil Aviation Authority Nepal (CAAN) are attached in Annex B. The GoN, through a cabinet decision on September 21, 2018 (2075-06-05), has declared the ETP as a National Pride Project (see Annex B).

The ETP configuration is one of the outcomes of a Detailed Feasibility Study, or DFS (Tetra Tech 2017) commissioned by the MCC to identify transmission projects that could provide the greatest contribution to Nepal's development needs. The DFS included elements of stakeholder engagement, site surveys, technical assessments, and environmental and social assessments, which contributed to the screening and scoping of the environmental and social aspects of the candidate projects.

2.2 PROJECT DESCRIPTION

The ETP is a 400-kV double circuit electricity transmission project spanning 313.9 kilometers (GIS measured horizontal length) and includes the construction of approximately 856 transmission towers and three new substations (Ratmate, New Damauli, and New Butwal). The transmission line will also connect with two other existing substations (Lapsiphedi and New Hetauda), as shown in Figure 2.2-1 (a) and 2.2-1 (b) This section presents a description of the Project location, facilities, land requirements, impact areas, construction activities, and operation and maintenance (O&M) activities.

[1] Nepal has made good progress in reducing transmission loss in the past year. However, the losses are still high.

For ease of reference in this document, the transmission line has been divided into five segments, in accordance with the request from DoED during their review of the Project's Scoping Document (SD) and Terms of Reference (ToR):

• India Border to New Butwal Substation	18.2 kilometers
• New Butwal to New Damauli Substation	89.5 kilometers
• New Damauli to Ratmate Substation	89.7 kilometers
• Ratmate to New Hetauda Substation	57.5 kilometers
• Ratmate to Lapsiphedi Substation	59.0 kilometers
Total	313.9 kilometers

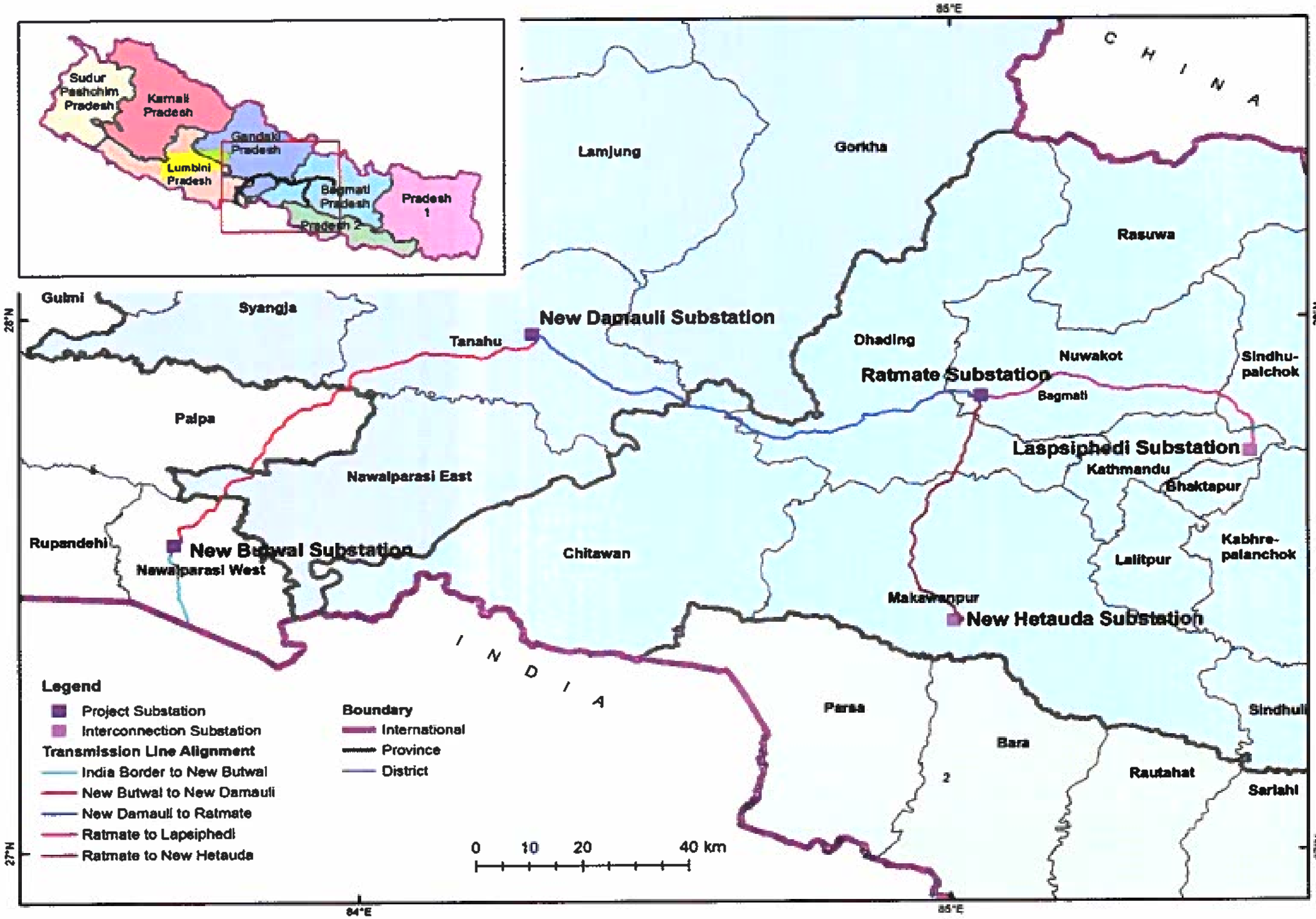

Figure 2.2-1 (a): Project Location

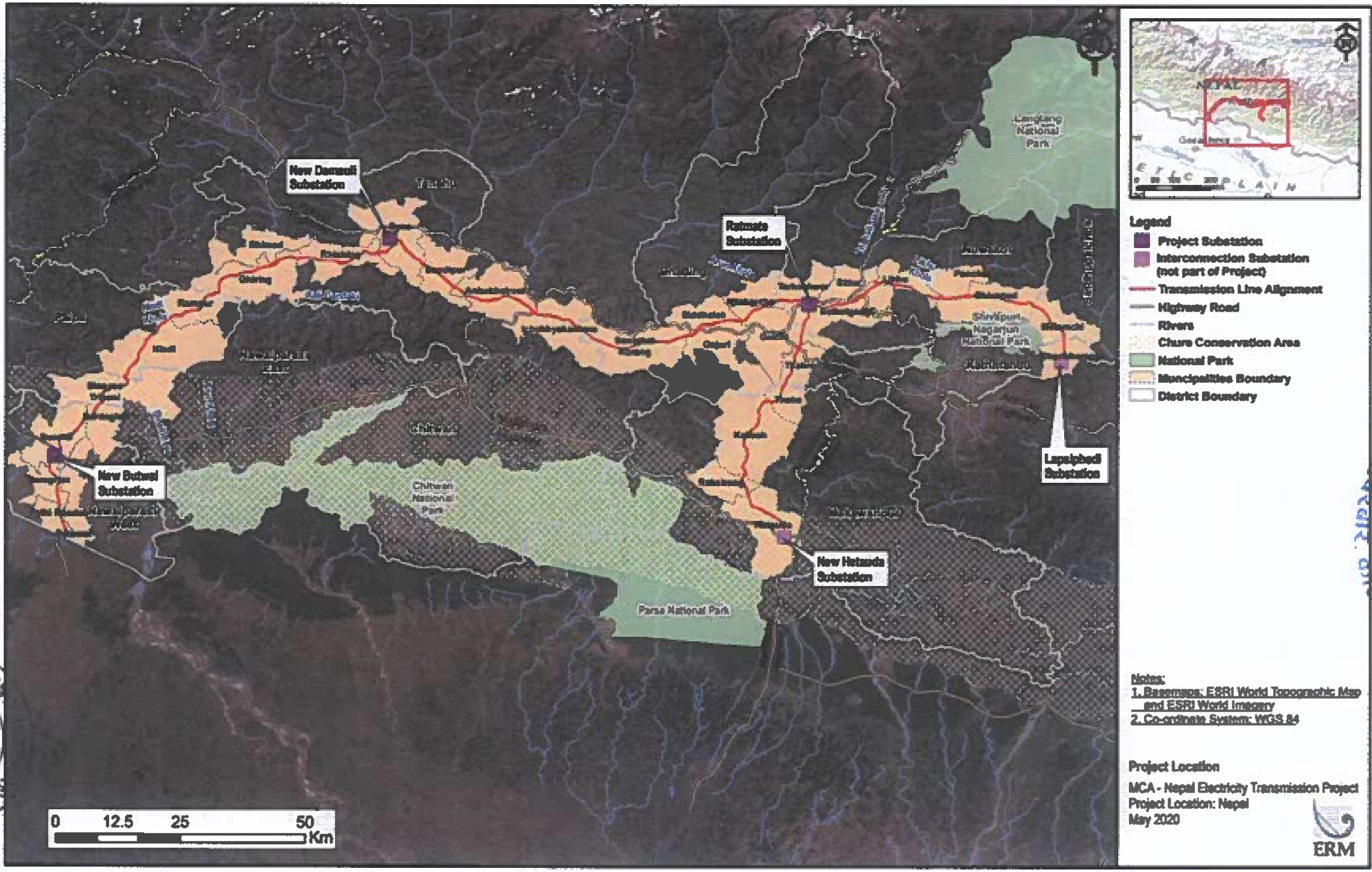

Figure 2.2-1 (b): Project Location

2.3 PROJECT OBJECTIVES, NEED AND RELEVANCY

The objective of the ETP is to increase electricity consumption by improving the availability and reliability of electricity supply in Nepal's electricity grid and by facilitating power trade (OMCN 2017). The ETP is a significant component of Nepal's east-west electricity transmission backbone and includes the Nepal section of the second major planned cross-border interconnection with India. These lines are designed to improve the transmission of generated electricity around Nepal, and both ways between Nepal and India. The Project was identified through a wider consultation with the government and non-governmental organizations, donors working in the transmission line sector in Nepal, and other stakeholders. This Project is also consistent with the priorities of transmission sector master plans of Nepal (RPGCL 2018).

The overall aim of this Project is to help enable industrial and commercial development, and to improve the living conditions for a large number of people of Nepal through improved electrical reliability. The proposed transmission line and its substations will help to evacuate electricity generated from hydropower projects in various river basins along the alignment including:

- New Butwal/New Damauli substations: Kali Gandaki basin;
- New Damauli Substation: Marshyangdi and Seti basins;
- Ratmate Substation: Trishuli basin; and
- Lapsiphedi Substation: Tamakoshi, Sunkoshi and Indrawati basins.

In summary, the Project is needed to address poor electric system reliability, the lack of infrastructure to evacuate electricity from hydropower projects, and the lack of capacity to import or export electricity to India.

2.4 PROJECT LOCATION AND ACCESSIBILITY

2.4.1 Project Location

Under Nepal's new administrative organization, the current Project alignment will affect land in 98 wards of 30 Local Administrative Units (which includes three municipality types: sub-metropolis, municipalities, and rural municipalities) of 10 districts in three provinces. Figure 2.2-1 above and Table 2.4-1 below identify the location and names of each of the provinces, districts, and local levels affected by the Project along with the total length of the transmission line. Large scale topographic maps and alignment maps showing the transmission line alignment and tower locations are provided in Annex D.

Table 2.4-1: Project Affected Districts, Municipalities, and Wards

Province	District	Local Level	Type of Local Level	Wards	Number of Towers	TL Length (km)
Lumbini Province	Nawalparasi (West of Bardaghat Susta)	Sunwal	Nagarpalika	11, 12, 13	45	13.5
		Ramgram	Nagarpalika	1, 8, 11, 12, 13, 17	32	10.7
		Palhi Nandan	Gaunpalika	1, 2, 3	15	5.6
		Bardaghat	Nagarpalika	2	10	3.9
	Palpa	Nisdi	Gaunpalika	5, 6, 7	46	16.1
		Rampur	Nagarpalika	1, 2, 3, 4	28	10.3
Gandaki Province	Nawalparasi (East of Bardaghat Susta)	Binayee Tribeni	Gaunpalika	3, 5	23	8.4
	Tanahu	Anbukhaireni	Gaunpalika	4, 5, 6	48	16.6
		Bandipur	Gaunpalika	2, 3, 4, 6	21	7.0
		Vyas	Nagarpalika	1, 13, 14	40	13.6
		Rhishing	Gaunpalika	1, 6, 7, 8	38	15.4
		Ghiring	Gaunpalika	1, 2, 3, 5	52	18.8
Bagmati Province	Chitwan	Ichhyakamana	Gaunpalika	2, 3, 5, 6	20	7.5
	Dhading	Siddhalekh	Gaunpalika	6, 7	25	8.3
		Benighat Rorang	Gaunpalika	3, 4, 5, 6, 7, 8, 9, 10	59	23.5
		Gajuri	Gaunpalika	2	9	3.0
		Nilakantha	Nagarpalika	5	7	2.7
		Thakre	Gaunpalika	1, 2, 3, 11	20	8.5
		Galchhi	Gaunpalika	2, 3, 8	26	9.7

Province	District	Local Level	Type of Local Level	Wards	Number of Towers	TL Length (km)
	Makawanpur	Kailash	Gaunpalika	3, 4, 5, 6	40	17.1
		Raksirang	Gaunpalika	1	12	4.8
		Hetauda	Upamahanagarpalika	1, 3, 11, 19	37	14.0
		Thaha	Nagarpalika	8	8	4.4
	Nuwakot	Shivapuri	Gaunpalika	1, 3, 5, 7, 8	41	14.9
		Panchakanya	Gaunpalika	5	8	2.8
		Likhu	Gaunpalika	3, 5 ,6	34	12.1
		Belkotgadhi	Nagarpalika	5, 6, 7, 8, 9, 10, 12	62	21.6
		Tarkeshwar	Gaunpalika	2, 4	10	4.2
	Sindhupalchok	Melamchi	Nagarpalika	1, 2, 3, 4	28	10.1
	Kathmandu	Shankharapur	Nagarpalika	1, 2, 3	12	4.8
			Total	98	856	313.9

Source: Consultant Team 2020

2.4.2 Project Accessibility

A description of the five substations is presented in Table 2.4-2, including a description of the existing access and the need for access improvements that will be required for Project construction and operations. For further detail refer to Figure 2.4-1 and Annex D.

Table 2.4-2: Substation Access

Substation	Vehicular Access from KTM	Distance from KTM	Access Improvements
New Butwal (new construction)	Follow Prithvi Highway, then Mugling Narayanghat Road, and then follow Narayanghat to Butwal section of East-West Highway Substation is 0.77 km south from Badera in East-West Highway.	239 km	None, direct access already exists to site
New Damauli (new construction)	Follow Muglin Pokhara section of Prithvi Highway, then travel 3.39 km east from Galfu Basi Bus Stop (Near Damauli)	153 km	MCA-Nepal to construct a new 280 m access road
Ratmate (new construction)	Follow Prithvi Highway, then Galchhi-Trishuli-Rasuwagadhi Road up to Sundari Chowk then turn south	62 km	MCA-Nepal to construct a new 150 m access road, and upgrade 0.71 km of the existing Lok Sanchar Marg Road
New Hetauda (line connection)	Follow Kathmandu-Mugling-Narayanghat-Hetauda Road, then go 0.24 km south from Thana Bharyang on East-West Highway	225 km	None, direct access already exists to site
Lapsiphedi (line connection)	Sankhu-Melamchi Road	26 km	None, direct access already exists to site

Source: Consultant Team 2020

Figures 2.4-2 and 2.4-3 show the proposed new access roads at the New Damauli and Ratmate substations. The new access roads will be 7.5 m wide with a crushed gravel stone surface treatment.

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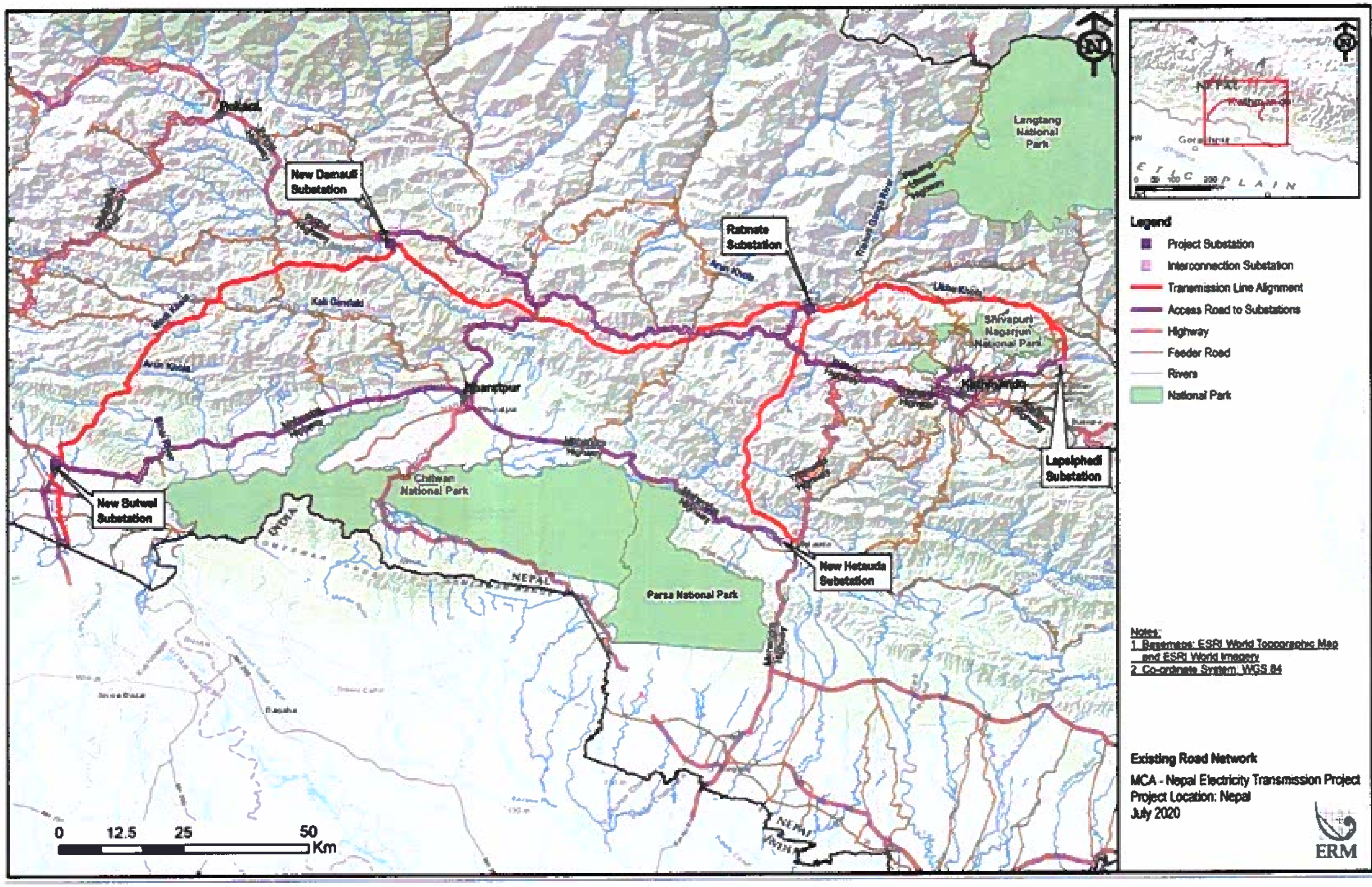

Figure 2.4-1: Existing Road Network

Figure 2.4-2: Proposed New Access Roads at New Damauli Substation

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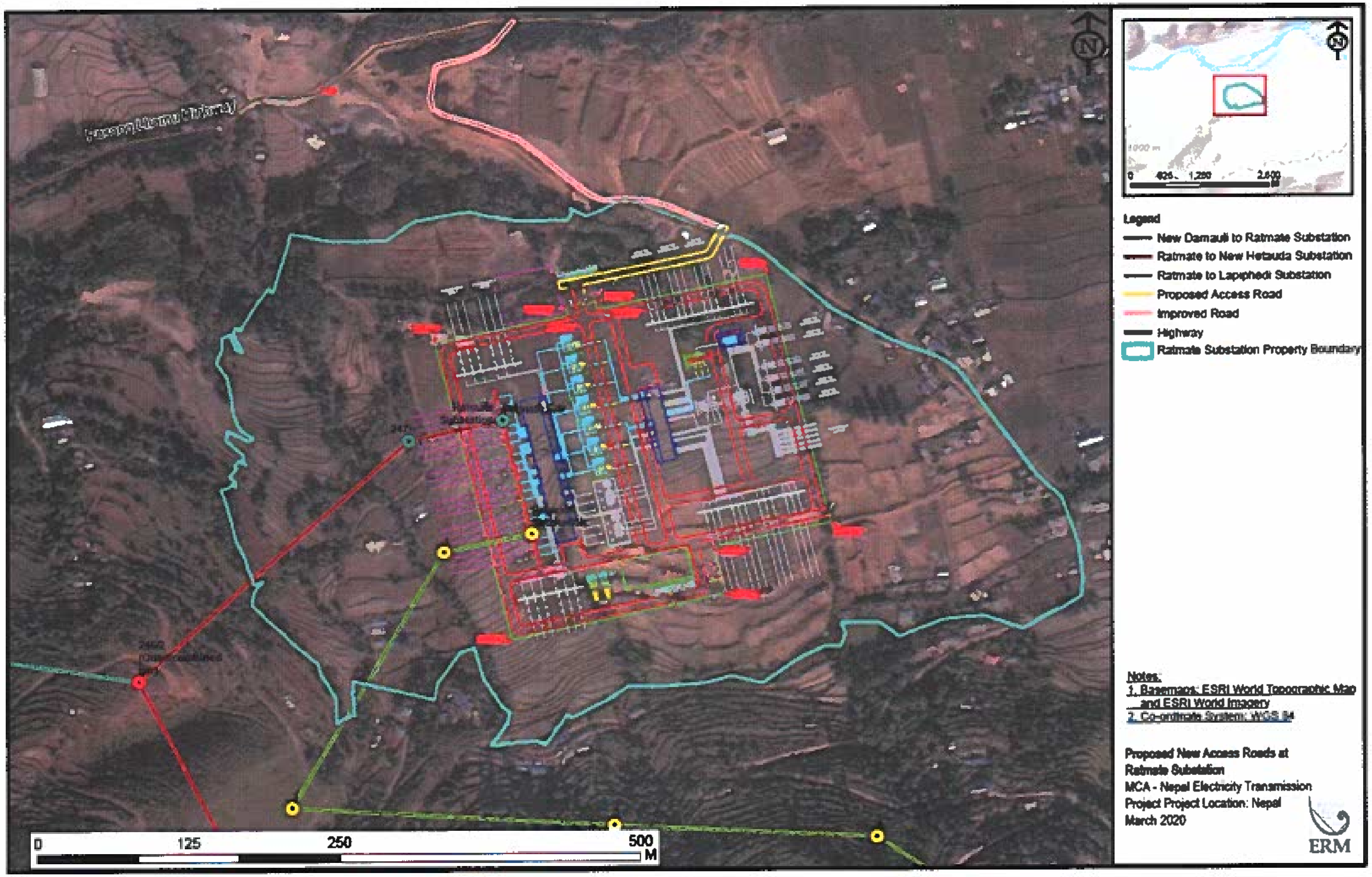

Figure 2.4-3: Proposed New Access Roads at Ratmate Substation

The transmission towers will be accessed through the existing road network. The primary roads to access each of the transmission line segments are listed below (see Figure 2.4-1 and Annex D for more detail):

- **India Border to New Butwal Substation**
  - Sunwal–Parasi–Maheshpur Road
- **New Butwal to New Damauli Substation**
  - Khairenitar–Bhimad–Ghiring–Rampur (Palpa) Road
  - Rampur (Palpa)–Nisdi–Daunne Road
  - Daunne–Hongshi Cement–Deurali (Dhurkot) Road
  - Butwal–Narayanghat section of East-West Highway
- **New Damauli to Ratmate Substation**
  - Devighat–Galchhi–Mugling–Narayanghat Road
  - Kathmandu–Naubise–Galchhi Road
  - Prithvi Highway (Mugling-Damauli–Khairenitar)
  - Damauli–Ghumouni Road
  - Damauli–Chhabdi Road
- **Ratmate to New Hetauda Substation**
  - Devighat–Galchhi–Mugling–Narayanghat - Hetauda Road
  - Kathmandu–Naubise–Galchhi Road
  - Muwakhola–Orlang Road
  - Hetauda–Manahari–Raksirang Road
  - Hetauda–Namtar–Kalikatar Road
  - Kalikatar–Raksirang Road
  - Naubise–Agra–Kalikatar Road
  - Palung–Dandabas–Mahadevbesi Road

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- **Ratmate to Lapsiphedi Substation**
  - Kathmandu–Lapsiphedi Road
  - Lapsiphedi–Bhotechour–Mid-hill Highway
  - Kathmandu–Chhahare–Devighat Road

Porters, pack animals, small motorize vehicles (e.g., motorcycles, all-terrain vehicles [ATVs]) via existing or creating new foot trails will be used to access these tower sites from the primary roads listed above. This approach will reduce forest clearing, land acquisition, and physical resettlement requirements. Further, this approach will increase local employment opportunities by requiring the use of porters for transporting construction equipment and materials. Table 2.4-3 shows the length of foot trails to access the 856 towers. Annex D shows the approximate location of these foot trails and Annex E identifies the approximate length of these trails for each tower.

Table 2.4-3: Tower Access and Foot Trail Length

Existing + Proposed Trail Length	Number of Towers
Greater than 4 km	5 towers
Between 3.0 and 3.99 km	5 towers
Between 2.0 and 2.99 km	5 towers
Between 1.0 and 1.90 km	31 towers
Between 500 m and 999 m	54 towers
Between 100 m and 499 m	307 towers
Less than 100 m (i.e., accessible by existing road)	449 towers
Total	856 towers

Source: Project GIS Analysis 2019

The trails will be sited using these criteria

- Use existing trails to the extent possible;
- Avoid national parks and wildlife preserves;
- Avoid clearing of any forest;
- Avoid any physical displacement;
- Maintain at least a 50 m buffer to any cultural heritage sites; and
- Avoid disturbance of cropland to the extent possible, and if unavoidable, then compensation for damages will be provided;

The trail surface will be simply the ground surface, augmented with gravel if needed in wet areas and wooden planks over swales or intermittent streams. No significant grading should be needed. Temporary bridges will be constructed if any of the trails will cross streams, and will be removed when construction is completed. As part of the overall land compensation process, the D&B Contract will execute a Temporary Access Agreement with each property owner affected by a trail.

The D&B Contractor may decide to use helicopters to access some tower sites if it is determined that the trail to the tower will to be too long (~more than 2 kilometers) or too steep to transport construction materials using porters/pack animals/ATVs. As indicated above, 15 towers require the use of trails with a length over 2 kilometers, at which transport of construction materials using porters and pack animals begins to become difficult. Of these 15 towers requiring trails greater than 2 kilometers, 14 are found in two clusters:

- **New Butwal to New Damauli Substation**
  - Tower 45—2.47 kilometers
  - Tower 46—2.90 kilometers
  - Tower 47—3.19 kilometers
- **New Damauli to Ratmate Substation**
  - Tower 60—2.90 kilometers
  - Tower 61—3.24 kilometers
  - Tower 62—5.05 kilometers
  - Tower 63—5.42 kilometers
  - Tower 64—4.88 kilometers
  - Tower 65—4.61 kilometers
  - Tower 66—4.66 kilometers
  - Tower 67—3.99 kilometers
  - Tower 68—3.53 kilometers
  - Tower 69—3.05 kilometers
  - Tower 70—2.23 kilometers

The use of helicopters for these two clusters would reduce the longest trail length to approximately 2 kilometers. See Section 2.6.4 for more details. The helicopters would take off from an approved heliport or a helipad at a designated laydown area (see Section 2.6.12) with required construction materials/equipment and fly to the tower sites. In most cases, the helicopters would not land because of slope constraints, but will hover at a safe distance above the ground and lower required construction materials/equipment to construction crews.

In summary, it is anticipated that for construction purposes about 52.5 percent of the tower sites will be accessed by vehicles, 46 percent of the tower sites will be accessed by porters/ pack animals/ATVs using trails, and about 1.5 percent of the tower sites may be accessed by helicopters.

2.5 NATURE AND TYPE OF PROJECT

The ETP is a high voltage electrical transmission project, which includes the construction of a 313.9 kilometers long, double circuit 400 kV transmission line, three new substations (i.e., New Butwal, New Damauli, and Ratmate), connections to two existing substations (New Hetauda and Lapsiphedi), and ancillary facilities required for Project construction (e.g., laydown areas, worker camps). It is intended to be a significant component of Nepal's electricity transmission grid and includes Nepal's second major cross-border interconnection with India.

2.6 SALIENT FEATURES OF THE PROJECT

This section describes the salient features of the ETP, including the transmission line, substations, and ancillary facilities.

2.6.1 Right-of-Way

The right-of-way (RoW) is the area of land that will be used to locate, operate, and maintain the transmission line. The RoW also ensures there will be no future incompatible development that will affect transmission line operations and protects local residents from any adverse health effects from electric and magnetic fields (EMF, see Section 7.4).

The standard RoW width for a 400 kV transmission line in Nepal is 46 meters, 23 meters horizontally on each side from the centerline. The transmission line towers will be located along the centerline of the RoW.

2.6.2 Transmission Towers and Conductors

The proposed transmission line route is 313.9 kilometers long and will involve construction of 856 transmission towers. Annex E shows the proposed route overlaid on recent (2019) high--resolution LiDAR aerial imagery. Table 2.6-1 provides a summary of the transmission line salient features.

Table 2.6-1: Transmission Line Salient Features

Feature	Description	Remarks
General		
Name of Project	ETP	Electricity Transmission Project (Lapsiphedi -Ratmate, Ratmate- Hetauda, Ratmate-New Damauli, New Damauli - New Butwal, New Butwal -India Border)
Project Provinces	3 Provinces	Bagmati (6 districts) Gandaki (2 districts) Lumbini (2 districts)
Project Districts	10 Districts	Nawalparasi (West of Bardaghat Susta), Nawalparasi (East of Bardaghat Susta), Palpa, Tanahu, Chitwan, Dhading, Nuwakot, Makawanpur, Sindhupalchok, Kathmandu
Project Affected Gaunpalika/Nagarpalika/Upamahanagarpalika and Wards	Number of Gaunpalika – 19 Number of Nagarpalika – 10 Number of Upamahanagarpalika – 1 Number of Affected Wards – 98	Ichhyakamana Gaunpalika - 2, 3, 5, 6 Benighat Rorang Gaunpalika - 3, 4, 5, 6, 7, 8, 9, 10 Gajuri Gaunpalika - 2 Siddhalekh Gaunpalika - 6, 7 Nilakantha Nagarpalika - 5 Galchhi Gaunpalika - 2, 3, 8 Thakre Gaunpalika - 1, 2, 3, 11 Thaha Nagarpalika - 8 Kailash Gaunpalika - 3, 4, 5, 6 Raksirang Gaunpalika - 1 Hetauda Upamahanagarpalika - 1, 3, 11, 19 Shivapuri Gaunpalika - 1, 3, 5, 7, 8 Panchakanya Gaunpalika - 5 Likhu Gaunpalika - 3, 5 ,6 Belkotgadhi Nagarpalika - 5, 6, 7, 8, 9, 10, 12 Tarkeshwar Gaunpalika - 2, 4 Melamchi Nagarpalika - 1, 2, 3, 4 Shankharapur Nagarpalika - 1, 2, 3 Binayee Tribeni Gaunpalika - 3, 5 Anbukhaireni Gaunpalika - 4, 5, 6 Bandipur Gaunpalika - 2, 3, 4, 6 Vyas Nagarpalika - 1, 13, 14 Rhishing Gaunpalika - 1, 6, 7, 8

Feature	Description	Remarks
		Ghiring Gaunpalika 1, 2, 3, 5 Nisdi Gaunpalika - 5, 6, 7 Rampur Nagarpalika - 1, 2, 3, 4 Sunwal Nagarpalika - 11, 12, 13 Ramgram Nagarpalika - 1, 8, 11, 12, 13, 17 Palhi Nandan Gaunpalika - 1, 2, 3 Bardaghat Nagarpalika-2
Project Type	Overhead high voltage line	
Construction period (years)	3.5	
Operational life expectancy (years)	50+	
Total RoW Length (km)	313.9	
RoW Width (m)	46	23 meter each side from center line.
Financial Arrangements		Project funding is via a grant from the MCC (a U.S. government agency) and contributions from the GoN
System Data		
System nominal voltage (kV)	400	
System maximum voltage (kV)	420	
Number of Phases	3	Three phases make up one circuit and each tower carries two circuits.
System nominal frequency (Hz)	50	
Estimated transmission line power loss	2 – 3 %	
Line Data		
Circuit	Double Circuit	Quad circuit for some limited number of towers
Conductor	Quad Moose	
Conductor type	ACSR	Aluminum-conductor steel-reinforced (ACSR) cable where the core (inner strands) is steel reinforced while the outer strands are aluminum.
Length of conductor including sag, jumpers, and slack spans (km)	327	

Feature	Description	Remarks
Conductor cross-sectional area (mm^2)	597	
Conductor diameter (mm)	31.78	
Ultimate strength (kg)	16,785	
Modulus of elasticity final (kg/mm^2)	7,035	
Coefficient of linear expansion (per □C)	19.30 x 10^{-6}	
Standard mass of conductor (kg/km)	1,997	
Electrical D.C. resistance at 20□C (ohm/km)	0.05458	
Standard unjointed length on reel (m)	1,800/2,000/2,200	
Insulator Type	Porcelain or Glass	
Number of overhead ground wires (OHGW)	2 per tower	One OHGW (steel) and one OPGW (fiber optic equipped ground wire)
Geographic and Climatic Conditions		
Highest elevation along the route (masl)	1,918	
Lowest elevation along the route (masl)	101	
Maximum ambient temperature □C	50	
Minimum ambient temperature □C	-5 □C	(Ref. TL Design Report, page 2.13)
Maximum temperature of conductor □C	80	80 □C in some circumstances and 100 □C in some other (Emergency) (Ref. TL Design Report page 2.8)
Everyday temperature of conductor □C	32	
Wind pressure on the whole projected area of conductors in Pascals (Pa)	As Per IS 802 (2015)	Varies per weather case. 2,083 Pa under Extreme Wind loading.
Wind pressure on the whole projected area of steel angle members (Pa)		Varies per weather case. 6,074 Pa under Extreme Wind loading.
Wind pressure on 1.71 times projected area of steel angle face of structure (Pa)		Varies per weather case. 6,074 Pa under Extreme Wind loading.
Transmission Line Crossings		
Number of Highway/Major Road Crossings	29	See Table 2.6-2

Feature	Description	Remarks
Number of Large Stream, River, and Reservoir Crossings	54	No existing reservoir crossings See Table 2.6-3 for large streams and river crossings
Number of TL Crossings	23	66 kV–2 existing lines 132 kV–6 existing lines, 2 proposed lines 220 kV–11 proposed lines 400 kV—2 proposed lines See Table 2.6.4
Aviation Route Crossings	12	See Figure 2.6-1
Principal Towns/Villages Affected		Butwal, Hetauda, Ratmate, Shankharapur
Towers		
Tower Type	Lattice Steel Self-Supporting and Monopoles	
Total Number of towers	856	
Tower width (max/avg/min) (m)	40/28/21	Max only for multi-circuit towers
Average tower span (m)	367	
Maximum Tower span (m)	1,574	
Max/Average/Min Tower Height (m)	92.5/61/43	
Suspension (DA Tower Type)	126	
Angle/Tension (DB/DC Tower Types)	419	
Dead End (DE/DF Tower Types)	302	
Station Gantry	9	
Tower foundation type	Non-limitative list, including - Pad and chimney; concrete foundation; RC; Micropiles; monopoles, steel grillages, etc.	Foundations will be designed to withstand uplift, settlement/bearing pressure, overturning, and sliding (as appropriate) when subjected to the applied system loading. Allowances will also be made for hydrostatic pressure that may occur and the effects of seasonal rains, drying out or other cyclic loading.

Towers		
Phase spacing (Vertical) (mm)	9.300–10. 300	Varies between 9, 300 and 9,500 for Tension tower types; and is 10,300 for DA suspension type
Shield Angle (DEG)	5	
Minimum Conductor Clearance (at + 100□C conductor temperature) – NEA standards		
To Ground	10.0	
Residential area	10.0	
Crossing Highway/Road	10.8	
Crossing Communication Lines	6.5	
Crossing Rivers (non-navigable)	9	Clearance above highest flood level
Crossing Rivers (Navigable)	Variable	
Buildings (m)	8.4	To metal clad or roofed buildings or building or structures
Power line crossings (m)	6.49	Power line crossings (above or below)
Tree Clearance	6.7 m	
Aircraft Warning and Aviation Protection Devices		
Painting of tower structure	Per CAAN	
Aircraft warning sphere characteristic	915 mm diameter	Color – orange, white, and yellow
Lighting	LED	
Project Cost		
Project Cost (US dollars)	$528 million	Approximate ($1=110 NPR)

Source: Power Engineers, Inc. ETP Project Design Report, August 2019

The Project will cross highways and major roads at 29 locations, as identified in Table 2.6-2.

STANTEC CONSULTING INTERNATIONAL LLC 2000

वन तथा वातावरण मन्त्रालय
नेपाल सरकार
सिंहदरबार, काठमाडौं

Table 2.6-2: Highways and Major Road Crossings

Road Name	Adjoining Towers	Distance from Nearest Tower to Edge of Road (m)	Municipality
India Border to New Butwal Substation			
Hulaki Marg Road	31-32	132 m	Ramgram
Parasi Road	40-41	32 m	Ramgram
New Butwal to New Damauli Substation			
Mahendra Highway	6-7	127 m	Sunwal
Benimanipur Sadak Road	51–52	50 m	Binayee
Nisdi-Galdha Road	115-116	8 m	Nisdi
Pragatinagar Rampur Highway	143–144	98 m	Rampur
Baidi-Delgaun Road	146-147	54 m	Ghiring
Bhimad-Baidi-Road	150-151	18 m	Ghiring
	152-153	140 m	Ghiring
	153-154	19 m	Ghiring
	162-163	77 m	Ghiring
	170-171	24 m	Ghiring
	174-175	79 m	Ghiring
	176-177	147 m	Ghiring
	178-179	16 m	Ghiring
	179-180	30 m	Ghiring
	182-183	63 m	Ghiring
	184-185	50 m	Ghiring
New Damauli to Ratmate Substation			
Bharatpur-Mugling Highway	94-95	124 m	Abukhairani
Prithvi Highway	183-184	112 m	Gajuri

Road Name	Adjoining Towers	Distance from Nearest Tower to Edge of Road (m)	Municipality
Pasang Lhamu Highway	240-241	65 m	Belkotgadi
Ratmate to New Hetauda Substation			
Prithvi Highway	24-25	294 m	Galchhi
Dangdunge Road	T4-T5	28 m	Hetauda
Ratmate to Lapsiphedi Substation			
Pasang Lhamu Highway	29-30	67 m	Belkotgadhi
Tokha-Chharae Road	74-75	66 m	Likhu
Mid Hill Highway	82-83	59 m	Shivapuri
Mid Hill Highway	134-135	74 m	Melamchi
Bhotechaur Melamchi Road	139-140	12 m	Melamchi
Sankhu–Melamchi Road	155–156	27 m	Shankharapur

Source: Project GIS Analysis 2019

The Project will cross 54 rivers and streams, including six named rivers, some multiple times: Jharai (6), Kali Gandaki River (1), Seti River (1), Trishuli River (3), East Rapti River (1), and Likhu River (3) as identified in Table 2.6-3. Annex U provides coordinates, ground elevations, river bed levels, and predicted high flood levels (HFL) for transmission towers near rivers. Ground elevation and river bed level elevations are taken from LiDAR survey data (drawn plan and profile with PLS-CADD). HFL flood level data were obtained and verified through consultation with local people and based on 50-year return period.

Table 2.6-3: River and Reservoir Crossings

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
India Border to New Butwal Substation Segment					
Jharai River	9-10	85	36	Stream	Palhi Nandan
Jharai River	14-15	90	34	Stream	Ramgram
Jharai River (double crossing)	18-19	50	34	Stream	Ramgram

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
Jharai River	19-20	30	36	Stream	Ramgram
Jharai River	20-21	14	25	Stream	Ramgram
Tributary of Jharai	28-29	36	34	Stream	Ramgram
Tributary of Jharai	41-42	61	44	Stream	Ramgram
Tributary of Jharai	43-44	54	45	Stream	Ramgram
Tributary of Jharai	44-45	66	42	Stream	Sunwal
New Butwal to New Damauli Substation Segment					
Tributary of Jharai	1-2	115	27	Stream	Sunwal
Tributary of Jharai	3-4	67	18	Stream	Sunwal
Tributary of Jharai	7-8	32	21	Stream	Sunwal
Tributary of Jharai	8-9	10	26	Stream	Sunwal
Tributary of Jharai	9-10	85	30	Stream	Sunwal
Tributary of Jharai	10-11	365	21	Stream	Sunwal
Tributary of Jharai	11-12	24	37	Stream	Sunwal
Tributary of Jharai	AP 14 81 - AP 80/5-15	25	39	Stream	Sunwal
Tributary of Jharai	W18-17	115	27	Stream	Sunwal
Tributary of Jharai	17-18	450	27	Stream	Sunwal
Tributary of Jharai	24-25	60	24	Stream	Sunwal
Tributary of Jharai	44-45	132	30	Stream	Bardaghat
Tributary of Narayani	47-48	140	48	Stream	Binayee Tribeni
Tributary of Narayani	49-50	36	99	Small River	Binayee Tribeni
Tributary of Narayani	50-51	120	90	Small River	Binayee Tribeni
Tributary of Narayani	64-65	225	30	Stream	Binayee Tribeni
Tributary of Narayani	77-78	180	80	Small River	Nisdi

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
Tributary of Nisdi Khola	100-101	180	30	Stream	Nisdi
Nisdi Khola	108-109	164	40	Stream	Nisdi
Nisdi Khola	126-127	160	49	Stream	Rampur
Kali Gandaki River	143-144	134	140	Large River	Rampur
Tributary of Seti Gandaki	220-221	127	23	Stream	Rhising
Seti River	233-234	140	75	Large River	Rhising
New Damauli to Ratmate Substation Segment					
Tributary of Seti	38-39	80	40	Stream	Bandipur
Tributary of Seti	46-47	465	30	Stream	Anbukhaireni
Tributary of Seti	49-50	280	20	Stream	Anbukhaireni
Tributary of Seti	59-60	220	30	Stream	Anbukhaireni
Trishuli River	94-95	70	105	Large River	Anbukhaireni
Tributary of Trishuli	138-139	440	39	Stream	Benighat Rorang
Tributary of Trishuli	155-156	270	30	Stream	Benighat Rorang
Tributary of Trishuli	174-175	65	46	Stream	Benighat Rorang
Trishuli River	183-184	144	105	Large River	Gajuri
Trishuli River	240-241	105	110	Large River	Tarkeshwar
Ratmate Substation to New Hetauda Substation Segment					
Tributary of Trishuli	12-13	26	46	Stream	Belkotgadhi
Tributary of Trishuli	24-25	130	46	Stream	Thakre
Tributary of Aagra Khola	49-50	43	20	Stream	Thaha
Tributary of East Rapti	68-69	52	32	Stream	Kailash
East Rapti River	86-87	106	98	Small River	Kailash
Tributary of East Rapti	108-109	25	12	Stream	Hetauda

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
Ratmate to Lapsiphedi Substation Segment					
Tributary of Tadi	30-31	65	26	Stream	Belkotgadhi
Tributary of Tadi	39-40	85	30	Stream	Belkotgadhi
Likhu River	82-83	140	44	Stream	Shivapuri
Likhu River	116-117	262	24	Stream	Shivapuri
Likhu River	122-123	55	25	Stream	Shivapuri

Source: Project GIS Analysis 2019

The Project will cross 23 existing and proposed transmission lines, as identified in Table 2.6-4.

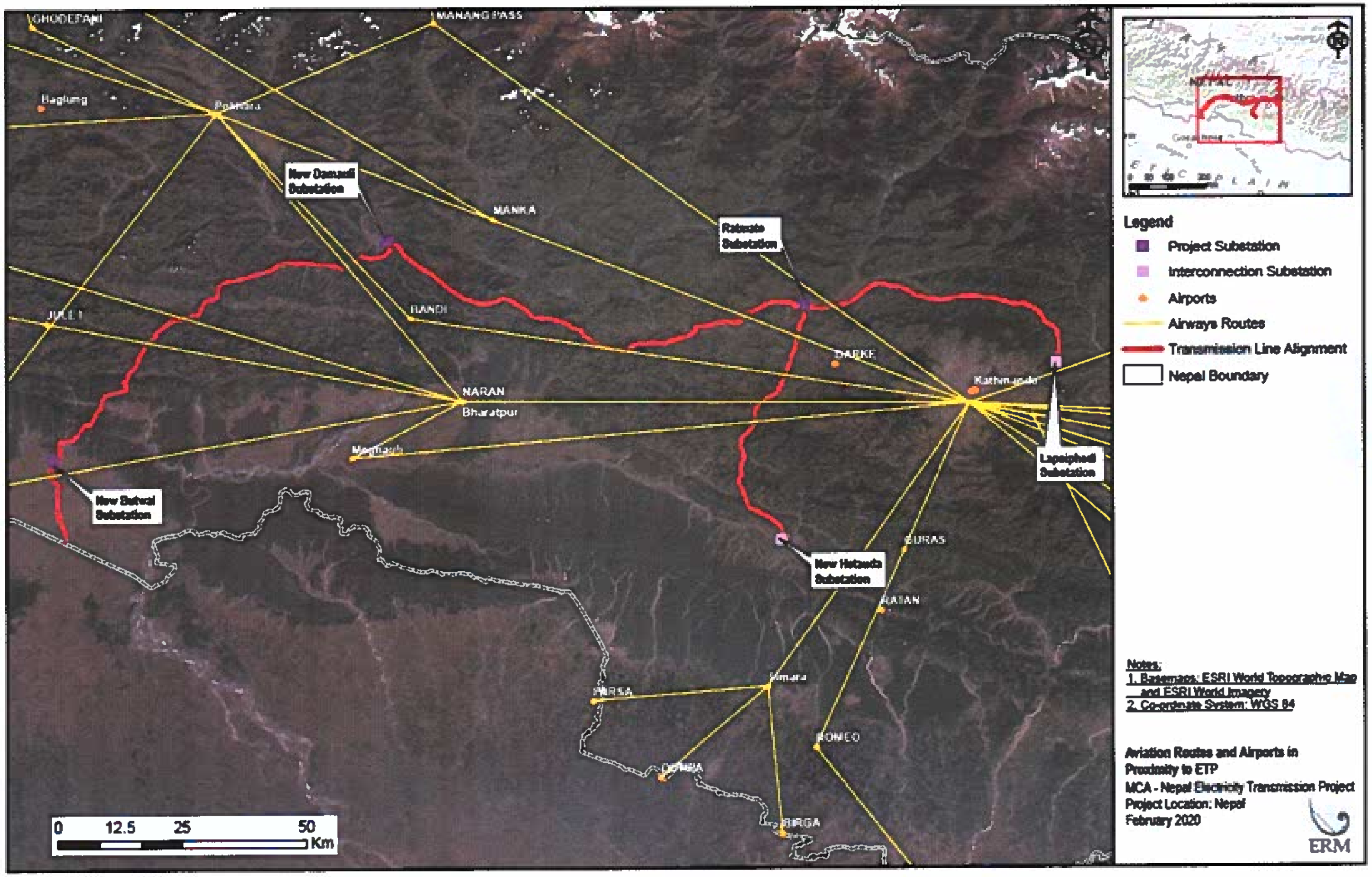
Table 2.6-4: Existing and Proposed Transmission Line Crossings

TL Name	kV	Status	Adjoining Towers	Municipality
India Border to New Butwal Substation				
None				
New Butwal to New Damauli Substation				
Butwal to Bardghat	132	Existing	3–4	Sunwal
New Butwal to Bardaghat	220	Proposed	4 - 5	Sunwal
New Butwal to New Bharatpur	220	Proposed	5 - 6	Sunwal
New Damauli to New Bharatpur	220	Proposed	233–234	Rhishing
New Damauli to New Bharatpur hydropower line	220	Proposed	233-234	Vyas
New Damauli to Ratmate Substation				
Damauli to Bharatpur	132	Existing	3–4	Vyas
New Marshyangdi to New Bharatpur	220	Proposed	78 - 79	Anbukhaireni
Marsyangdi to Bharatpur	132	Existing	81–82	Anbukhaireni
New Marsyangdi to Super Trishuli Galchi	220	Proposed	81 - 82	Anbukhaireni

TL Name	kV	Status	Adjoining Towers	Municipality
New Marsyangdi to Trishuli Galchhi	132	Proposed	181-182	Gajuri
Third Trishuli Nadi (Marsyangdi) to Siuchatar	132	Existing	185-186	Siddhalek
Marsyangdi to Bad Bhaniyan (Matatirtha)	220	Proposed	185-186	Siddhalek
Ratmate to New Hetauda Substation				
Marsyangdi to Bad Bhaniyan (Matatirtha)	220	Proposed	24 - 25	Thakre
Third Trishuli Nadi (Marsyangdi) to Siuchatar	132	Existing	27 - 28	Thakre
Hetauda to Bharatpur	132	Existing	T1 – T2	Hetauda
Hetauda to New Hetauda	132	Proposed	T3-T4	Hetauda
New Hetauda to New Dalkhebar	400	Proposed	T8 – T9	Hetauda
New Hetauda to Parwanipur	400	Proposed	T9 – BMI/1	Hetauda
Ratmate to Lapsiphedi Substation				
Upper Trishuli 3A to Matatirtha	220	Proposed	13 - 14	Belkotgadhi
Trishuli/Devighat HEP to New Chabel	66	Existing	32–33	Belkotgadhi
Trishuli HEP to Balaju	66	Existing	40–41	Likhu
Upper Trishuli 3B Hub to Naubise	220	Proposed	47–48	Likhu
Upper Trishuli 3A to Matatirtha	220	Proposed	49–50	Likhu

Source: NEA-provided kmz files 2019

MCA-Nepal has consulted with the Civil Aviation Authority of Nepal (CAAN) regarding the ETP and aviation safety. The CAAN has reviewed and approved the transmission line alignment, tower heights, and river spans, but will require installation of obstruction lights on all towers taller than 60 m that are located on hilltops, or paint the upper 30 m of the tower with red and white colors, and placement of aviation safety markers (e.g., marker balls) (see Annex B for agency consultation letter). Figure 2.6-1 shows the location of aviation routes and airports in proximity to the ETP, including the approximately 12 locations where aviation routes cross the proposed alignment.



Source: Civil Aviation Authority of Nepal (CAAN) 2019

Figure 2.6-1: Aviation Routes and Airports in Proximity to ETP

2.6.2.1 Transmission Towers

The Project will require seven tower types as described below. See Annex E for typical tower details.

- Suspension Towers (DA type): these towers are in lines for straight-run or minor angle deviations of up to 2°. Suspension (passing through) clamps support the conductors on this type of tower.
- Angle/Tension Towers (DB and DC type): these towers are used at locations where the deviation angle exceeds 2° or 3° or where the towers are subjected to uplift loads. These towers are further classified as small angle towers for deviation angles of up to 15° (called DB), and medium angle towers for deviation angles of 15° to 30° degrees (called DC). Tension (dead end) clamps support the conductors on this type of tower. These DB and DC towers are of the most common tower types found along the line route, being equivalent to about 60 percent of all towers, and approximately one third of them could end up be substituted for by Running Angle Suspension Towers, to allow direct conductor continuity without the need to use jumpers.
- Dead End Towers (DD, DE, and DF type): dead-end towers are used as large angle towers and line termination points and can hold a deviation angle of about 30° to 90°. They are also be used as anti-cascading towers, which are used at certain intervals in line routes to prevent the propagation of a failure. These towers are further classified as large angle towers.
- Gantry Towers: are terminal towers within the substation sites.

The allocation of the different transmission towers types across the five segments of the route is presented in Table 2.6-5. Typical tower foundation sizes are presented in Table 2.6-6. Annex E provides details for each tower (i.e., tower/segment identification number, location coordinates as well as applicable district/municipality/ward designation, ground elevation, height, type, and access).

Table 2.6-5: Tower Type by Transmission Line Segment

Transmission Line Segment	Total Line Length (km)	Tower Type DA	Tower Type DB	Tower Type DC	Tower Type DD	Tower Type DE	Tower Type DF	Station Gantry	Total Number of Towers
India Border to New Butwal	18.2	29	3	10	2	10	0	1	55
New Butwal to New Damauli	89.5	20	99	43	3	45	36	2	248
New Damauli to Ratmate	89.7	29	69	59	8	42	41	2	250
Ratmate to New Hetauda	57.5	35	33	15	10	13	32	2	140
Ratmate to Lapsiphedi	59.0	13	51	37	2	38	20	2	163
Total	**313.9**	**126**	**255**	**164**	**25**	**148**	**129**	**9**	**856**

Source: Power Engineers, Inc. ETP Project Design Report August 2019

Table 2.6-6: Typical Tower Foundation Footprint Sizes

Tower Types	Typical Tower Foundation Footprint
DA	28.6 m x 28.6 m = 817.9 m^2
DB	29.2 m x 29.2 m = 852.6 m^2
DC	29.6 m x 29.6 m = 876.2 m^2
DD	29.6 m x 29.6 m = 876.2 m^2
DE	30.9 m x 30.9 m = 954.8 m^2
DF	34.6 m x 34.6 m = 1,197.2 m^2
Substation Gantry	28.0 m x 28.0 m = 784.0 m^2

Source: Power Engineers, Inc. ETP Project Design Report August 2019

In coordination with NEA, and in an effort to reduce social impacts in a highly developed area, multi-circuit towers are proposed in three locations:

- New Butwal to New Damauli Segment - the first 16 towers in this segment (Towers 1 – NEA W18, approximately 4 kilometers) will be quad-circuit towers, supporting both the ETP 400 kV double-circuit transmission line as well as NEA's Lamahi 400 kV double-circuit transmission line (see Figure 2.6-2 below).
- New Damauli to Ratmate and Ratmate to New Hetauda Segments – the last two towers in the New Damauli to Ratmate segment and the first two towers in the Ratmate to New Hetauda Segment (Towers 264/2 and 265/1) will be shared quad-circuit towers (see Figure 2.6-3 below).
- Ratmate to New Hetauda Segment – the last two towers entering the New Hetauda substation (Towers BM1/1 and BM1) will be quad-circuit towers supporting both the ETP 400 kV double-circuit transmission line as well as NEA's New Hetauda to Parwanipur 400 kV double-circuit transmission line.

Since this will be a D&B Contract, there is the potential that aspects of the tower design may change. For example, some tension towers (e.g., DB/DC towers) could be replaced with a suspension type tower. In addition, some special towers are anticipated (e.g., monopoles are tentatively proposed for Ratmate to New Hetauda Towers T5 – T9), which would reduce land acquisition and floodplain impacts.

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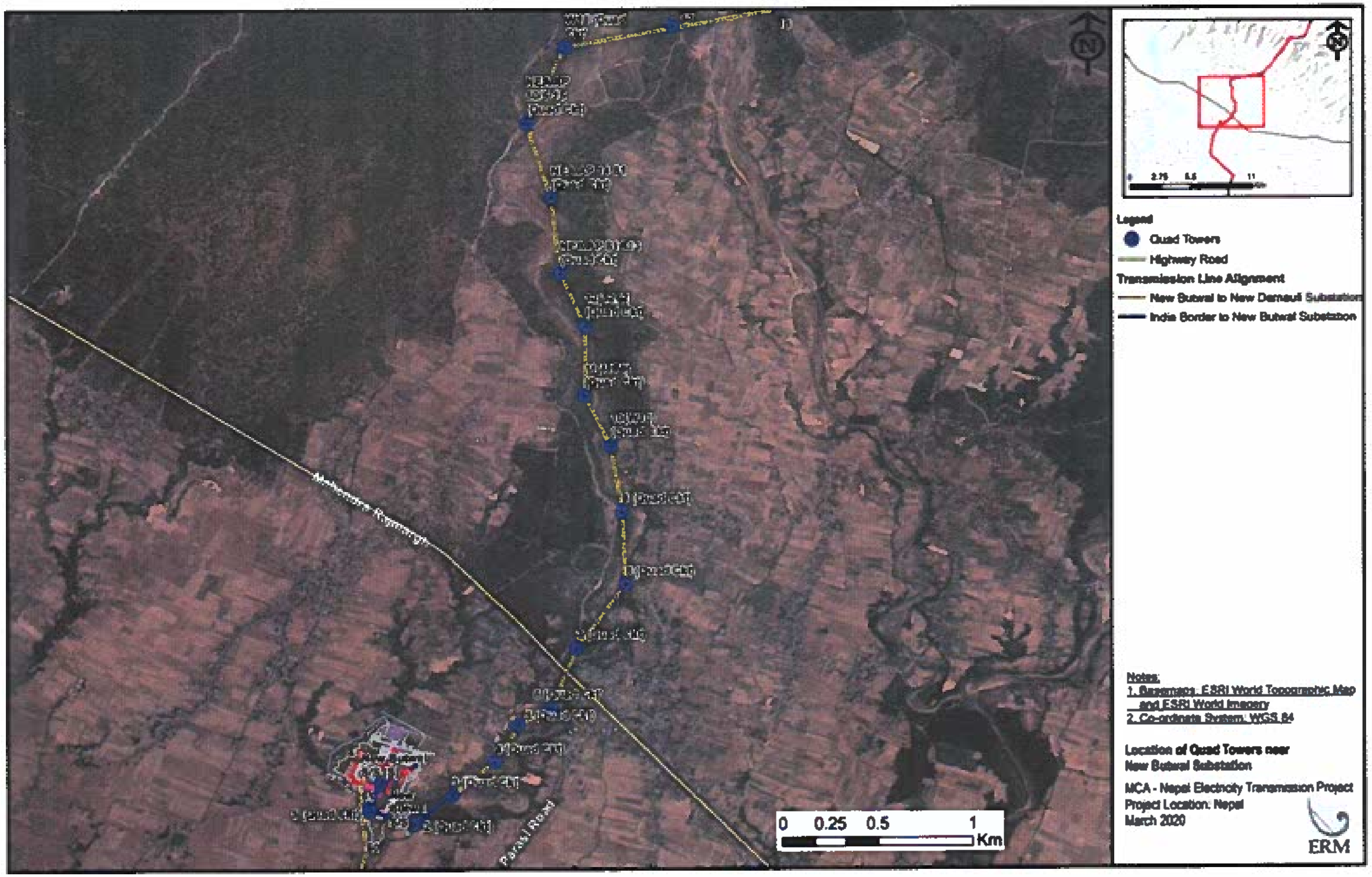

Figure 2.6-2: Location of Quad Towers near New Butwal Substation

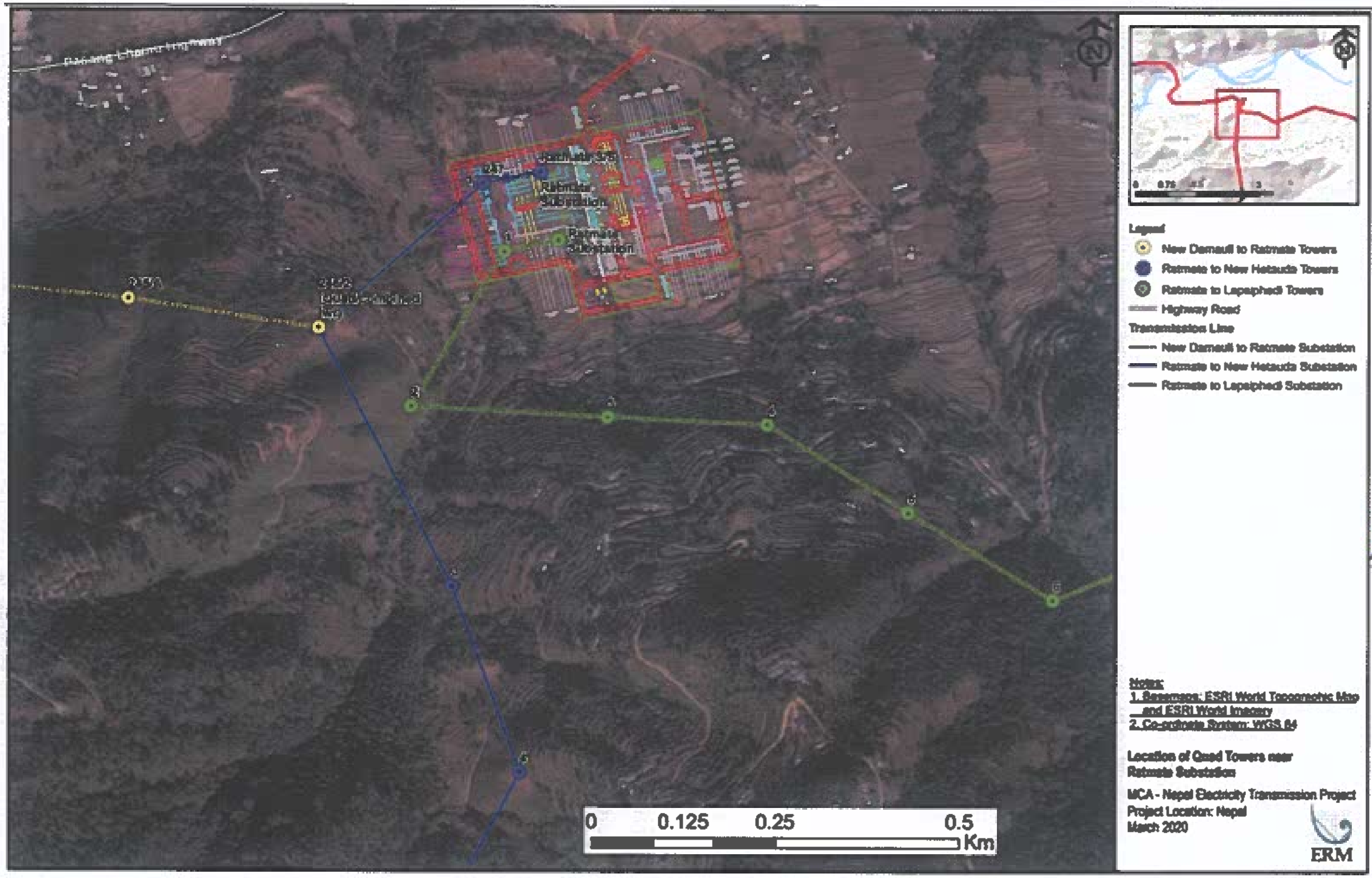

Figure 2.6-3: Location of Quad Towers near Ratmate Substation

2.6.2.2 Conductors and Overhead Shield Wire

The 400 kV transmission line conductors are made of aluminum wires wrapped around a stranded steel cable. The conductors will be suspended from an insulator string attached to the arms on the tower at a safe height above the ground. Two overhead shield wires will be installed at the top of the towers. One is a fiber optic ground wire and the other is a steel wire.

2.6.2.3 Safety and Security Measures

Each tower will be protected by two overhead cables that serve to shield the energized circuits from lightning strikes. In addition, each tower will be grounded, which establishes an electrical path from the steel tower to the earth in order to allow stray currents, which occur on all transmission lines due to lightning, switching, and surge events, to be conducted to the earth.

The electric and magnetic fields (EMF) that naturally occur with energized circuits will be minimized at the edge of the transmission line RoW by establishing proper distances between the ground and the energized conductors. As discussed in Section 7.4, EMF levels are well below international health standards at the edge of the RoW.

Towers will have a level of physical security to prevent the public or climbing animals from ascending them. This may take the form of a security fence or anti-climbing device added to the supporting legs. Anti-climbing devices and safety warning notices will be installed on towers close to roads and areas with easy public access.

2.6.2.4 Interconnection with India

The Joint Steering Committee (JSC) on Nepal–India Cooperation in Power Sector has been meeting to coordinate the cross-border transmission line from New Butwal (Nepal) to New Gorakhpur (India), among other cross-border projects. This coordination will ensure that the technical design of the crossing is thoroughly synchronized between the two systems. At present, there is a terminal tower proposed approximately 30 meters from the India border.

2.6.3 Substations

Substations are typically used to transform voltage from high transmission voltages to lower distribution voltages for use by consumers. Substation details and configurations are presented in Annex F.

2.6.3.1 Salient Features of Substation

The design specifications for the operation the three new substations (i.e., New Butwal, New Damauli, and Ratmate) are presented in Table 2.6-7, which provides a summary of the substation's salient features. All three substations will have same design specifications.

Table 2.6-7: Salient Features of Substation

Substation Feature	Description
Number of Affected Provinces	3 (Bagmati, Gandaki, and Lumbini)
Number of Affected Districts	3 (Nuwakot, Tanahu, and Nawalparasi (West of Bardaghat Susta)
Number of Affected Municipalities	3 (Belkotgadi, Vyas, and Sunwal)
Switchgear	Gas Insulated Switchgear (GIS) at all three main substations namely Ratmate S/S, New Damauli S/S and New Butwal Substations. Interconnection works at Lapsiphedi and New Hetauda S/S(no switchgear involved)
Operational Staffing	50 people
Nominal system voltage	220/400 kV
Maximum voltage	420 kV
Corona extinction voltage	320 kV
Control System	SAS (Substation Automation System)
GIS Hall(Building) Type	RCC framed structure
Telecommunication media	Fibre Optic Cable
Rated frequency	50 Hz
Grounding /Material	Effectively earthed /Copper
Phase conductor material	Aluminium Bus Bar
Minimum Clearances • Phase to Phase • Phase to Earth • Sectional clearance • Live part to tower body (no swing)	 4,200 mm 3,500 mm 6,500 mm 3,050 mm
Seismic factor	0.5 of gravitational acceleration (g)
Construction period	3.5 years
Operating life expectancy	Approximately 50 years

Source: Power Engineers, Inc. ETP Project Design Report August 2019

2.6.3.2 Substation Land Acquisition, Permitting, and Construction Responsibilities

MCA-Nepal will construct 400 kV sub-stations in New Butwal, New Damauli, and Ratmate. For the other two substations (New Hetauda and Lapsiphedi), MCA-Nepal will only connect the ETP transmission line into existing 400 kV GIS bays reserved within the existing substations being constructed by NEA. The land for the New Butwal, New Hetauda, and Lapsiphedi substations has already been acquired by NEA. NEA is in the process of acquiring land for New Damauli substation. MCA-Nepal is only acquiring the land for the Ratmate substation. The Ratmate substation site is larger than the others as additional land is being acquired for future expansion of this substation, which is envisioned to be an important transmission hub.

Table 2.6-8: Entities Responsible for Substation Land Acquisition and Construction

Substation	Land Acquisition Responsibility	Site Area (ha)	MCA-Nepal Construction Responsibility
New Butwal	NEA—land has already been acquired	9.8	Construct 400 kV GIS substation, and provide space for two future 220 kV AIS bays to be permitted and constructed by others (3.6 ha), with remaining land for NEA 220 kV substation. Total site area including both MCA-Nepal 400 kV and NEA 220 kV substations is 15.1 ha).
New Damauli	NEA—land acquisition is in process	8.1	Construct 280 m long east access road and new 400 kV GIS substation.
Ratmate	MCA-Nepal	19.8	Construct 150 m access road and upgrade 710 m of Lok Sanchar Marga Road, and construct new 400 kV and 220 kV GIS substation. Total site area allows for future NEA expansion.
New Hetauda	NEA—land has already been acquired	6.2	Tie transmission lines coming from Ratmate into existing substation.
Lapsiphedi	NEA—land has already been acquired	8.0	Tie transmission lines coming from Ratmate into existing substation.

Source: Power Engineers, Inc. ETP Project Design Report August 2019

The location of the new substations and access roads are indicated in Figures 2.2-1, 2.4-1 and 2.4-2 and on the MCA-Nepal ETP route alignment sheets in Annex D.

2.6.3.3 Configuration

The lines and voltage requirements for each bay featured on all five substations are described in Table 2.6-9, including a description of the configuration of necessary transformers.

Table 2.6-9: Summary of Substation Configurations

Substation	400 kV Bays[1]	220 kV Bays	132 kV Bays	Transformers
New Butwal (GIS)	2 bays for lines to New Damauli 2 bays for lines to India 6 bays for future 400 kV lines	Space for 2 future bays in the existing yard	Provided by others	2 bays for 3 phase 315 MVA, 400/220 kV transformers Space for 2, 3 phase, 315 MVA 400/220 kV future transformer
New Damauli (GIS)	2 bays for lines to Ratmate 2 bays for lines to New Butwal 4 spare bays for future lines	Space for future bays by NEA/KfW	Space for future bays by NEA/KfW	2 bays for 3x single phase, 167 MVA, 400/220 kV transformer Space for 2 bays 3x single phase, 167 MVA, 400/220 kV future transformer 1 x spare single phase unit
Ratmate (GIS)	2 bays for lines to New Damauli 2 bays for lines to New Hetauda 2 bays for lines to Lapsiphedi 2 bays for lines to China Space for 2 bays for future lines from Budhi Gandaki Hydro	GIS for 8 line bays	Space for 4 future 132 kV bays Space for 4 future 33 kV bays.	2 bay for 3 x single phase, 167 MVA, 400/220 kV transformer Space for 2 bays for 3x three phase, 167 MVA, 400/220 kV future transformer. 1 bay for 220/132 kV Auto and 1 future bay for a 220/132 kV Auto. Space for one future 132/33 kV power transformers. 1 x spare single phase unit
New Hetauda (GIS)	2 bays for lines from Ratmate	Provided by others	Provided by others	Provided by others
Lapsiphedi (GIS)	2 bays for lines from Ratmate	Provided by others	Provided by others	Provided by others

Source: Power Engineers, Inc. ETP Project Design Report August

[1] Bay is defined as one breaker, two switches, and current transformers associated with that breaker

2.6.3.4 Substation Supporting Infrastructure

Table 2.6-10 summarizes the supporting infrastructure that MCA-Nepal will provide at each of the five substations. As indicated above, the ETP will only be connecting into the existing substations at New Hetauda and Lapsiphedi, and therefore will not be providing any supporting infrastructure at those locations.

Table 2.6-10: Substation Supporting Infrastructure Summary

Substation	Control Building	GIS Switch-Gear Building	Storage Building	Staff Living Quarters	Potable Water/Waste System	Fire Protection System	Auxiliary Power Supply
New Butwal	√	√	√		√	√	√
New Damauli	√	√	√	√	√	√	√
Ratmate	√	√[1]	√	√	√	√	√

Source: Power Engineers, Inc. ETP Project Design Report August

[1] At Ratmate there are two GIS buildings (400 kV and 220 kV).

More details on each of the supporting infrastructure facilities is provided below:

- Control building—will include offices, control panels, battery/chargers, AC/DC panels, protection and control panels, and washroom;
- GIS switchgear building—will house GIS switchgear and associated equipment;
- Storage and maintenance building—will provide covered storage for spare parts for major equipment unsuitable for long-term outdoor storage, as well as water pumps;
- Staff living quarters—sufficient to accommodate 50 employees as well as parking for 25 vehicles;
- Potable water system—will include a water treatment building, water storage tank, and distribution system;
- Wastewater treatment system—will include a septic system for domestic wastewater treatment and disposal;
- Fire protection system—will include a firefighting water storage tank, and fire walls between transformers and transformer oil collection system; and
- Auxiliary power system—will include a 10 kW diesel generator to allow for black starts and provide backup power when no other sources are available.

2.6.3.5 Safety and Security

MCA-Nepal will provide the following safety and security features at each of the three substations it will be constructing—firewalls between the transformers and transformer oil collection system, a guardhouse, perimeter security fence, adequate grounding, shielding, lighting, and controlled gate access to protect the public and the facility.

2.6.4 Ancillary Facilities

Construction of the ETP will also require work camps, laydown areas, and some access improvements, which are described below.

2.6.4.1 Workers Camps and Laydown Areas

Construction of the ETP will involve three types of workers camps and laydown areas, which are listed and described below:

- Substation Workers Camps and Laydown Areas
- Tower Laydown Areas
- Tower Workers Camps and Storage Areas

2.6.4.1.1 Substation Workers Camps and Laydown Areas

Three sites, which are located within the New Butwal, New Damauli, and Ratmate substation sites, will provide worker accommodations and laydown areas for construction equipment (e.g., light and heavy-duty cranes, cement mixers, dozers, graders) and materials (e.g., cement, fine and coarse aggregate, steel, rebar). Table 2.6-11 provides details on the facilities that will be provided at the substation work camps and laydown areas. The worker accommodations and other infrastructure improvements will also be used during Project operations.

2.6.4.1.2 Tower Laydown Areas

The Tower Laydown Areas will provide limited worker accommodations and storage areas for construction equipment (e.g., light and heavy-duty cranes, cement mixers, dozers, graders) and materials (e.g., cement, fine and coarse aggregate, steel, rebar). Table 2.6-11 provides details on the facilities that will be provided at the Tower Laydown Areas.

Nine sites have been identified as tower laydown areas, plus two smaller helipad sites (see Table 2.6-12 and Figure 2.6-4). The two helipad sites are helipad sites are proposed for difficult to access tower sites along the New Butwal to New Damauli Substation segment (i.e., Towers 45–47) and New Damauli to Ratmate Substation segment (i.e., Towers 60–70) (see Section 2.4.2 and Figure 2.6-4). These helicopter supported sites will be smaller than the typical laydown area and will not provide the facilities described in Table 2.6-11, but rather would simply be locations where construction materials and equipment would be offloaded from the helicopters and then carried by porters and/or pack animals to the respective tower sites.

Table 2.6-11: Substation Workers' Camp and Tower Laydown Area Infrastructure

Infrastructure Requirements	Substation Workers' Camp	Tower Laydown Areas
Total Area	Approximately 1 ha within the substation site.	Varies depending on the number of towers the laydown area is supporting, but at least 1 ha and possibly as large as 4 or 5 ha.
Accommodations	Housing for 50 workers Comply with the Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project	Housing for 10 workers Comply with the Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project
Sanitation Facilities	Comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project	Comply with IFC/EBRD Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project
Canteen/Cooking/ Laundry Facilities	Comply with Workers' accommodation: processes and standards (IFC 2009) Food purchased locally and measures outlined in the D&B Contractor's ESHSMP for the Project	Comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project Food purchased locally
Medical Facilities	Onsite first aid room to address non-emergency response to comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project	Onsite first aid supplies to address non-emergency response to comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project
Security	Unarmed security to comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project Perimeter fencing installed	Unarmed security to comply with Workers' accommodation: processes and standards (IFC 2009) and measures outlined in the D&B Contractor's ESHSMP for the Project Perimeter fencing typically installed
Access	Direct access to public road	Direct access to public road
Helipad	Yes, if needed, approximately 20 m x 20 m area	Yes, if needed, approximately 20 m x 20 m area
Parking	Onsite parking for approximately 25 vehicles	Onsite parking for approximately 10 vehicles
Power	Connection to local existing electrical distribution lines One backup 10 kW diesel generator	One 10 kW diesel generator
Fuel Storage	One 3,000-liter diesel storage tank for vehicle refueling	One 3,000-liter diesel storage tank for vehicle refueling

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Infrastructure Requirements	Substation Workers' Camp	Tower Laydown Areas
	One 1,000-liter diesel storage tank for onsite diesel generator One 3,000-liter jet fuel or diesel storage tank for helicopter refueling	One 1.000-liter diesel storage tank for onsite diesel generator One 3,000-liter jet fuel or diesel storage tank for helicopter refueling
Water	Source–onsite well Treatment - water treatment system Potable Water - 25 liters/person/day Other Water – 75 liters/person/day	Source–onsite well Treatment - water treatment system Potable Water - 25 liters/person/day Other Water – 75 liters/person/day
Wastewater	Package wastewater treatment or large septic system sized to accommodate 5,000 liters/day (100 liters/worker/day)	Septic system sized to accommodate 1,000 liters/day (100 liters/worker/day)
Stormwater	Provision shall be made at the sites for surface water drainage systems, sumps to collect sediment and safe discharge points into the environment	Provision shall be made at the sites for surface water drainage systems, sumps to collect sediment and safe discharge points into the environment
Office	Mobile offices (e.g., trailer) approximately 500 m^2	Mobile office (e.g., trailer) approximately 200 m^2
Laydown Area	Approximately 0.5 ha for construction equipment and material storage, including shelter for cement	Approximately 0.5 ha or larger for construction equipment, material storage, and partial tower assembly, including shelter for cement
Batch Plant	Possibly, will be determined by D&B Contractor	No

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Table 2.6-12: Tower Laydown Proposed Locations and Areas

Tower Laydown Areas	Municipality	Coverage	# Towers Supporting	Area
Laydown Area #1	Sunwal	India Border to New Butwal Towers 1–51 New Butwal to New Damauli Towers 1–44	100	0.5 ha
Laydown Area #2 (helipad)	Binayee	New Butwal to New Damauli Towers 45–47	3	0.0 ha (helicopter)
Laydown Area #3	Rampur	New Butwal to New Damauli Towers 48–233	186	1.9 ha
Laydown Area #4	Vyas	New Butwal to New Damauli Towers 234–246 New Damauli to Ratmate Towers 1–59 New Damauli to Ratmate Towers 69–104	108	2.0 ha
Laydown Area #5 (helipad)	Anbukhaireni	New Damauli to Ratmate Towers 60–68	9	0.2 ha
Laydown Area #6	Siddhalek	New Damauli to Ratmate Towers 105–238	134	1.1 ha
Laydown Area #7	Belkotgadhi (Ratmate SS)	New Damauli to Ratmate | Towers 239-247/1 Ratmate to New Hetauda Towers 247/1–45 Ratmate to Lapsiphedi Towers 1–39	97	2.1 ha
Laydown Area #8	Kailash	Ratmate to New Hetauda Towers 46–99	50	2.0 ha
Laydown Area #9	Hetauda	Ratmate to New Hetauda Towers 100–BM1	45	2.1 ha
Laydown Area #10	Likhu	Ratmate to Lapsiphedi Towers 40–127	88	2.4 ha
Laydown Area #11	Melamchi	Ratmate to Lapsiphedi Towers 128–163	36	1.0 ha
Total			856	15.3 ha

Source: Consultant Team 2020

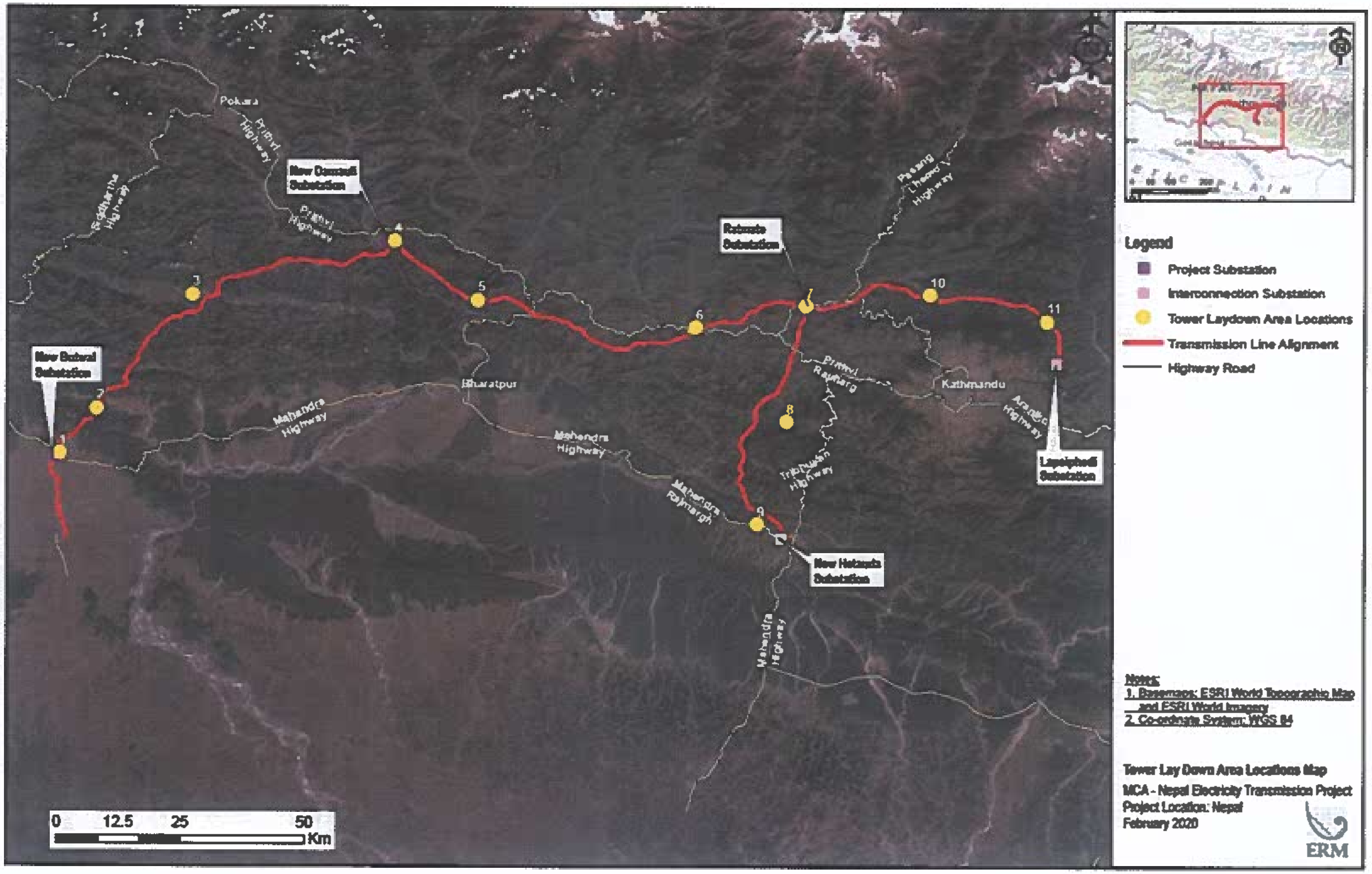

Figure 2.6-4: Tower Lay down Area Proposed Locations

2.6.4.1.3 Tower Workers Camps and Storage Areas

Tower work camps and storage areas will be established at each of the 847 tower site (excluding the 9 gantry towers that are located within the substation sites) and will be used intermittently for the duration of tower construction. Given the remote location and difficult access of many of the ETP tower sites, and the nature of transmission line construction, with separate crews working in "waves" for short periods (e.g., weeks) at each tower site and then moving on to the next tower (see Section 2.7.1 below for more details), it would be time consuming and expensive for construction crew to return to a centralized worker camp each evening. Rather, the common practice in Nepal is for most of the tower crews to camp at the tower sites.

For purposes of ETP tower construction, a small (approximately 2,000 m^2) work camp and storage area will be established near each tower site at the beginning of construction. These Tower Work Camps will be used multiple times on a short-term basis (i.e., up to one month) as each of the various waves of construction crews pass through the tower site (e.g., geotechnical site investigation, clearing/excavation, foundation installation, tower erection, insulator assembly, and stringing). The Tower Work Camps will be supplied from the Tower Laydown Areas described above with construction equipment and materials appropriate for the next stage of tower construction (e.g., rebar, fine and coarse aggregate, and cement for foundation installation). These equipment and supplies will be transported from the Laydown Areas to as close to the tower site as possible using existing roads without clearing any additional forest. From this point, porters, pack animals, and possibly small motorized vehicles (e.g., ATVs) will transport the equipment and materials to the tower site, where they will be temporarily stored.

The Tower Work Camps, including the storage areas, will be located within the transmission line RoW, and will meet the following tower work camp siting criteria:

- Not require the clearing of any forest;
- Not require any physical displacement;
- Maintain at least a 100 m buffer to any cultural heritage sites;
- Maintain at least a 100 m buffer to floodplains, streams, and springs; and
- Maintain at least a 100 m buffer to the nearest residence.

MCA-Nepal will not allow workers to do homestays because of the risk of social conflicts, communicable disease, and trafficking in persons (TIP).

The Tower Workers Camps will be cleaned up, but not removed, after each wave of construction crews. After completion of tower construction, these Tower Workers Camps will be dismantled and removed, and the site restored to its pre-construction condition before MCA-Nepal releases the final payment to the D&B Contractor.

Table 2.6-13 describes the facilities that will be provided at each Tower Work Camp.

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Table 2.6-13: Tower Workers Camp Infrastructure

Infrastructure Requirements	Tower Workers Camp Facilities
Total area	Up to approximately 2,000 m^2
Accommodations	Tents for up to 20 workers.
Sanitation Facilities	Pit toilets with separate latrines for men and women
Canteen/Cooking Facilities	Cooking tent
Medical Facilities	Each work crew will have a first aid kit to address non-emergency situations (to include a snake bite kit)
Security	No security personnel or fencing
Access	Access via roads or variable length trail from closest road (see Annex E) For trail access, construction equipment/materials transported by porters/pack animals/ATVs or helicopters
Parking	No parking
Power	One portable 10 kW diesel generator
Fuel Storage	Diesel for refueling generators stored in portable containers
Water	Sourced locally and carried to site Potable Water - 10 liters/person/day Other Water – see Table 2.8-6
Wastewater	Pit toilets
Stormwater	Provision shall be made at the sites for surface water drainage systems, sumps to collect sediment, and safe discharge points into the environment
Office	No office
Storage Area	Approximately 1,000 m^2 designated area (roughly 20 m x 50 m) to store construction materials (e.g., aggregate, rebar, cement, steel)

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2.6.4.2 Other Ancillary Facilities

The Project will not require a dedicated quarry or crusher plant as the Project's aggregate requirements for concrete are too dispersed along the 313.9 kilometers route to make a dedicated quarry/crusher economical. Section 2.8.3 (Construction Materials and Equipment) discusses the planned sourcing of aggregates. In terms of crushers, the Project will only use crushers approved by the Department of Industry as recommended by the respective District Coordination Committee, with the consent of the Government of Nepal's Department of Mines and Geology, and with appropriate Initial Environmental Examination (IEE) approval.

The D&B Contractor may decide to have a concrete batching plant at the new substation sites (i.e., New Butwal, New Damauli, and Ratmate). Batch plants will not be required at the Tower Laydown Areas or the Tower Work Camps as concrete will be mixed at a small scale at each tower site. Depending on the tower type, the amount of concrete required for tower foundations will average approximately 125 m^3 (range of 100–150 m^3), which is within the capacity of a portable concrete mixer that can produce about 4 m^3/hour of concrete.

Tower foundation excavation will not generate a large amount of excavated materials, as most excavated material will be used to backfill the tower foundation or spread onsite, so dedicated spoil disposal sites are not required. An estimated amount of excavated material from a tower foundation is approximately 25 m^3. Approximately half will be used for backfilling. The remaining half will be spread at the site and stabilized using native plants or on agricultural land in consultation with the property owner.

2.6.4.3 Associated Project Facilities

MCA-Nepal is committed to meeting the requirements of the International Finance Corporation (IFC), part of the World Bank, Performance Standards (IFC 2012). The Performance Standards require that any Associated Project Facilities (APF) also be considered in an EIA. APFs include other facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist, and without which the project would not be viable (IFC 2012).

For the ETP, there are no APFs. The only facilities involved with this Project that are not included in this EIA are the New Hetauda and Lapsiphedi substations. Both of these substations are currently under construction by NEA and would be needed even without the ETP as they will serve other transmission lines, so are not considered APFs.

2.7 PROJECT ACTIVITIES

2.7.1 Pre-Construction and Construction Stages

MCA-Nepal intends to bid construction in two packages - a substation package and a transmission line package.

The Substation Package will comprise three lots:

- Lot 1: Ratmate Substation + Lapsiphedi Substation bay extension;
- Lot 2: New Damauli Substation; and
- Lot 3: New Butwal Substation + New Hetauda Substation bay extension.

The Transmission Line Package will comprise three lots:

- Lot 1: Ratmate Substation to New Hetauda Substation to Lapsiphedi Substation;
- Lot 2: New Damauli Substation to Ratmate Substation; and
- Lot3: India Border to New Butwal Substation to New Damauli Substation.

Therefore, several separate contractors and construction crews will be working simultaneously to complete construction of the ETP within the 3.5-year construction period (see Section 2.9). The construction procedures described below will be ongoing concurrently at several locations along the route.

2.7.1.1 Transmission Towers and Conductors Construction Activities

Transmission line construction requires specialized skills and cannot be completed by a single work crew. Typically, construction occurs in multiple mobilizations. Specialized work crews complete certain construction activities at one tower site, and then move on to the next tower site, and are then replaced at the tower by the next specialized work crew. After completion of pre-construction activities, individual transmission tower and associated line construction typically occurs in four mobilizations, as follows:

- Initial Site Preparation—typically requires about 3 weeks;
- Tower Foundation Excavation and Installation—typically requires about two months;
- Tower Erection—typically requires about one month; and
- Conductor Stringing– with the predominant structures being tension type structures, it is estimated that manual methods will progress at 10 kilometers per month per crew. For manual stringing methods, sections of cable will likely be 2 kilometers or less per month per crew.

After completion of each phase of tower construction, the tower work crew will remove all solid waste and any hazardous materials, fill the pit latrines, and ensure bare ground is stabilized. Each of these activities is described below for a single tower, although this process would be repeated for all towers. The D&B Contractor will be required to comply with these general principles, unless they obtain specific authorization from MCA-Nepal:

- Avoid noise generating activities during the night (i.e., between 10 p.m.–6 a.m.)
- Avoid ground-disturbing activities during the active monsoon season (15 June to 15 September) unless specifically authorized by MCA-Nepal for both environmental and safety reasons.

2.7.1.1.1 Pre-Construction Activities

Prior to any construction, MCA-Nepal will obtain MoFE EIA approval, Department of Forests and Soil Conservation's Forest Clearance Permit approval, and acquire land and enter into temporary use agreements with affected property owners.

Prior to mobilizing construction crews in the field, MCA-Nepal will require the D&B Contractor to conduct induction training for all field crews and new hires. This induction training will include:

- Appropriate health and safety (H&S) training to all field crews and new hires;
- Provision of appropriate personal protective equipment (PPE) to all personnel;
- Introduction to the Worker Grievance Redress Mechanism and procedures;
- Environmental and cultural sensitivity training for all field personnel; and
- Project's Worker Code of Conduct training and a requirement that all personnel sign the code and the D&B Contractor is required to retain copies of the signed Codes.

The D&B Contractor will develop the Worker Code of Conduct, for review and approval by MCA-Nepal, prior to the initiation of construction. The Code of Conduct will also be made available to local communities at the MCA-Nepal ESP Community Assistant Offices. The Worker Code of Conduct will emphasize the importance of appropriate behavior with local residents, respect for local communities and their customs, protection of the environment, and compliance with all Nepalese laws and regulations. The Code of Conduct will also include disciplinary sanctions (e.g., penalties up to dismissal) for workers violating this Code of Conduct. Chapter 9 on Environmental, Social, Health, and Safety Management Plan (ESHSMP) includes minimum requirements for the Worker Induction Training and Code of Conduct Management Plan.

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The D&B Contractor will also conduct the following pre-construction work activities:

- Confirm access to each tower site and execute temporary access agreements with each private property owner across whose property trail or other access may be required;
- Conduct a check survey of all tower sites to confirm their constructability;
- Conduct geotechnical investigations and tower footing resistance measurement (for all tower footings) at selected tower locations to confirm the suitability of soil and underlying geology conditions;

2.7.1.1.2 Initial Site Preparation

Construction crews will do a check survey and stake the tower corners based on the tower type and clear the vegetation from a limited area, which will be approximately 1,280 m^2 (40 meters by 32 meters) for all except the approximately 30 largest towers. These largest towers will require variable clearing up to a maximum of 40 meters by 50 meters (2,000 m^2). The Tower Work Camps and storage areas will be identified and underbrush removed, but no clearing of trees will be allowed.

The D&B Contractor must provide safe access to the work sites for its construction crews and their equipment. As indicated above, no new access roads will be constructed. If vehicular access is not available to the tower site, then existing or new trails will be used/established to allow construction equipment and materials to be transported to the tower site via porters, pack animals, ATVs, or, in some cases, helicopters. Access may require limited clearing of underbrush for construction of trails, but no trees will be cleared. The D&B Contractor will execute Temporary Access Agreements with any affected private property owners.

There are approximately 204 structures (approximately 150 houses, with the remainder being sheds, latrines, water tanks, and similar ancillary facilities) within the Project RoW (excluding the substations). The property owners will be compensated for these structures and then these structures will be demolished for safety reasons.

2.7.1.1.3 Tower Foundation Excavation and Installation

Once the tower sites are surveyed and vegetation cleared, the tower foundation will be excavated. The D&B Contractor will be required to avoid or minimize tower foundation excavation during the monsoon season for environmental and health & safety reasons.

The size of the excavated area depends on the type of soil, presence of bedrock, and the type of tower. Tower sites with extremely steep slopes may require "benching' (significant excavation to level the pad site). The tower design allows for leg extensions between 1.5 to 12 meters in order to account for sloped terrain and to minimize benching. Topsoil will be salvaged and set aside for re-use in restoration. In most cases, including all towers without vehicular access, the foundations will be excavated by hand. In areas with vehicular access, backhoes may be used. The excavated material will be stockpiled adjacent to the foundation area.

In areas with shallow bedrock or large boulders, and especially where benching may be required, the D&B Contractor may create small holes in the rock by drilling or jack hammering methods or by installing special rock anchor or micro-pile type foundations. Controlled blasting with the use of explosives may be required in some cases, however, this activity, if needed, will be carried out as per Explosive Act 2018 B.S. in coordination with the Nepal Army (see also the blasting management provisions in Chapter 9 - ESHSMP). The project will coordinate with Nepal Army for making proper arrangement of procurement, transport, storage, and security of any explosives. Table 2.7-1 identifies the number of towers requiring use of explosives and the amount of explosives to be used.

Table 2.7-1: Tower Requiring Use of Explosives

Segment of TL	No of Towers	Rock to be Blasted (m^3)	Explosive Amount
Indian Border - NB	0	0.0	0.0
NB - ND	6	2.0	4.0 kg
ND - RT	8	4.5	9.0 kg
RT - LAP	5	3.0	6.0 kg
RT - NH	5	1.8	3.6 kg
Total	24	11.3 cum	22.6 kg

Source: Power Engineers, Inc. ETP Project Design Report August

Concurrently with foundation excavation, trucks will transport tower construction materials (i.e., aggregate, cement, rebar, and in some cases water) and equipment (e.g., portable generator, cement mixer) from Tower Laydown Areas via existing roads to as near the tower site as possible. For sites without vehicular access, the construction materials and equipment will be transported to the tower site by porters, pack animals, ATVs, and in a few cases helicopters.

The construction crew will use pumps, if necessary, to remove groundwater and dry the site. Once the foundation area is excavated and dry, reinforced-steel anchor rebar cages will be installed. These cages are designed to increase the structural integrity of the foundations. They can be assembled at site location. These cages will be inserted in excavated holes and assembled in the holes prior to pouring concrete. For micro-pile foundations, multiple small diameters holes (25 to 30 cm in diameter) will be drilled, a reinforcing shaft will be inserted into the holes, and bonded to the rock using cementitious materials. The cement, aggregates, and water will be mixed on site to produce concrete, typically using a small portable concrete mixer unless vehicular access is available and then larger cement mixer can be used. The concrete will be used to create the foundation over the rebar cage.

Self-supporting lattice tower foundations typically produce about 25 m^3 of spoils per tower. About half of this material can be used to backfill around the tower foundation. The remaining spoils material will be spread, in consultation with the affected or adjoining property owners, in the general disturbance area to maintain grades and runoff and to facilitate restoration. No transport or disposal of spoil is planned beyond adjoining property owners.

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2.7.1.1.4 Tower Assembly and Erection

Generally, the D&B Contractor will assemble the towers on site and construct them from the ground up. The selected towers use pre-fabricated sections, which allow for simple transport and construction in remote locations. In some cases, semi-assembled tower structures may be fabricated at the Tower Laydown Areas and transported to, and positioned on, the tower pad by helicopter.

Once the foundation is cured in about two to four weeks, the construction materials required for the tower will be brought to the tower site. In areas accessible by vehicles, bundles of steel members (all types of lattice structures) and associated hardware (insulators, hardware, and stringing sheaves) will be transported to each structure site. In areas requiring trail access, the construction materials and equipment will be transported to each structure site by porters, pack animals, ATVs, or in some cases helicopters.

The wood blocking, which is typically scrap wood, is needed to prevent the steel from directly laying on the ground, which can result in corrosion of the steel. The wood blocking will be laid out at each tower site. The tower steel bundles will be opened and laid out for assembly by sections and assembled into subsections of convenient size and weight. The assembled subsections will then be hoisted into place using a gin and fastened together to form a complete tower. The crew will shall then tighten all the bolts in the required joints.

Prior to electrification, for safety purposes, the tower structures will be earthed. Depending on the soil resistance properties at the tower site, the tower will be earthed via a ground rod and/or counterpoise techniques.

2.7.1.1.5 Stringing of Conductors, Shield Wires, and Fiber Optic Ground Wire

Once the transmission towers are in place, construction crews will clear or trim vegetation as previously marked by the Divisional Forest Offices to meet regulatory clearance requirements to ensure the reliable operation of the line. The type of clearing depends on the height of the trees, type of vegetation growing on the site, and presence of sensitive areas. Trees that could become tall enough to grow or fall into the transmission line must be removed or topped.

With the towers in place and the necessary RoW clearing completed, the next step is to string the transmission line wire ("conductor"), shield wires, and fiber optic ground wire. As with the foundation and tower construction equipment and materials, the conductors, insulators, hardware, and stringing sheaves needed for stringing will be delivered as close to each tower site as possible by vehicle and then transported by porters, pack animals, ATVs or helicopters to the tower site. Where necessary, the conductors will be re-packaged in smaller reels. The towers will be rigged with insulator strings and stringing sheaves at each shield (ground) wire and conductor position. The wires are unreeled and strung section by section from tower to tower. There is a cable drum with a reel and tensioner at one end, and a puller and take-up reel at the other. In this step, workers make sure that the tension levels in the wires are within acceptable limits and that there is adequate clearance between the ground and the cables. Practices are adapted to account for sensitive and special environments.

Interruption of road traffic where the transmission line crosses roads is not anticipated during conductor stringing and tensioning activities unless required under the terms and conditions of a specific road or highway crossing permit. As described below, pilot lines will be pulled from tower to tower. For protection of the public during stringing activities, temporary guard structures will be required at road crossing locations. Guard structures will typically consist of H-frame wood or steel poles placed on either side of the road to prevent ground wires, conductors, or equipment from falling on underlying facilities and disrupting road traffic. Although the preference is for access to each of these guard structures to be located outside the road RoW, it may be necessary for access to be in the road RoW depending on topography and access restrictions imposed by the regulatory agency. Access use in the road RoW will be performed in compliance with the stipulations of the crossing permit and regulatory agency requirements. Alternatively, a pulling rope system can be used in areas where traffic congestion and other constraints might make it difficult, if not impossible, to install temporary guard structures.

Typical equipment for erecting guard structures typically includes trucks, backhoes, and pole trailers depending on the width of the road and the volume of traffic. Guard structures may not be required for small roads. In such cases, other safety measures such as barriers, flagmen, or other traffic controls will be used. Following stringing and tensioning of all ground wires and conductors, the guard structures will be removed, and the area restored.

Pilot lines can be pulled (strung) from tower to tower manually, by land-operated equipment (e.g., winch machines, tensioner and puller machine), drones, or by helicopter, and then threaded through the stringing sheaves at each tower. Following pilot lines, a stronger, larger-diameter line will be attached to conductors to pull them onto towers. This process will be repeated until the shield wire, optical ground wire, and conductor is pulled through all sheaves. Once each type of wire has been pulled in, the tension and sag will be adjusted, stringing sheaves will be removed, and the conductors will be permanently attached to the insulators.

At tangents, the conductors will be attached to the insulators using clamps while at the small and larger angle dead-end structures, the conductors are cut and attached to the insulator assemblies by "dead-ending" the conductors.

The conductors need to be attached to the insulators, which will be required on all angle/tension and dead end tower types (i.e., DB, DC, DD, DE, and DF tower types) and separate reels of conductors will need to be spliced together along the length of a span. The total number of "dead-end' compression connections for the Project is estimated to be approximately 69,216 (a total number of 721 (dead-end) tension towers with 48 conductor connections (6x4 on each side) required for each tower, plus exactly same number for all the jumpers needed). Each of these connections will be done in one of following two ways to dead-end, splice, and terminate conductors:

- Hydraulic type compressive connectors—uses a motor-driven hydraulic press to splice the conductors together. This is the traditional method used for connecting conductors, but requires relatively heavy equipment, a source of power, and can be cumbersome and time consuming, which may limit its use at some of the more remote and difficult to access tower sites.

- Implosive type compressive connectors—is a newer technology that involves wrapping a metallic sleeve with a special explosive charge. When that charge is detonated, which sounds like a large firecracker, the energy of the explosion compresses the metallic sleeve around the conductor and forms a solid connection between two ends of conductor (in the case of a splice) or between the conductor and dead-end hardware. Implosive connectors do not require large equipment to install. Individual explosive wraps can be handled by one person and other components such as detonators are also portable. The set-up and execution of the connection can be done quickly by an experienced crew and multiple connections can be made on the same structure at the same time.

After the conductor is placed, the sagging operations are completed using the transit method. This method is usually the most desirable method of checking sag because it can provide the most accurate control of conductor sag. There are three types of transit sagging methods used—calculated angle of sight method, calculated target method, and horizontal line of sight. On flat terrain, the target or line of sight methods would provide the best results. In steep slopes with long spans, and large conductor sag the angle of sight method is preferred.

Due to the terrain, a large number of towers are of a tension type. For these towers, pilot lines can be pulled (strung) from tower to tower manually, by land-operated equipment (e.g., winch machines, tensioner and puller machine), drones, or by helicopter. Following pilot lines, a stronger, larger-diameter line will be attached to conductors to pull them onto the tension towers. The conductors will be cut and attached to the insulator assemblies by "dead-ending" the conductors. If tensioning and pulling equipment are required, an area of approximately 30 meters by 10 meters in line with each circuit must be available, otherwise a transit sagging method should be implemented.

Ground rods and counterpoise wires are installed to ground each tower and protect the line from lightning. A counterpoise wire is a special conductor that ensures the electrical connection between some or all of the line's towers and the ground.

2.7.1.1.6 Post-Construction Cleanup and Restoration

Once the tower is erected and the wire is strung, and depending on the site conditions, the D&B Contractor will restore the site as follows:

- Remove all the debris and waste (e.g., packing crate reels, shipping materials);
- Backfill holes and ruts in any access trails and completing final grading;
- Dismantle the temporary infrastructure (worker camp, sanitation facilities);
- Repair any infrastructure damaged during the work (e.g., roads, fences.);
- Dress work sites and structure sites to remove ruts;

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- Mitigate soil compaction and leveling, disking, replacing subsoil and topsoil, and preparing all bare surfaces for replanting;
- Restore all disturbed areas to their previous condition either for agricultural use or replanting forest using native shrubs, groundcover, and herbs;
- Contact property owners and process address any claims for settlement; and
- Contact the MCA-Nepal Community Liaison staff to assist with the formal return of the land to its owner.

This general approach would be adopted for both private and non-private land. The D&B Contractor will meet with the respective landowners to ensure they are satisfied with the restoration. The D&B Contractor also takes responsibility for any damage that may have occurred as part of the work and compensates the landowners according to Project regulations. The specifics of the restoration works and any compensation arrangements will be undertaken in accordance with the Project Environmental, Social, Health, and Safety Management Plan (ESHSMP), and will be monitored and audited so as to confirm compliance with the ESHSMP.

2.7.1.1.7 Use of Helicopters

As determined by the D&B Contractor, helicopter construction techniques may be used to transport partially assembled towers, to assist with the erection of structures, to support stringing of conductors/shield wires, and other Project construction activities.

The D&B Contractor may decide to at least partially assemble some towers at the Tower Laydown Areas. In these cases, the tower or tower section will be attached by cables to the helicopter and airlifted to the tower site. Upon arrival at the tower site, the section will be placed directly onto the foundation or atop the previous tower section. Guide brackets attached on top of each section will assist in aligning the stacked sections. Once aligned correctly, line crews will climb the towers to bolt the sections together permanently.

The use of helicopters for structure erection facilitates access to structure locations, limits the impact on sensitive resources, reduces forest clearing requirements, expedites the construction schedule, and enables transportation of structural components. It is anticipated that helicopter erection may be used in areas with extremely difficult access, in areas with some form of access restriction, or in areas required by mitigation measures.

Other Project construction activities potentially facilitated by helicopters may include delivery of construction laborers, equipment including small excavators and steel reinforcement and concrete for foundations, and tower materials to structure sites.

2.7.1.2 Substation Construction Activities

Construction at the three new substations will generally follow the procedure below.

- Survey the land and mark the boundaries. Check to confirm there are no underground utilities or pipes in the area to be used.
- Install specified erosion and sediment control measures in accordance with the D&B Contractor's Erosion and Sediment Control Plan.
- Construct access road to substation and install security fencing as needed
- Clear structures and vegetation so that the entire land to be worked on is clear. There are approximately 104 structures at the Ramate substation site (34 houses with the remainder being sheds and various out-buildings). The D&B Contractor will need to demolish one major industrial structure at the Ramate substation site, a large brick kiln. This may require specialized equipment.
- Remove and stockpile topsoil, and grade the site. Preliminary design estimates the following earthwork quantities. The final design will attempt to balance earthwork at each substation (i.e., cut = fill) so that no earthwork needs to be hauled to or away from any of the substations:
  - New Butwal substation—5,540 m^3 of cut
  - New Damauli substation—1,470 m^3 of cut
  - Ratmate substation—8,760 m^3 of fill
  - New Hetauda and Lapsiphedi substations—no earthwork required
- Establish construction power and water sources.
- Install batching plant, if required.
- Dig and install foundations for required buildings and equipment.
- Install drainage and cable trench as required.
- Install grounding grid and required stingers to the foundation.
- Set up steel structures in the yard.
- Construct buildings, including associated water and wastewater infrastructure
- Install equipment inside and outside the buildings.
- Install cables, conductors, and tubes to connect all these equipment.
- Install necessary lightning mast for lightning protection.
- Connect transmission lines to the towers and bring the conductors down to connect to the equipment in the yard.

- Stabilize all remaining disturbed areas using the stockpiled topsoil and native seeds/plants.
- Test all equipment per their testing procedure and functionality.
- Test protection system for their functionality.
- Test all safety devices for their operation and functionality.
- Carry out pre-commissioning tests and implement relay settings.
- Commission the substation.
- Complete all the miscellaneous cleaning and provide finishing touches to the substation.

The D&B Contractor may decide to use helicopters to transport some equipment or materials to the three proposed new substation sites, and if so, will have a designated helicopter landing pad.

Project Operation and Maintenance Stage

The proper operation and maintenance (O&M) of transmission systems and substations is critical for keeping equipment in continuous service. The objectives of the O&M strategy are:

- Achieve system availability as specified by the regulator/system administrator at the most economic cost;
- Carry out periodic preventive maintenance so as to maximize the life of transmission lines; and
- Minimize the down time of the transmission lines due to maintenance requirements. The towers have been designed to allow for live line maintenance by trained personnel.

The Maintenance Engineering Strategy is a result of the engineering performed during the design process to define the maintenance requirements of the asset. These typically include the following:

- Inspection and test requirements;
- Maintenance tasks with activities;
- Inspection, test and maintenance triggers (frequency and condition);
- Maintenance spares requirements;
- Training requirements; and
- Facilities (such as workshops, simulators, tools, test equipment and safety requirements).

Failure Modes and Effects Analysis (FMEA) is performed to determine how maintenance triggers may be affected. Based on the specific ~~plant~~ functional location (the plant environment, usage and health) and an aging analysis, indicates intended design life, plant aging mechanisms, specific plant health indices and calculations to determine useful remnant life, which also serve as primary input to the technical and economic end-of-life assessments.

2.7.1.3 Project Operation and Maintenance Procedures

Once construction is completed, MCA-Nepal will turn the Project facilities over to the Project Operator (assumed to be NEA or another GoN entity) for O&M as part of the overall electric transmission system of Nepal. The Project Operator will operate the system in an efficient, coordinated, and economical manner, in compliance with the latest electricity rules, safety regulations, grid code, *Electricity Act*, Standards of Performance Regulation, and other applicable regulations and laws. The Project Operator will use experienced and trained staff to carry out preventive maintenance and condition monitoring of the transmission system. All necessary tools and equipment will be procured and kept in storage at various locations along the transmission system to reduce downtime.

Tower O&M procedures will include:

- Ground or aerial patrolling: Trim overgrown trees; monitor for any "new and recent" structure encroachment into the RoW; detect and replace displaced vibration dampers/spacers/and other components; conduct thermo-vision scanning; stabilize soil erosion; repair rusting tower members; replace stolen tower members and accessories, among other standard maintenance activities. Current RoW management practices in Nepal does not usually involve the use any herbicides to manage plant growth. O&M procedures shall also include monitoring for birds nesting in the towers, and typically their removal for safety reasons. The Project Operator will, as accurately as possible, keep a record on the number and cause of all Project-related avian mortality along the line route and especially near important bird flyways.
- Pre-monsoon patrolling: Inspect foundation and tower conditions at each of the tower locations that will be difficult to access during the monsoons or that are vulnerable to water logging, soil erosion, and flooding.
- Post-monsoon patrolling: Inspect each of the locations for any damage to/exposure of the foundations, missing tower parts, damaged revetments, and all others that are scheduled for regular ground patrolling.

2.7.1.4 Project Operating Life

The nominal operational period of the Project's infrastructure is approximately 50 years. However, although it is likely that towers, cables, and substation elements might need replacing, the facilities (substation and transmission line) should be able to be used indefinitely. Therefore, for the purposes of the EIA, the infrastructure should be considered permanent. Decommissioning will therefore not be considered.

2.8 CONSTRUCTION PLANNING

Construction planning includes land requirements, required human resources, required construction materials and equipment, and the Project implementation schedule.

2.8.1 Project Land Requirements

Tables 2.8.1 and 2.8.2 present estimated land requirements by land types. As table 2.8.1 shows, the Project will acquire 124 hectares of land for the Ratmate Substation, access roads to the Ratmate and New Damauli substations, and the transmission towers. This land acquisition will include 49.8 hectares of forest and 68.7 hectares of cultivated (agricultural) land, and 5.5 hectare of other (barren and built-up/residential) land cover categories.

The Project will also place permanent restrictions on future development of approximately 1,347.1 hectares of land within the RoW (i.e., prohibition on new residential dwellings and restrictions on the height of any structures) for safety reasons. These permanent land use restrictions include 727.7 hectares of forest, 542.7 hectares of cultivated (agricultural) land, and 76.7 hectares of other (river/flood plains, and built-up/residential) land cover categories. Of the 1,347.1 hectare land within the RoW, about 169.4 hectare will be used temporarily for workers camps/laydown areas during construction period (See Table 7.4-5).

In addition, as table 2.8.2 shows, the Project will require 13.2 hectares of land (outside of the transmission line RoW and substation) for temporary use including the land required for laydown areas and tower workers camps during construction phase.

Table 2.8-1: Land Requirements by Land Type by Project Component

Line Components	Particulars	Forest					Cultivated		Barren		River & Flood Plain	Built up/ Residential		Total area (In ha.)
		Govt.	CF	LHF	Rel.	Pvt.	Govt. ( )	Pvt.	Govt.	Pvt.		Public	Pvt.	
Under T/L Conductor (Permanent Land Use Restriction)	IB to NB (18.2 km)	8.7	1.1	0.0	0.0	0.0	0.0	61.9	0.0	0.0	2.4	0.0	3.9	78.0
	NB to ND (89.5 km)	130.7	86.4	2.2	0.0	0.0	0.0	139.5	0.0	0.0	8.6	0.0	15.4	382.8
	ND to RTE (89.7 km)	112.1	84.2	2.1	0.0	0.0	0.0	170.4	0.0	0.0	2.2	0.0	15.5	386.5
	RTE to NH (57.5 km)	104.4	67.2	0.0	0.0	0.0	0.0	60.8	0.0	0.0	2.7	0.0	12.1	247.24
	RTE to LAP (59.0 km)	59.1	69.5	0.0	0.0	0.0	0.0	110.0	0.0	0.0	1.6	0.0	12.3	252.52
	Sub-Total	*415.0*	*308.4*	*4.3*	*0.0*	*0.0*	*0.0*	*542.7*	*0.0*	*0.0*	*17.5*	*0.0*	*59.2*	*1347.10*
Tower Pads	IB to NB (55 Towers)	0.7	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	6.78
	NB to ND (248 Towers)	8.1	6.8	0.0	0.0	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	30.02
	ND to RTE (250 Towers)	8.0	6.7	0.1	0.0	0.0	0.0	15.6	0.0	0.0	0.0	0.0	0.0	30.36
	RTE to NH (140 Towers)	6.1	6.1	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	16.86
	RTE to LAP (163 Towers)	3.5	3.7	0.0	0.0	0.0	0.0	12.4	0.0	0.0	0.0	0.0	0.0	19.58
	Sub-Total	*26.4*	*23.3*	*0.1*	*0.0*	*0.0*	*0.0*	*53.8*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*103.60*
Substation	Ratmatae	0.0	0.0	0.0	0.0	0.0	0.0	14.3	3.2	0.0	0.0	0.0	2.0	19.50
	New Damauli	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
	New Butwal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
	Sub-Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*14.3*	*3.2*	*0.0*	*0.0*	*0.0*	*2.0*	*19.50*
Access	Ratmatae SS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.30
	New Damauli SS	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.60
	Sub-Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.6*	*0.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.90*
	Grand Total	441.4	331.7	4.4	0.0	0.0	0.0	611.4	3.5	0.0	17.5	0.0	61.2	1471.1

Govt.= Government managed forest; CF= Community forest; LHF= Leasehold forest; Rel.= Religious forest; Pvt.= Private

Table 2.8-2: Land Requirements by Land Type by Transmission Line Segment

Line Components	Particulars	Forest					Cultivated		Barren		River & Flood Plain	Built up/ Residential		Total area (ha.)
		Gvt.	CF	LHF	Rel.	Pvt.	Govt. ( )	Pvt.	Govt.	Pvt.		Public	Pvt.	
Temporary Land Required														
Laydown area 1	Sunwal	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.50
Laydown area 2	Binayee (Helicopter hover)	0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.00
Laydown area 3	Rampur	0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	1.90
Laydown area 4	Vyas	0	0.0	0.0	0.0	0.0	0.0	2	0.0	0.0	0.0	0.0	0.0	2.00
Laydown area 5	Abukhairani (Helipad)	0.2	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.20
Laydown area 6	Siddhalekh	0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.10
Laydown area 7	Ratmatae Substation	0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.00
Laydown area 8	Kailash	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	2.00
Laydown area 9	Hetuda	0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	2.10
Laydown area 10	Likhu	0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	2.40
Laydown area 11	Melamchi	0	0.0	0.0	0.0	0.0	0.0	1	0.0	0.0	0.0	0.0	0.0	1.00
Total		**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**12.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**13.2**

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2.8.2 Project Resource Requirements

2.8.2.1 Construction Contractor Workforce

The construction of the ETP will require approximately 7,364 full-time equivalent construction workers over the 3.5-year construction duration, not including MCA-Nepal staff.

Table 2.8-3 presents the estimated workforce per transmission tower, which totals approximately 29.4 person-years (10,721 person days). With 856 towers, this totals to 25,166 person-years, or about 7,190 full-time equivalent workers over the 3.5 year construction duration.

Table 2.8-4 presents the estimated construction workforce for each substation, which totals to approximately 610 person-years (222,600 person-days), or about 174 full-time equivalents over the 3.5 year overall Project construction period. These workforce estimates are very dependent on the construction methods used. The use of drones and helicopters, for example, will reduce the number of workers required.

2.8.2.1.1 Skilled vs Unskilled Labor

Based on the estimates above, about 14 percent of the labor hours would be for skilled workers, about 20 percent semi-skilled workers, and about 66 percent unskilled workers.

2.8.2.1.2 Foreign vs Local Labor

It is estimated that Nepali workers will fill about 80 percent of these construction jobs, with most of the unskilled positions likely filled by workers from the immediate Project area. As indicated above, the type of construction methods used will affect the number of workers required, and the use of equipment likes drones and helicopters will disproportionately affect the number of unskilled position required, most of which would be filled by Nepali workers.

2.8.2.1.3 Male vs Female Labor

The hiring of qualified female will be encouraged in the D&B Contract with a goal of female's representation of 33 percent of the workforce. The hiring of other individuals from marginalized and traditionally excluded groups will also be encouraged. Ways to increase this estimate will be explored with the D&B Contractors to further improve, and provide more opportunities for women and other marginalize/excluded groups to participate in the Project workforce.

Table 2.8-3: Estimated Transmission Tower Construction Workforce Requirements, for each Tower

Tower Construction Activity	Duration per tower (days)	# of workers				Person Days			
		Skilled Labor	Semi-skilled Labor	Unskilled Labor	Total	Skilled Labor	Semi-Skilled Labor	Unskilled Labor	Total
Initial Site Preparation									
Check Survey	10	4	4	4	12	40	40	40	120
Initial Site Preparation	14	2	2	12	16	28	28	168	224
Foundation Excavation and Installation									
Foundation Excavation	28	2	3	20	25	56	84	560	700
Tower Foundation Materials Transport	28	9	11	111	131	240	314	3,120	3,674
Tower Foundation	28	5	5	15	25	140	140	420	700
Coping	2	1	2	5	8	2	4	10	16
Backfilling	7	2	3	10	15	14	21	70	105
Retention Wall	28	7	10	10	27	196	280	280	756
Tower Assembly and Erection									
Tower Materials Transport	28	4	7	22	33	98	203	609	910
Tower Erection	28	10	20	20	50	280	560	560	1,400
Hardware Fittings	1	5	5	0	10	5	5	0	10
Conductor/Shield Wires/OHGW/OPGW Stringing									
Conductor/ OHGW/OPGW	28	5	5	30	40	140	140	840	1,120
Pilot Wire Stringing	1	3	4	3	10	3	4	3	10
Conductor Stringing (Rough Sag)	7	20	20	30	70	140	140	210	490
Conductor Stringing (Final Sag)	7	20	10	20	50	140	70	140	350

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Tower Construction Activity	Duration per tower (days)	# of workers				Person Days			
		Skilled Labor	Semi-skilled Labor	Unskilled Labor	Total	Skilled Labor	Semi-Skilled Labor	Unskilled Labor	Total
OHGW/OPGW Stringing	4	5	5	10	20	20	20	40	80
Earthing	7	2	2	4	8	14	14	28	56
Total		105	119	326	550	1,556	2,067	7,098	10,721

These workforce estimates assume use of porters/pack animals/ATV to access tower sites, and use of a stringing machine (no hand pulling).

Table 2.8-4: Estimated Substation Construction Workforce Requirements

Substation Construction Activity	Duration per Substation (days)	# of Workers				Person Days			
		Skilled Labor	Semi-Skilled Labor	Unskilled Labor	Total	Skilled Labor	Semi-Skilled Labor	Unskilled Labor	Total
New Butwal	910	10	20	50	80	9,100	18,200	45,500	72,800
New Damauli	910	10	20	50	80	9,100	18,200	45,500	72,800
Ratmate	910	10	20	50	80	9,100	18,200	45,500	72,800
New Hetauda	84	3	7	15	25	252	588	1,260	2,100
Lapsiphedi	84	3	7	15	25	252	588	1,260	2,100
Total	**NA**	**36**	**74**	**180**	**290**	**27,804**	**55,776**	**139,020**	**222,600**

2.8.2.2 Operation and Maintenance Workforce

Transmission line inspection and maintenance activities are expected to require about 50 personnel per line segment, or about 250 personnel total for the ETP, comprising about 5 percent skilled, 10 percent semi-skilled, and 85 percent unskilled workers.

The operations at each substation would involve approximately 50 personnel, including about 40 percent skilled and 60 percent semi-skilled. There would be a few additional support staff for general maintenance and cleaning.

All of the operation and maintenance workforce will be Nepali. Preference will be given to hiring people from project-affected areas. The hiring of qualified female will be encouraged with a goal of female representation of 33 percent of the workforce. The hiring of other individuals from marginalized and traditionally excluded groups will also be encouraged. Preference will be given in hiring workers from project affected areas, when available.

2.8.3 Construction Materials and Equipment

2.8.3.1 Construction Materials

The main construction materials for the Project will comprise galvanized steel for the transmission towers, steel reinforced aluminum wire for the conductors; and cement, aggregates, water, and rebar for the tower and substation foundations. Indicative amounts of the materials required for each tower are provided by tower type in Table 2.8-5 below.

Table 2.8-5: Construction Materials Required per Tower[1]

Tower Type	Concrete (m^3)	Rebar (Tones)	Cement (bags)	Course Aggregate (m^3)	Fine Aggregate (m^3)	Water (m^3)	Steel (kg)
DA	37	1	503	26	13	7	22370
DB	101	9	1372	72	36	19	35710
DC	151	9	2059	107	54	29	36890
DD	201	9	2745	143	72	38	42266
DE	224	10	3054	159	80	42	49610
DF	238	11	3243	169	85	45	56790
Gantry	76	7	1031	54	27	14	25800

Source: Consultation with MCA-Nepal Project team

[1] Data is based on normal loads

Tower Type: DA = Double Circuit A type 0-2 degrees; DB= Double Circuit B type 2-15 degrees; DC= Double Circuit C type 15-30 degrees; DD= Double Circuit D type 30-60 degrees

Indicative total amounts of materials required by each tower type, and the overall totals for all the towers required for the ETP are provided in Table 2.8-6 below.

Table 2.8-6: Total Construction Material Requirements for Tower Construction[1]

Tower Type	Number of Towers	Total Concrete (m^3)	Total Rebar (Tones)	Total Cement (bags)	Total Course Aggregate (m^3)	Total Fine Aggregate (m^3)	Water (m^3)	Tower Steel (kg)	Explosives (kg)
DA	126	4,662	126	63,378	3,276	1,638	882	2,818,620	22.6
DB	255	25,755	2,295	349,860	18,360	9,180	4845	9,106,050	
DC	164	24,764	1,476	337,676	17,548	8,856	4756	6,049,960	
DD	25	5,025	225	68,625	3,575	1,800	950	1,056,650	
DE	148	33,152	1,480	451,992	23,532	11,840	6,216	7,342,280	
DF	129	30,702	1,419	418,347	21,801	10,965	5,805	7,325,910	
Gantry	9	684	63	9,279	486	243	126	232,200	
Total All Towers	856	120,250	7,084	1,699,157	88,578	44,522	23,580	33,931,670	

Source: PEI, 2020

[1] Data is based on normal loads

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Table 2.8-7 provides estimates for the quantities of ETP transmission line components.

Table 2.8-7: Transmission Line Components

Transmission Line Component	Total Amount Required
Aluminum Conductor Steel Reinforced (ACSR) Conductor Wire	7,700 km
Optical Ground Wire (OPGW)	314 km
Overhead Ground Wire (OHGW)	314 km
Number of Insulator discs	750,000
Number of Suspension insulator assemblies	1,000
Number of Dead end/strain assemblies	11,000
Number of Jumper assemblies	1,300

Source: Power Engineers, Inc. ETP Project Design Report, August 2019

Table 2.8-8 provides an estimate for the materials required for the construction of the three new substations and upgrading the two existing substations to accept the ETP transmission lines.

Table 2.8-8: Substation Construction Materials

Substation	Concrete (m^3)	Rebar (Ton)	Cement (bags)	Coarse Aggregate (m^3)	Fine Aggregate (m^3)	Water (m^3)	Steel (Ton)
New Butwal	3175	226	43180	2223	1111	603	2389
New Damauli	5120	398	69632	3584	1792	973	3005
Ratmate	5567	446	75711	3897	1948	1058	2374
New Hetauda	210	10	2856	147	74	40	30
Lapsiphedi	300	14	4080	210	105	57	39
Total	14372	1094	195459	10060	5030	2731	7838

Source: Consultant Team 2020

2.8.3.1.1 Sources of Construction Materials

Table 2.8-9 identifies the sources of the construction materials needed for transmission line and substation construction. In some cases, water may be sourced from local rivers or streams on a "single tower basis," especially for towers located in remote areas in lieu of using porters and/or pack animals. Dispersed sourcing of water on a single tower basis is preferred over more concentrated sourcing from a single source. Section 8.2 describes the conditions for sourcing water from local rivers or streams. Given the small amount required, explosives will be procured from the Nepal Army.

Table 2.8-9: Sources of Construction Materials

Construction Materials	Sources
Fine and coarse aggregates	• Current District-approved aggregate suppliers (see Table 2.8-9) • Quarries with Department of Mines and Geology environmental authorization (e.g., approved IEE)
Cement	• Domestic purchase
Steel	• Import
Rebar	• Domestic purchase
Explosives	• Nepal Army
Water	• Locally sourced on a "single tower basis"

Table 2.8-10 presents the list of District-approved aggregate suppliers.

Table 2.8-10: District-Approved River Aggregate Suppliers

S. No.	District	Municipality	River Aggregate Suppliers	Authorized River Source
1.	Kathmandu	Shankarapur	Palchowk Infrastructure Crusher Udhyog	Melamchi
2.	Kathmandu	Shankarapur	Palchokimai Crusher Udhyog	Melamchi
3.	Kathmandu	Shankarapur	Pokhari khola baluwa prasodhan	Pokhari khola
4.	Nuwakot	Likhu	Suryamati Crusher Udhyog	Likhu
5.	Nuwakot	Panchakanya	Natyashori Crusher Udhyog	Likhu
6.	Nuwakot	Belkotgadhi,	Trishuli Aggregate	Trishuli
7.	Dhading	Benighatroarng	Makalu Nirman Samagri Pvt. Ltd.	Trishuli
8.	Dhading	Bairani	New B.K.S. Baluwa Prasodan Udhyog	Trishuli
9.	Dhading	Gajuri	Buddham Baluwa Prasodan Udhyog	Trishuli
10.	Dhading	Gajuri	Indrayani Aggregate Enterprises	Trishuli
11.	Makawanpur	Hetauda	Saibaba Crusher Udhyog	Rapti
12.	Makawanpur	Hetauda,	Sagarmatha Roda Crusher Udhyog	Rapti
13.	Makawanpur	Hetauda	Tamang Aggregate Crusher Udhyog	Rapti
14.	Makawanpur	Hetauda	Subha Crusher Udhyog	Rapti
15.	Makawanpur	Hetauda	OM Crusher Udhyog	Rapti
16.	Makawanpur	Hetauda	Sambhu Roda Crusher Udhyog	Rapti
17.	Makawanpur	Hetauda	Dipjoyoti Crusher Udhyog	Rapti
18.	Makawanpur	Hetauda	Jayalaxmi Crusher Udhyog	Rapti
19.	Makawanpur	Hetauda	Swastic Crusher Udhyog	Manahari
20.	Tanahu	Vyas	Tanahun Kalika Construction	Seti
21.	Tanahu	Vyas	Shiva Kalika Construction	Seti

S. No.	District	Municipality	River Aggregate Suppliers	Authorized River Source
22.	Tanahu	Abukhairani	Chhabdi Barahi Construction	Marshangdi
23.	Tanahu	Bhimad	Chhang Barahi Construction	Seti
24.	Palpa	Rampur	Pokharel Construction Pvt. Ltd.	Kaligandaki
25.	Palpa	Rampur	Yam Construction Pvt. Ltd.	Kaligandaki
26.	Palpa	Rampur	Mobile Nirman Construction Pvt. Ltd.	Kaligandaki
27.	Nawalparasi E	Binayee Tribeni	Mahavir Aggregate Industries Pvt. Ltd.	Dumkibas
28.	Nawalparasi E	Binayee Tribeni	Madhyabindu Crusher Udhyog	Dumkibas
29.	Nawalparasi W	Sunwal	Indrani Crusher Udhyog	Bhumai

Source: Consultant Team consultation with District Officials 2019

2.8.3.2 Construction Equipment

Tower construction will be completed primarily by hand, with little use of mechanized equipment other than portable cement mixers, winches, and standard hand and power tools. In a few readily accessible areas, backhoes, and cranes may be used. Trucks and light vehicles will be used to transport construction crew, and motorcycles, ATVs, and at a few sites helicopters will be used to deliver construction materials to the tower sites. Drones will also be used where appropriate, for example during conductor stringing.

Substation sites have better vehicular access than the tower sites and substation construction will use bulldozers, graders, front-end loaders, and cement mixers during site preparation, foundation laying, and building construction. Cranes and lifting equipment will be used during the substation construction phase. Trucks and light vehicles will be used to deliver construction materials to the substation sites and suitable vehicles will transport the construction crews.

Tower construction sites will obtain power from diesel generators, while the substation construction sites will connect to the local electrical distribution network with a backup diesel generator.

2.8.3.3 Construction Material and Equipment Sourcing

Table 2.8-11 describes the anticipated sourcing of the materials and equipment identified above for Project construction.

Table 2.8-11: Construction Material and Equipment Sourcing

Construction Material	Anticipated Sourcing
Coarse and Fine Aggregate	District approved river aggregate suppliers Quarries with GoN environmental authorizations
Cement	Domestic Purchase
Water	Local

Construction Material	Anticipated Sourcing
Rebar	Foreign Import
Fabricated Steel	Foreign Import
Transmission Line Components	Foreign Import
Substation Components	Foreign Import
Construction Equipment	Domestic Rental/Foreign Import
Vehicles and Helicopters	Domestic Rental/Purchase
Generators	Domestic Rental/Purchase
Fuel	Domestic Purchase

Source: Consultant Team 2020

MCA-Nepal will encourage the D&B Contractors to maximize domestic sourcing of construction materials and equipment to the extent possible. MCA-Nepal will also encourage the D&B Contractors to maximize opportunities for local businesses. This may include sourcing and delivering construction materials and equipment, as well as providing food, cooking, cleaning, vehicle rental, and similar support services.

2.8.3.4 Construction Power

As indicated in Tables 2.6-11 and 2.6-13, construction power will be provided as follows:

- Existing substations (i.e., New Hetauda, Lapsiphedi) – tap into existing electricity distribution lines at substations;
- New Substations (i.e., New Butwal, New Damauli, Ratmate) – extension of existing local electricity distribution lines, with one 10 kW backup generator at each substation;
- Laydown areas – one 10 kW generator for each laydown area (excluding the helipad only sites); and
- Tower work camps and storage areas – one 10 kW diesel generator per work camp.

2.9 PROJECT IMPLEMENTATION SCHEDULE

MCA-Nepal estimates that the overall ETP construction process will take no longer than 5 years, which is a requirement of the agreement between the MCC and the GoN, although this includes D&B Contractor procurement and final engineering design. Actual construction activities are estimated as follows:

- Transmission towers and line construction—3.5 years;
- New substation construction (New Butwal, New Damauli, Ratmate)—2.5 years; and
- Existing substation connections (New Hetauda and Lapsiphedi)—2.0 years.

The anticipated Project construction schedule is shown in Table 2.9-1.

Table 2.9-1: Project Implementation Schedule

Key Activity	Start (mm/yy)	Finish (mm/yy)
Permitting		
Conduct EIA Public Hearings	11/19	12/19
Submit EIA for DoED and MoFE review	03/20	03/21 (estimated)
Resettlement Action Plan (RAP)	09/19	06/22
RAP Implementation	10/20	10/23
Pre-Construction Phase		
Bidding Process	07/19	01/22
Bid Evaluation and Negotiations	12/21	07/22
Contract Awards	06/22	07/22
Contract Commencement—Transmission Lines	-	07/22
Contract Commencement – Substations		07/22
Construction—Transmission Lines		
Transmission Line India Border to New Damauli	07/22	12/25
Transmission Line New Damauli to Ratmate	07/22	12/25
Transmission line Lapsiphedi to Ratmate to New Hetauda	07/22	12/25
Transmission line Ratmate – Lapsiphedi	07/22	12/25
Construction – Substations		
Substation New Damauli GIS 400-220 kV	07/22	06/25
Substation Ratmate GIS 400-220 kV	07/22	06/25
Substation New Butwal GIS 400-220 kV	07/22	06/25
Substation New Hetauda GIS 400kV T/L feeders	07/22	06/25
Substation Lapsiphedi GIS 400kV T/L feeders	07/22	06/25
Project Commissioning		

Key Activity	Start (mm/yy)	Finish (mm/yy)
Commissioning Activities & Energizing	06/25	01/26
DLP, Final Payment and Contract Closed	01/26	03/27
End of Compact		03/27

Source: Consultant Team 2020

CHAPTER THREE
METHODS FOR PREPARING THE REPORT

This chapter provides a description of the methods used: (1) to describe and characterize the physical/chemical, biological, and socioeconomic and cultural environments potentially affected by the Project; and (2) to explain the approach used to analyze the expected Project-related impacts. The methodologies presented are consistent with the requirements of the approved Scoping Document (Stantec 2019a) and the Terms of Reference (ToR) for the EIA (Stantec 2019b), and include the following: impact area delineation, literature review, field studies, stakeholder consultation, and impact evaluation.

3.1 IMPACT AREA DELINEATION

The Project Impact Area (i.e., direct and indirect impact areas) was defined in the Scoping Document and ToR and is presented in Table 3.1-1. MCA-Nepal is also committed to meeting the International Finance Corporation's (IFC) Performance Standards (PS) requirements, which defines an Area of Influence that includes the direct and indirect impact areas, but also includes areas affected by Associated Facilities and Cumulative Impacts (IFC 2012). These areas have been added to the table below and are shown on Figure 3.1-1.

Table 3.1-1: Project Impact Areas

Project Impact Areas	Description	Type of Impact	Area
Direct Impact Area	RoW, towers, substations, and ancillary facilities (see Chapter 2, Project Introduction, for a detailed description)	Land acquired and/or disturbed	1,507.4 ha
Indirect Impact Area	Environmental Resources - land within 1 km of the edge of the transmission line RoW.	Potential nuisance impacts (e.g., noise, vibration, dust, traffic)	613 km^2
	Social Resources—boundaries of the affected sub-metropolis, municipalities, rural municipalities	Includes impacts that may be felt at the municipal level	4,396 km^2
Associated Facilities Impact Area	"Facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable" (IFC 2012)	Includes impacts from Associated Facilities	No associated facilities identified for the ETP
Cumulative Impact Area	Cumulative impacts on Valued Environmental and Social Components (see Section 3.5)	Includes area affected by potential cumulative impacts associated with the ETP	Varies by Valued Environmental and Social Component (see Section 3.5)

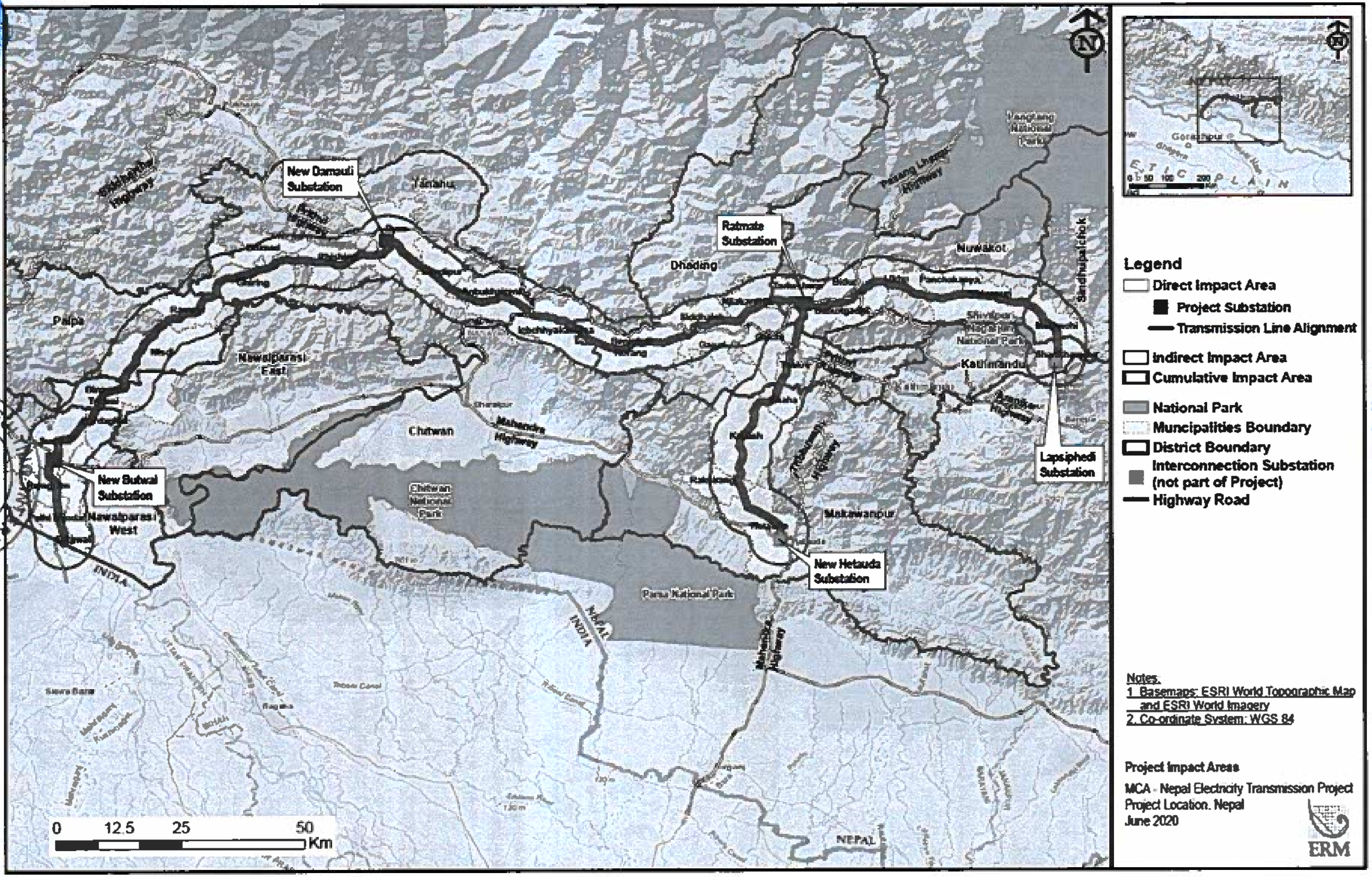

Figure 3.1-1: Project Impact Areas Map

3.2 LITERATURE REVIEW

This method involves collecting and reviewing secondary sources of information related to the Project and its direct and indirect impact areas. These secondary sources of information are referenced in Chapter 5 (Existing Environmental Condition) and Chapter 7 (Environmental Impacts) and listed in the References section, but in general include published and unpublished literature from the following sources:

- Government agencies, including Nepal Electricity Authority (NEA), Department of Electricity Development (DoED), Ministry of Forests and Environment (MoFE), Department of Archaeology; Department of National Parks and Wildlife Conservation, Department of Mines and Geology, the Topographic Survey Department, Central Bureau of Statistics (CBS), District Coordination Committees (DCO), Department of Hydrology and Meteorology, Department of Plant Resources, the Ministry of Energy, Water Resource and Irrigation (MoEWRI), and concerned Rural Municipality (Gaunpalika), Municipality (Nagarpalika), and Sub-Metropolis (Upamahanagarpalika);
- Educational and research organizations, including Tribhuvan University (e.g., Central Department of Botany and Central Department of Zoology, Natural History Museum); Centre for Nepal and Asia Studies (CNAS).
- Nepali Federations, including the Federation of Community Forestry Users Nepal (FECOFUN), Nepal Federation of Indigenous Nationalities (NEFIN), and National Foundation for the Development of Indigenous Nationalities (NFDIN);
- International organizations, including United Nations Educational, Scientific and Cultural Organization (UNESCO) Nepal, International Centre for Integrated Mountain Development (ICIMOD); and
- National and international conservation organizations, including the Bird Conservation Nepal (BCN), President Chure Terai Madesh Conservation Development Board (PCTMCDB), World Wildlife Fund (WWF), National Trust for Nature Conservation (NTNC), and International Union for Conservation of Nature (IUCN).

This literature review includes information on:

- Other projects – including feasibility studies, and IEE and EIA reports of other transmission line and hydropower projects within the Project Impact Area.
- Physical baseline conditions in the Project Impact Area:
  - Topographic maps from Department of Survey, Google, and aerial images,
  - Hydrology data from the Department of Hydrology and Meteorology,
  - Existing and proposed hydropower projects from the Department of Electricity Development,

- Roads data from the Department of Roads,
- Available air quality monitoring data from MoFE,

- Biological baseline conditions in the Project Impact Area
  - Peer reviewed scientific literature on biodiversity,
  - Online species distribution maps produced by the Integrated Biodiversity Assessment Tool (IUCN 2019),
  - IUCN Red List Version 2019-1,
  - Red List for Birds of Nepal (Inskipp et al. 2016),
  - Red List for Mammals of Nepal (Jnawali et al. 2012),
  - Bird Data Zone from Birdlife International,
  - Databases on Reptile base and Amphi base,
  - Government reports on wildlife management plans.
- Social/cultural baseline conditions in the Project Impact Area
  - National Population and Housing Census data (CBS 2011),
  - District/municipalities/rural municipalities profile,
  - Existing literature and studies on benefit sharing,
  - Annual Household Survey, Nepal Rastra Bank
  - Nepal Living Standards Survey, CBS
  - Cadastral maps for the affected districts and municipalities,
  - Municipalities/ Rural Municipalities plans and policies.

3.3 FIELD STUDIES

3.3.1 Physical and Chemical Environment

3.3.1.1 Topography, Geology, and Soils

The Consultant Team conducted helicopter flights over the transmission line alignment between December 2018 and January 2019 using the Light Detection and Ranging (LiDAR) remote sensing method to obtain highly accurate topography (minimum of 10 points per square meter and minimum accuracy of 15 centimeters in elevation [Z direction]) and high-resolution land cover data (Table 3.3-1). Prior to conducting LIDAR survey 24 number of ground control points were established using DGPS. The results of the LiDAR survey include a digital terrain model, a digital elevation model, a topographic base map, aerial photographs, and vector maps.

Table 3.3-1: Project-Specific LiDAR Parameters

Parameter	Description
Horizontal Datum	WGS 84
Vertical Datum	WGS 84
Projection	PPP Methodology
Units	SI Survey Meters
Required Corridor Width	400 Meters
Aerial Imagery Resolution	10 point per square meter

Source: Power Engineers 2018

The digital terrain model, digital elevation model, topographic base map, and aerial photographs developed from the LiDAR survey were reviewed to identify steep slopes, landslide -prone areas, and other topographic vulnerabilities. This analysis was used to support selection of the preferred alignment and final tower spotting, and geology and soils impact assessment.

The following activities were undertaken to further assess geology and soil conditions.

- – 6 borings along transmission line
- – 2 borings and resistivity tests at New Butwal substation

- New Butwal to New Damauli Substation Segment
  - – 15 borings along transmission line
- New Damauli to Ratmate Substation Segment
  - – 13 borings along transmission line
  - – 2 borings and resistivity tests at Ratmate substation
- Ratmate to New Hetauda Substation Segment
  - – 8 borings along transmission line
  - – 2 borings at New Hetauda Substation
- Ratmate to Lapsiphedi Substation Segment
  - – 8 borings along transmission line

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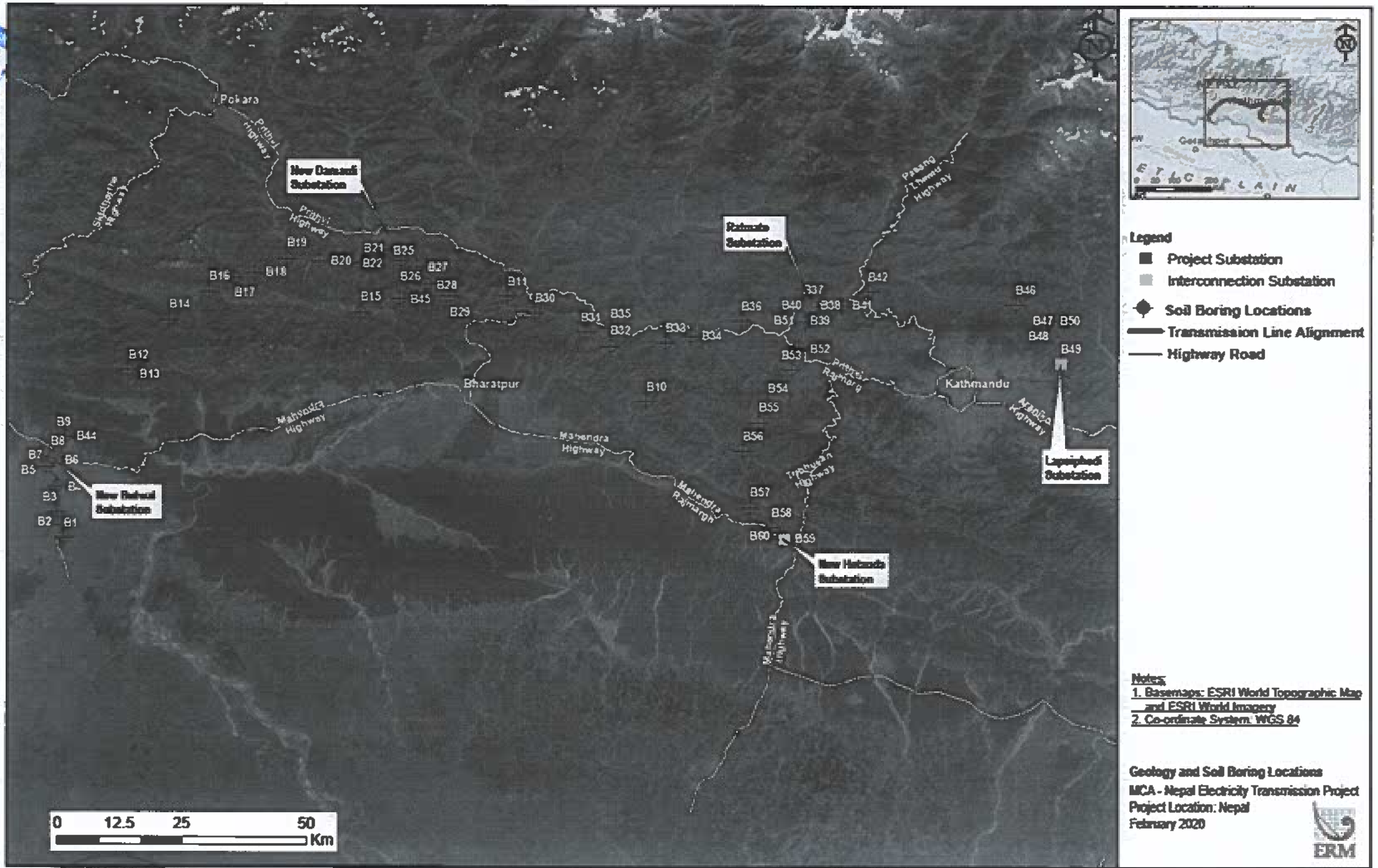
- 2 borings at Lapsiphedi Substation

Figure 3.3-1 presents the soil boring locations.



Source: ICGS Pvt. Ltd. 2019

Figure 3.3-1: Geology and Soil Boring Locations

वन तथा वातावरण मन्त्रालय
नेपाल सरकार
सिंहदरबार, काठमाडौं

STANTEC CONSULTING INTERNATIONAL LLC
2000

The soil borings were conducted as follows:

- Borings were drilled to a minimum depth of 7 meters (Stantec 2019c).
- Standard penetration tests were obtained at intervals to allow accurate logging of the soil nature, thickness, and characteristics, and to obtain material for geotechnical testing.
- When cohesive soils were encountered, at least one thin-walled tube sample was taken for each significant stratum of cohesive soil, or as required to adequately describe the design parameters.
- When rock was encountered before reaching the specified depth of the boring, rock coring was performed.
- The borings were logged on a continuous basis during drilling. Soil was visually classified in the field using the Unified Soil Classification System by ASTM International Standard D2487. A record of standard penetrometer blow counts was made. The following characteristics were noted in the sequence presented below for each soil type encountered:
  - Soil Type—Primary, Secondary (e.g., clay, sand)
  - Color—primary colors only
  - Consistency/Density—using blow count, pocket penetrometer
  - Plasticity—visual observation
  - Moisture—visual observation
  - Grain Size Distribution—note the presence of boulders
  - Any Other Features—such as mineralization, presence of organics, odor, lack of bedding, or structure.

Where fill was encountered, it was described in detail and included such information as approximate amount of organic material, topsoil, wood, or other decaying matter; loose or well compacted soil; amount of moisture; amount and type of debris; and whether the fill was compactable or would need to be removed.

For each boring, the location of the borehole, depths of investigation, and soil and rock types encountered were documented.

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Rock Coring

Where rock coring was required, continuous cores were obtained, labeled, and stored in appropriate core boxes. Core drilling was performed around every 18th tower structures as an indicative sample. Rock materials were described in the sequence described below and in accordance with standard geologic nomenclature, including:

- Rock Type
- Relative Hardness
- Density
- Texture
- Color
- Weathering
- Bedding
- Fractures, Joints, Bedding Planes, and Cavities (including any filling material and whether open or closed)
- Rock Quality Designation
- Other Descriptive Features (e.g., fossils, pits, crystals, etc.)

Soil Resistivity Tests

Soil samples for the purpose of laboratory soil box resistivity testing, were collected at 0.5 meter, 1.5 meter, 3.0 meter, 4.5 meter, and 6 meter depth intervals during the soil boring. These samples were laboratory-tested for resistivity based on ASTM G57-06 (Standard Test Method for Field Measurement of Soil Resistivity using the Wenner Four-Electrode Method). The soil samples were stored in airtight containers that were sealed to protect the sample and its natural water contents.

Soil resistivity tests were also conducted at the New Butwal, New Damauli, and Ratmate substation sites and at intervals along the transmission line RoW to determine the field conditions that affect resistivity. These tests documented ground resistance parameters representative of the soil type encountered. Recommendations and notes on potential corrosive environment and considerations along the alignment centerline were subsequently made. (Stantec 2019c).

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Geological Hazards

The geotechnical team also performed field-inspections to support alignment selection and tower spotting activities in areas that the LiDAR imagery or the digital terrain model indicated the potential for slope or landslide hazards, including estimates of ground motion values for the area and liquefaction potential.

Lab Testing and Analysis

All laboratory testing was performed in accordance with current applicable ASTM standards. The laboratory had the general capability for soil and rock testing as indicated in ASTM D3740, "Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction." The laboratory tests were done to provide data for the classification of the soil and rock encountered in the field and for the prediction of their engineering behavior when used as construction materials or for the support of the structures at specific locations. Laboratory tests included the following:

- Index Testing—Index testing including, but not limited to, dry density, moisture content, gradation, and Atterberg limits, was performed to adequately classify the soil in accordance with ASTM standards and evaluate subsurface conditions.
- Strength Testing—Strength testing was performed on undisturbed and/or relatively undisturbed soil samples to determine cohesion, angle of internal friction, shear strength and stress-strain modulus. Shear strength testing included, but was not limited to, Triaxial Compression Tests (Unconsolidated Undrained, Consolidated Drained, or Consolidated Undrained), direct shear, and/or consolidation testing. Uniaxial compression of rock specimens for determination of uniaxial strength and shear modulus was performed to support the engineering analysis and develop foundation design criteria.
- Design Parameters—The Consultant Team used established calculation procedures for external stability of chimney and pad foundations and bond capacity of rock/soil pre-tensioned anchors. The geotechnical subcontractor provided the soil design parameters required for these engineering procedures. The values were listed in a tabular fashion for each distinctive soil layer of each boring. All design parameters were specified as ultimate and not working values, because the Engineer designed the structure foundations using factored loads.
- Testing for Water-Soluble Sulfates—Testing for water-soluble sulfates was performed on a representative number of soil samples to evaluate the corrosive potential of the soil to buried concrete foundations. The geotechnical subcontractor measured the level of water-soluble sulfate (SO_4) in the soil and categorized it as "negligible" to "very severe" based on Table 4.3.1 of ACI 318 (ACI 2019).
- Testing for pH of the Soil—Testing for pH of the soil was performed on a representative number of soil samples to evaluate the corrosive potential of the soil to buried metal foundations and grounding systems. The geotechnical subcontractor measured the level of pH in the soil in accordance with ASTM G51. Where test borings encountered soil strata

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that were classified as peat or muck, the soil samples from these strata were tested for pH in accordance with ASTM D2976, Standard Test Method for pH of Peat Materials.

Ground Truthing

In April through June 2019, the Consultant Team ground-truthed the LiDAR data especially for areas that appeared to pose any significant topographic/slope/landslide risks.

3.3.1.2 **Land Use/Land Cover**

A fit-for-purpose 10 meter resolution, land cover classification was created for the RoW using March 2019 Sentinel 2 satellite imagery developed by the European Space Agency (refer to Annex G). The land-cover model incorporated both automated and semi-automated analyses to identify natural and manmade features within the terrestrial component of the RoW. The analysis was completed using a combination of supervised classification techniques (such as maximum likelihood classification) and manual identification primarily using geospatial analysis programs such as ESRI ArcPro to characterize all land into the following coverage following categories:

- Settlements
- Roads
- Railroads
- Low-density vegetation
- Medium-density vegetation
- High-density vegetation
- Riparian vegetation
- Wetlands
- Rivers
- Streambed
- Agriculture—non-irrigated
- Agriculture—irrigated
- Barren or non-vegetated land

This land cover analysis also included LiDAR-identified physical features in accordance with Table 3.3-2. As needed, land cover was confirmed in the field in specific areas (e.g., where potential buildings were obscured by forest cover or to confirm the building use).

Table 3.3-2: LiDAR-Identified Physical Features

Feature Code	Feature Code Name	Feature Code Description
1	Survey Monument/benchmark	Brass or metal disks in the ground
5	Right of Way (Edge)	Boundary of the RoW
103	Water, Surface	Surface elevation of bodies of water
104	Edge of Water	Water edge of large bodies of water
107	Centerline of Creek	Centerline of small creeks, less than 4 foot wide
108	Wetland Boundary	Edge of wetland area
109	Road, Overhead	Road surface on a bridge
110	Road, Edge	Edge of road, two lane; dirt, gravel or paved;
113	Highway, Edge	Edge of highway, two or four lanes, paved;
114	Trail, Edge	Edge of trail, single lane, generally dirt or gravel for vehicle travel
116	Drive, Edge	Edge of drive, access to house or business
120	Airstrip	Runway at an airport
121	Cemetery	Burial ground and headstones
126	Ditch, Bottom	Centerline of small ditches, less than 4'-0" wide
132	Treeline	Identifies the treeline
200	Mass Structure	Transmission and Distribution Structure Points
201	Existing Pole	Top of power pole, not on surveyed line
202	Distribution Pole	Pole of surveyed distribution line
203	Transmission Pole	Pole of surveyed transmission line
205	Transmission Tower	Tower of surveyed transmission line
210	Centerline Exist. Structure	Ground point at the midpoint of transmission structure
211	Substation Bus	An electrical conductor that makes a common connection between several circuits
212	Misc. Power Structure	Ground point at the base of misc. power structure, such as substation structures, electric pedestal, pad mount transformer, etc.
215	Conductor	Surveyed conductor
216	Shield Wire	Surveyed shield wire
220	Existing Anchor	Ground point where the guy-anchor enters the earth
221	Anchor Line	Guy wire between structure and anchors
238	Distribution Line Crossing	Distribution line span crossing the surveyed line - Voltage <46 kV
239	Transmission Line Crossing	Transmission line span crossing the surveyed line - Voltage >46 kV

Feature Code	Feature Code Name	Feature Code Description
242	Mass Conductor	Transmission and distribution wire points
301	Top and base of Building, Corner	Above ground and ground point on buildings, houses, sheds, etc.
307	Concrete Slab	Misc. concrete slab
321	Ground at Fence	Ground point at fence
331	Wall, Top and Base	Above ground and ground point on wall taller than 6'-0"
335	Bridge	Edge of bridge
336	Dam	Outline of dam
340	Tower, Base and Top	Ground point at the base and top of communication tower, water tower, look-out tower, etc.
360	Fuel Tank	Top of fuel tank
400	Pole, Streetlight	Top of streetlight
402	Pole, Telephone	Top of telephone pole
411	Underground Pipeline	Outline of below ground pipeline
412	Aboveground Pipeline	Outline of aboveground pipeline

Source: Consultant Team 2020

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3.3.1.3 Water Resources

Aerial imagery from LiDAR was used to determine the width of all river, stream, lake, and pond crossings by the transmission line. The floodplain boundary was assessed in the field by Project water resource engineers or geomorphologists based on physical morphological features indicative of floodplains, and by conversations with local residents regarding approximate height of historical flood events. Field investigations were conducted to identify any springs along the RoW, with tower locations adjusted to avoid them.

3.3.1.4 Air Quality

Ambient air quality sampling was conducted using air quality samplers (high volume/low volume samplers) at three proposed new substation sites in January 2020. The three substations sites included New Butwal, New Damauli and Ratmate Substations. Three parameters were measured in accordance with the National Ambient Air Quality Standards (NAAQS) of the Government of Nepal, including TSP, particulate matter less than 10 (PM10) and 2.5 (PM2.5) microns in diameter.

The only point source emission sources for the Project are diesel generators used during tower construction and backup diesel generators at the three new substation sites. The United States Environmental Protection Agency's (USEPA) conservative air dispersion model AERSCREEN was used to model air emissions from these sources.

AERSCREEN is a screening model used to predict the impact from a single source. The maximum 1-hour concentrations produced by AERSCREEN were converted to concentrations at different averaging periods, multiplying by factors as recommended by USEPA. Modeled pollutant concentrations in the ambient air are compared to the World Health Organization (WHO) guideline concentrations.

Table 3.3-3 presents the list of parameters used to generate the meteorological data using MAKEMET, a companion program to the AERSCREEN dispersion model (described further below). MAKEMET was used to generate worst-case meteorological conditions for a particular site. The temperature range was determined using the local temperature profile and the surface characteristics were determined by assuming the surrounding landscape is best characterized as deciduous forest.

Table 3.3-3: Parameters Used to Generate Meteorological Data

Min Temperature (K)	Max Temperature (K)	Anemometer Height (m)	Minimum Wind Speed (m/s)	Albedo	Bowen Ratio	Surface Roughness (m)
283.65	303.59	10	0.5	0.215	0.875	0.90

3.3.1.5 Noise

Since the transmission lines do not generate any appreciable noise, primary noise data collection focused on the substation locations. Noise monitoring was conducted at each of the five substation locations and at representative noise sensitive receptor locations (e.g., nearby residences or schools) near each substation.

At each monitoring location, measurements were taken by a digital noise meter fitted with a data logger. Noise readings were taken at an interval of 2 seconds for 24 hours and the data was stored. For monitoring at receptor locations, the same information was collected using hand-held noise monitors. Noise readings were noted at an interval of 2 seconds for a period of 15 minutes every hour for 24-hours. A suitable microphone shield was fitted to the noise meter to cut down on interference from wind. At each location hourly, day time, and night time and day-night equivalent noise levels (Leq hourly, Leq day, and Leq night) were computed from the hourly sound pressure level values measured between 6:00 a.m. to 10:00 p.m., and night time equivalent noise levels were computed from the hourly sound pressure level values measured from 10:00 pm to 6:00 am. This data was also utilized to calculate statistical noise level indicators (Lmax, Lmin, L10, L50, L90).

Brüel & Kjær's Predictor Type 7810 (Version 2019), a software for environmental noise modeling and mapping, was used to predict future noise levels during normal operations of the substations. Predictor is a three-dimensional prediction model that has multiple calculation methods for outdoor noise propagation from industrial plants. For this Project, Predictor used prediction methods prescribed by ISO Standard 9613, Part 1: Calculation of the Absorption of Noise by the Atmosphere (ISO 1993), and Part 2: General Method of Calculation (ISO 1996). The modeling approach accounts for factors included in ISO 9613, such as geometric divergence (distance attenuation), atmospheric absorption, reflection from surfaces, screening by obstacles (e.g., the control buildings and living quarters), ground effects, and meteorological conditions. The following inputs and assumptions were incorporated into the model:

- Average air temperature of 24, 20, and 22 degrees Celsius were used for the New Butwal, New Damauli, and Ratmate substations, respectively.
- Average relative humidity of 80 percent was used for the new substations (New Butwal, New Damauli and Ratmate Substations) and meteorological conditions favorable to sound propagation per ISO 9613 (i.e., downwind propagation in all directions).
- Terrain/elevation contours derived from Shuttle Radar Topography Mission data were spaced at 30-meter intervals.
- Ground absorption coefficient of 0.8 (i.e., 80 percent soft absorptive surface and 20 percent hard reflective surface) was used for the general modeled areas. For water bodies, which are reflective surfaces, a ground absorption coefficient of zero was assumed per ISO 961.

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The Predictor model was first configured by importing a Google Earth® base map of the area, which ensures a relatively high degree of accuracy for positions of various structures (buildings) and receptor locations. Specified noise levels for the Project were then entered into the model. After entering all required input data as described above, the model was run and the outputs were generated in tabular and graphical (contour) formats. The noise contribution levels at the nearest noise-sensitive receptor were then compared with applicable noise guideline values to determine compliance.

3.3.2 Biological Environment

Biological baseline field surveys focused on collecting information on forests, flora, and fauna within the Project Impact Areas. The field team used the Collector app for real-time updating of survey data (ESRI 2011). The Collector app is designed to access an ArcGIS database for the ETP alignment, which provides information on segment name, tower number, topography, land use, and areas of national and international significance for biodiversity conservation. Users can enter data on the location of sighting of a species, species, and species behavior information and attach a photo of the species. The Collector app works on global positioning system (GPS) enabled phones within or even outside mobile data networks. The data was then synchronized to the ArcGIS server. A screenshot of data entry into the Collector app is provided in Figure 3.3-2.

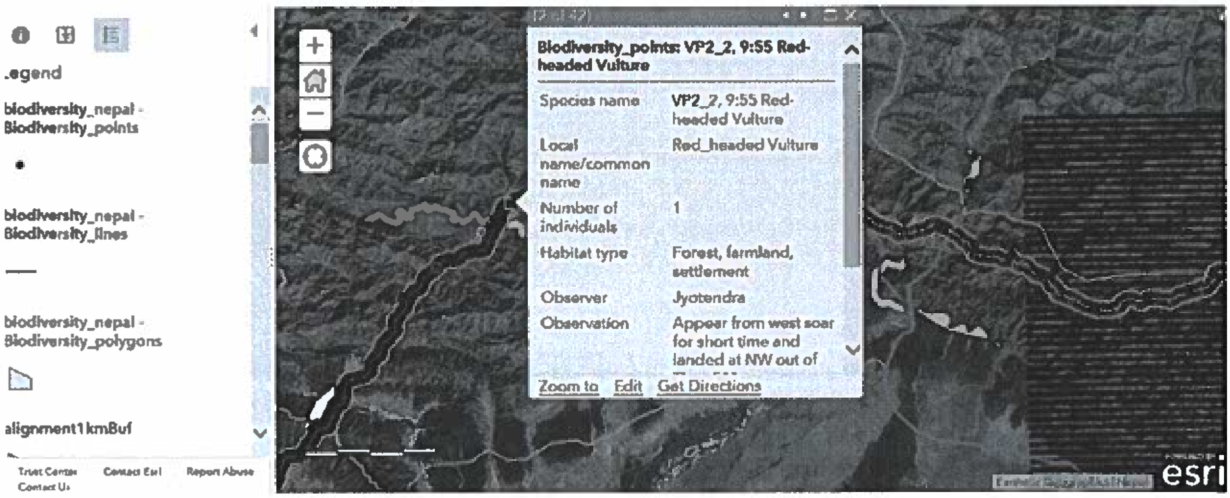

Figure 3.3-2: Screenshot of Collector Application Programming Interface

Paper records were simultaneously maintained along with the Biodiversity Collector app to ensure no data was lost while using the app. This involved entering data onto paper forms and providing the location using a GPS.

3.3.2.1 Forest Assessment and Estimation of the Number of Trees Affected

The objectives of the forest assessment are to characterize the various forest communities found along the Project Impact Area, estimate the vegetation loss/number of trees affected due to Project construction, and facilitate the impact assessment, the preparation of a compensatory plantation plan, and the preparation of a forest clearance permit application. The following process and methodology were used during the forest assessment process.

Consultation with Regulators and Other Stakeholders

The Consultant Team consulted with the MoFE, Department of Forests and Soil Conservation (DoFSC), and Forest Research and Training Centre (FRTC) to finalize the methodology used for the forest assessment.

The Consultant Team provided the applicable Division Forest Offices (DFO) with the approved methodology for the forest assessment and invited their participation in the field study before commencing the actual forest inventory work. Representatives from the FECOFUN district-level committees from each of the affected districts was also informed and consulted during the forest assessment. The Consultant Team also consulted with the affected Community Forest User Groups (CFUGs) to understand the Operational Plan and Constitution of the affected CFUGs, to obtain their suggestions regarding the planned fieldwork, and involve them in the assessment process. The CFUGs shared their knowledge regarding religiously and culturally important sites and trees; ethno-botanical use of their forests was also documented.

Forest Assessment Field Survey

The key guidelines related to EIA such as National EIA Guideline (1993), EIA Guidelines for the Forestry Sector (1995), Hydropower EIA Manual, MoFE (2018), and Sustainable Forest Management Guideline (2017) do not explicitly specify the sample size requirement for a forest assessment survey.

Since there are no specific guideline or prescribed sample size for a forest assessment in the existing EIA/IEE guidelines in Nepal, the GoN's Community Forest Inventory Guideline (2005) is widely used for the forest inventory and calculation of growing stock. Depending on the forest condition, the guideline recommends a sampling intensity (as a percentage of total forest) between 0.5 to 1.0 percent. Considering the geographical variation and diversity of the forests along the ETP alignment, MCA-Nepal, in consultation with the DoFSC, conservatively adopted a 1 percent sample size to ensure improved accuracy.

The total forest area within the RoW is estimated at approximately 777.5 ha, which would equate to approximately 156 sample plots at 20 x 25 meter (500 m^2) each to achieve a 1 percent sample. A total of 193 sampling plots were identified based on a stratified random sample and were distributed across the alignment to meet the percentage of forest that fell within each transmission line segment.

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A stratified sampling process was followed to locate the sample areas. The stratified sampling considered the following criteria:

- Project components such as location of towers, substations and within the RoW;
- Forest management regimes such as government forests, private forests, community forests, and leasehold forests;
- Adequate sampling across the various ecological zones crossed by the Project, including the Terai, Chure, Mid-hills and High-hills;
- Adequate sampling across each of the Project's five segments;
- Forest condition graded good, medium and good;
- Forest crown cover for percentages < 40 percent and > 90 percent; and
- Variations in elevations.

Table 3.3-4 presents the distribution of plots according to the above categories. The total number of plots for all categories totals 193.

The survey plots for the 1 percent survey were identified using the LiDAR aerial imagery and the MoFE's inventory of forested areas. Sampling plots have an area of 500 square meters and were centered within the TL RoW (25 meters length along the RoW and 20 meters length across the RoW). Within each of these 500 m^2 forest plots, smaller "nested plots" were also sampled for pole and *ballaballi* trees (100 m^2 plots), saplings (25 m^2 plots) and regeneration/seedlings (10 m^2 plots) (see Table 3.3-5 and Figure 3.3-3). The diameter (in centimeters) of all trees (over bark dimensions) within each of the plots was measured at 1.3 meters above the ground, which is referred to as Diameter at Breast Height (DBH).

Table 3.3-4: Distribution of Forest Plots According to Sampling Design Criteria

Criteria	Categories	Number of Plots	% Of Forest Area within ROW/Project Component	% of Plots in ROW/Project Component
Project Component	Substation	0	0.7	0
	Tower locations	20	6.7	10.4
	ROW	173	92.6	89.6
Forest Management Regimes	Community Forests	118	34.5	61.1
	Government Managed Forests	38	32.5*	19.7
	Leasehold Forests	3	0.2	1.6
	Private Forests	34	32.5*	17.6
Ecological Zones	Chure Conservation Area	12	12.5	6.2
	Terai	11	16.7	5.7
	Mid-Hills (outside Chure Conservation Area)	170	70.8	88.1
Segments	India Border to New Butwal	3	1.2	1.5
	New Butwal to New Damauli	50	30.7	25.9
	New Damauli to Ratmate	57	27.3	29.5
	Ratmate to New Hetauda	44	23.8	22.8
	Ratmate to Lapsiphedi	39	17.6	20.2
Forest Condition	Good	42	NA	21.8
	Medium	97	NA	50.3
	Poor	54	NA	28.0
Forest Crown Cover	>90 %	5	NA	2.6
	70-90 %	14	NA	7.2
	40 -70 %	83	NA	43.0
	<40 %	91	NA	47.2
Elevation	<499 m	31	NA	16.1
	500-999 m	94	NA	48.7
	1000-1499 m	55	NA	28.5
	>1500 m	13	NA	6.7

* Assuming that all other forests divided across government managed and private forests

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Table 3.3-5: Forest Assessment Sample Plot Sizes

Category	Diameter at Breast Height	Sample Plot Size	Sample Plot Dimensions	Figure 3.3-3 Reference
Trees	≥30 cm	500 m²	25 x 20 meter	A
Poles and *Ballaballi*	20 – 29.9 cm 10 – 19.9 cm	100 m²	10 x 10 meter	B
Sapling	4 – 9.9 cm	25 m²	5 x 5 meter	C
Regeneration	0 – 3.9 cm	10 m²	5 x 2 meter	D

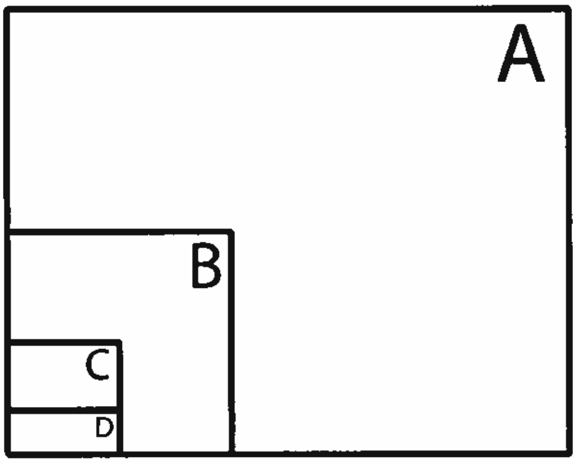

Figure 3.3-3: Forest Assessment Sample Plots Configuration

Field Methods

Five field teams were mobilized simultaneously for the survey (one team in each segment). Each team was composed of a forest inventory expert (team leader), forest technician, botanist, field survey assistant, and a FUG and/or DFO representative where possible. Each team was equipped with a GPS, Suunto clinometer, dendron meter/MTG tape, linear/D-tape and D-tape, and a vertex IV/Abneys label laser rangefinder.

Each field survey team had the X and Y coordinates in UTM/UPS format and WGS 84 datum for each of their assigned sample plots downloaded in GPS in order to identify the exact forest area to be inventoried. With the help of GPS, the survey team accessed and marked the corners of each sample number with trees or stones.[1]

Once the sample/nested plots were established, the DBH of all trees within each of the plots was measured using a D-tape, while the height of the tree (total and crown) was also estimated. The trees measured were classified as per the criteria defined in the forest bylaws and/or inventory guideline as grade 1st, 2nd, and 3rd class for the actual calculation of timber

[1] The team identified and located the four corners of each plot while establishing a plot on the ground but the plot number was marked only on permanent structures such as trees or stones

and fuel wood. A plot sheet was used to record the measurement and other information. The system illustration for plots allows trees to be easily referenced during the measurement exercise.

Information related to other biological environmental parameters such as agro-forestry practices, ethno botany, NTFPs, terrestrial wildlife found in the area, aquatic fauna, amphibians, ethno-zoology, protected species, and evidence of recent forest fires were also recorded during the forest assessment.

All the data were entered into an MS Excel spreadsheet in the office to document basal area (BA), volume, timber, fuel wood (growing stock), tree species, DBH, height, and grade of tree. Qualitative data was used to provide descriptions of biodiversity values and quantitative data was analyzed by using GIS, Excel, and SPSS software.

While conducting the 1 percent Forest survey, other information related to other biological environmental parameters, such as agro-forestry practices, ethno-botany, ethno-zoology, NTFPs, terrestrial wildlife found in the area, aquatic fauna, amphibians, habitat, protected species of flora and fauna, and evidence of forest fire were also recorded.

Annex D shows the location of each of the 1 percent survey plots. Annex H presents a data summary for each of the survey plots.

1 Percent Forest Survey Analysis Methodology

The number of trees that would need to be cleared for the ETP Project was estimated using tree/pole density from the 1 percent forest survey analysis. Approximate forest density for different forest types, ETP sections, and elevation ranges was collected during the 1 percent survey and used to estimate the number of trees within each forested area within the ETP right-of-way. LiDAR point cloud information, conducted by an MCA-Nepal consultant, was used to approximate the number of trees in landscape areas that were not covered by forest. Specifically, LiDAR was used to identify individual trees or small clusters of trees in locations such as agricultural plots, developed landscapes, or mostly barren environments. The FUSION/LDV LiDAR analysis and visualization software designed by the USDA Forest Service and Pacific Northwest Research Station was used to analyze the LiDAR and identify features which resembled tree poles in non-forested environments. The FUSION algorithm evaluates the LiDAR pulses and uses them to identify tree crowns. The LiDAR datasets were not used to approximate the number of trees in forested landscapes as the algorithm was determined to underestimate tree counts in high and medium density forest patches.

All the data collected from the field survey were entered in an MS Excel spreadsheet to calculate the number of trees affected, basal area (BA), growing stock, volume, and carbon. Different layers of data from the field survey were processed and analyzed using GIS and Excel software.

Annex 7 of the Forest By-laws 2051 B.S. (regulation) provides the methods and formula for calculating volume, which requires local volume tables of the particular sites. The formula provided below from MoFE's forest inventory guideline was used for calculating the stem value.

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The basal area, growing stock, volume, biomass, and carbon content of the affected trees, poles, and saplings was calculated as below:

- **Basal Area (BA) (m^2)** = π *DBH*DBH*/4*100*100 [DBH = diameter at breast height, centimeter]
- **Stem Volume (main stem of trees excluding branches) (m^3)** = BA* height* form factor (the form factor was used as for broad leaf – 0.55, and for conifer – 0.60) [BA = base area in m^2]
- **Tree volume** = Main Stem and branches = Stem Volume*1.3
- **Growing stock** = the total volume per hectare of trees greater than 10 centimeters DBH or number of stands per hectare
- **Timber volume (main stem effectively used for timber) per hectare (m^3)** = tree volume x value of particular tree per their grading (value of the first grade tree - 0.67, second grade tree - 0.5 and third grade tree - 0)* 35.28
- **Fuel wood (Chatta) per hectare in (m^3)** = Tree volume x value of particular tree grade i.e., (first grade tree - the value is 0.33, second grade tree - the value is 0.5, and third grade tree - the value is 1) x 35.28 / 500 (volume of each Chatta in ft^3 is value in m^3 multiplied by 35.28 (1 m^3 = 35.28 ft^3), one Chatta= 500 ft^3)
- **Biomass** = Stem Volume*Density
- **Total biomass** was calculated using the stem-to-branch and stem-to-foliage ratio of the MPFS, 1988
- **Stem biomass tonnes per hectare** = stem volume m^3 per ha x dry weight kg /1000 of particular species
- **Aboveground carbon tonnes per hectare** = Stem biomass of all species x 0.47 (IPCC GGP 2006) + branch carbon tonne (stem carbon tonne x 35.1 percent) + foliage (stem Ct *5.95 percent)
- **Total carbon tonnes per hectare** = Above ground carbon per ha + Below ground carbon (above ground carbon x 3.05 percent) per ha
- **Carbon dioxide tonnes per hectare** = Total carbon tonnes per ha x 3.67

Biomass was calculated using field survey data and LiDAR data and the regression model developed from them was used to calculate biomass for the whole RoW.

3.3.2.2 Flora Survey

Direct Surveys

In addition to the forest assessment described above, the Consultant Team also conducted a separate flora survey using 20 meter by 20 meter quadrat to generally characterize flora in accordance to vegetation types along the ETP alignment in the dry season of March-April 2019 (the locations of these plots were guided by a reconnaissance wet season survey carried out in September 2018). The sampling plots for flora were determined largely based on the presence of natural habitat within various forest management units, such as community forests, several of which were WWF Critical Biodiversity Sites and Hotspots. Prior to the survey, the proposed locations were reviewed by ERM to ensure that coverage of each section of the ETP alignment, altitudes, and forest extent was adequate.

The quadrats for the other vegetation types (i.e., shrubs and herbs) were nested within the tree quadrats. One nested quadrat was used to sample 50 hectares of forest area, which is approximately the mean size of a community forest in Nepal. If forest areas were larger, then additional quadrats were surveyed. The number of quadrats was thereby proportional to the forest areas surveyed, which ensured good representation of all forest land.

Within the plots, all flora species were recorded but attention was given to Critically Endangered (CR), Endangered (EN), Vulnerable (VU) species per the IUCN Red List, protected species (Nepal Rajpatra [part 3], Section 51, No. 36, dated 2058-9-16; and Section 53, No. 31, dated 2060-8-1), CITES listed species, and restricted-range species. Floral species identification was carried out by botanists with experience in species identification and the ability to use the appropriate regional and national keys for flora in Nepal. While the dry season data was used as the main source of data for the baseline, the wet season data was used to complement the species lists obtained from the dry season data.

The GPS coordinates of a point within the quadrat was recorded for reference. Photographs were taken of the site. The entire plot was visited by a botanist and the plants were recorded in a field data sheet. Botanists identified both flowering and non- flowering plants based on Volume 1 of *Flowering Plants of Nepal: An Introduction*, The Checklist of CITES Listed Flora of Nepal, and the Nepal Gazette (Rajbhandari et al. 2017; Joshi et al. 2017; Nepal Gazette 2074/7/17).

The plants with conservation significance were directly loaded in the Biodiversity Collector app and entered in paper forms. The quadrats were first subdivided into four quarters with ropes, from whose center the canopy cover photo was taken. The canopy cover was estimated by the CANOPEO app that uses these photos to provide approximate canopy cover.

For shrubs, 5 meter by 5 meter quadrats were laid at four corners of the tree quadrats. The shrubs and tree saplings were recorded and photographs were taken. Similarly, for herbs, 1 meter by 1 meter quadrats were laid at four corners of the tree quadrat. Herbs and shrubs, which are not found in their respective quadrats but found within the tree quadrats, were also recorded.

As mentioned above, quadrats were selected based on the presence of natural habitat likely to have floral biodiversity value and Word Wildlife Fund Nepal Biodiversity Hotspots. These forests were selected to ensure that all ETP segment vegetation types and altitudinal ranges were covered. Non-forest areas were not sampled.

Ethnobotanical use was recorded from the local people or the members of forest user groups for each quadrat. Plants found in the site but not recorded within the quadrat were also recorded as having significance for the life of people. The vegetation types were determined

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based on the dominant trees and altitude. Vegetation types were classified using Stainton's *Forests of Nepal* (Stainton 1972). Based on literature review, this reference is widely used in Nepal for forestry classifications.

Table 3.3-6 provides the flora plot numbers within each of the TL segments.

Table 3.3-6: Number of Flora Plots in each TL Segment

TL Segment	Number of Quadrats
India Border to New Butwal Substation	10
New Butwal to New Damauli Substation	83
New Damauli to Ratmate Substation	59
Ratmate to New Hetauda Substation	56
Ratmate to Lapsiphedi Substation	48

Source: Consultant Team 2020

Table 3.3-7 provides details of all floral plots distributed across the different elevation ranges, habitats, forest management regimes and across nationally and internationally recognized areas for biodiversity.

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Table 3.3-7: Distribution of Floral Plots across the ETP Alignment

Category	Sub-categories	Number of Flora Plots
Elevation Ranges	<1000 m	172
	1000-1500 m	59
	1500-2000 m	17
Forest Management Regime	Community and Leasehold Forests	70
Nationally and Internationally Recognized Biodiversity Areas	Terai Arc Landscape	62
	Chure Conservation Area	50
	Chitwan-Annapurna Landscape	215

Habitat Mapping

The objective was to classify land cover types along the 46-meter-wide RoW of the proposed transmission lines with a focus of distinguishing forest type and vegetation density.

A fit-for-purpose 10-meter resolution land cover classification was created for the 1,475.2 hectare area of the proposed transmission alignment using the most recent and cloud free open source Sentinel 2 satellite imagery. The imagery selected was from March 2019. Land cover was classified into 10 classes: water, barren, urban, roads, vegetation (forest, medium-density, low-density, or shrub/grass), agricultural lands, and wetlands. Forest vegetation was further categorized as one of the three forest types: tropical Sal forest, subtropical broadleaf *Schima* forest, and subtropical conifer pine forest.

All classes, with the exception of roads, were classified using a supervised maximum likelihood classification with ESRI ArcGIS Pro. Roads were then downloaded from the most recent Open Street Map database and added to the classification. Elevation data from Shuttle Radar Topography Mission (SRTM) was used to assist forest categorization with the 1,000 meter elevation selected as the boundary between tropical and subtropical forest. To maximize accuracy, classes within the 46 meter RoW were visually inspected and manually corrected post classification. During this process, the two subtropical forest types were separated by comparing the imagery with areas of known forest types.

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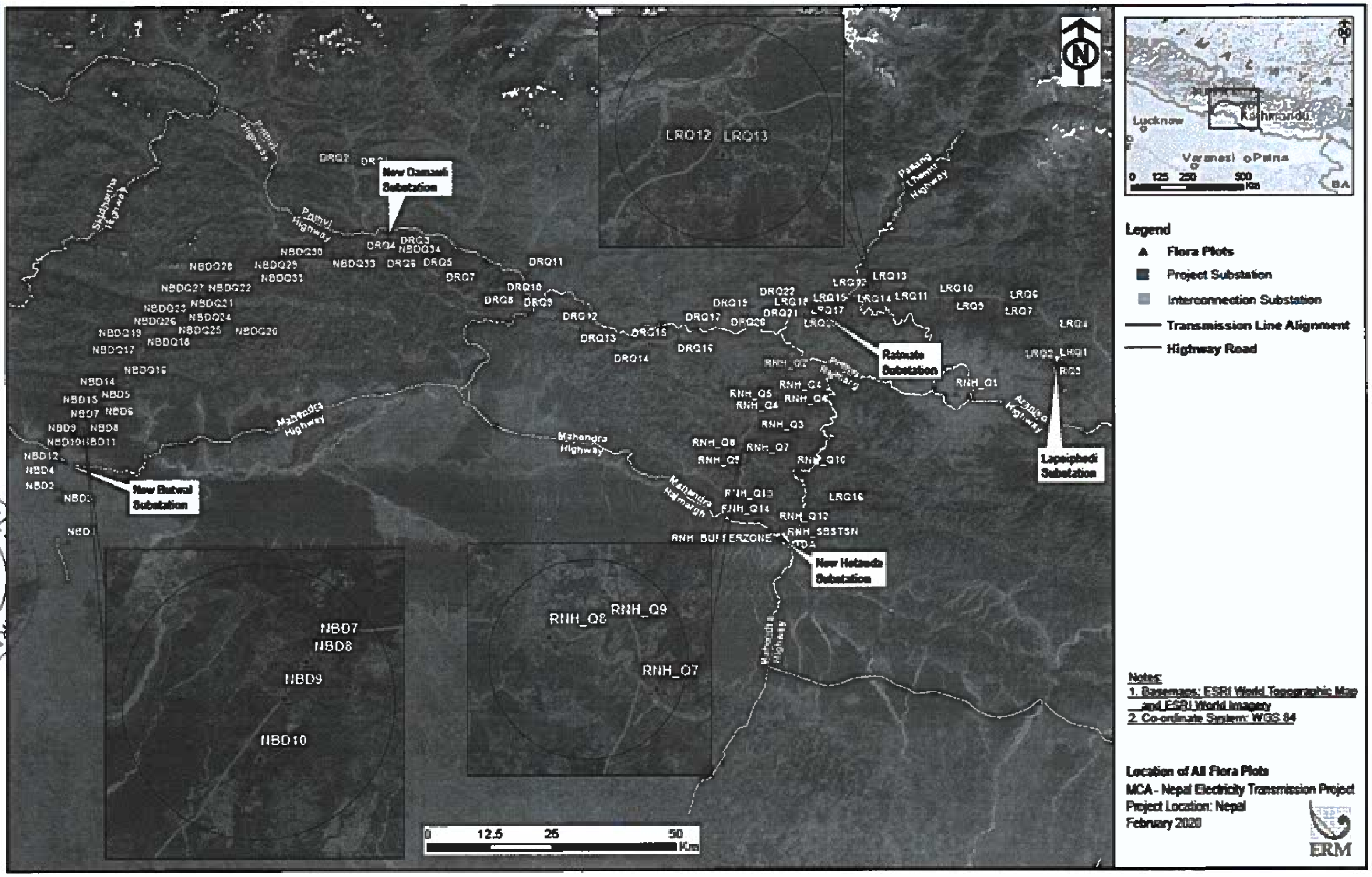

Source: Project GIS Analysis 2019

Figure 3.3-4: Location of All Flora Plots

3.3.2.3 Fauna Survey

The Consultant Team used line transects, local community consultation, and camera trapping to characterize terrestrial fauna, and vantage point surveys and line transects to characterize birds along the TL RoW, as described below.

Terrestrial Line Transects

Terrestrial line transects were used to record the presence of all terrestrial fauna (Burnham et al. 1980) in the dry season of March-April, 2019. The locations of these transects were guided by a reconnaissance wet season survey carried out in September 2018. The objective of the wet season survey was primarily to understand faunal diversity through rapid primary surveys and community consultations. The wet season surveys also attempted to establish whether there were any seasonal variations across dry and wet seasons with emphasis on amphibians that are likely to breed and be more active during the wet season. While the dry season data were used as the main source of data for the baseline, the wet season data was used to complement species likely occurring along the ETP alignment to the dry season data.

The transects for fauna were determined largely based on the presence of natural habitat within various forest management units, such as community forests, several of which were WWF Biodiversity Hotspots. Prior to the survey the proposed locations were reviewed by ERM to ensure that coverage of each section of the ETP alignment, altitudes and forest extent was adequate.

Terrestrial fauna includes mammals, reptiles, and amphibians. Attention was given to terrestrial fauna of conservation significance that include CR, EN, and VU species (as per IUCN Red List and the Red List for Mammals of Nepal), protected species (under the 1973 *Nepal National Parks and Wildlife Conservation Act*), species listed in CITES Appendices I and II, and restricted-range species. Mammals were identified using Indian Mammals, A field Guide Menon (2014). Herpetofauna were identified using Kastle et al (2013). Faunal species identification was carried out by an experienced set of zoologists, each with several years of experience in species identification and the ability to use the appropriate regional and national keys for mammals and herpetofauna.

For distinguishing pangolins, the adopted guidelines for the Project were that Indian pangolin have two types of burrows, feeding burrows and living burrows, and the burrows' average heights are 20 cm and 25 cm, respectively, at both sites (Mahmood et al. 2013). The burrows found were about 15 to 16 cm in height and were not completely round as is typical of the Indian pangolin (Chalise 2008). Furthermore, local people also said that there are several burrows in that area and when they go to the forest, they have sometimes seen pangolin hiding in these burrows. The structure of the head, body color, size of scales, and tail as stated by local people, and their species identification based upon photographs of both species shown to local people confirmed that Chinese pangolins were present and the nests belonged to them.

The feces of jungle cat and leopard cat were of same shape and diameter, so the length of scats were used. The diameter of scats of jungle cat is about 2 cm and length is about 8 cm,

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while scat of leopard cat is 1.5 to 1.8 cm in diameter and 5 to 6 cm long (Chame 2003 and Farrell 2000).

For small canids, scats of Bengal fox and golden jackal are also not clearly distinguishable. From local consultations on frequency of observations of either species, inferences were made on which species had deposited the scat.

Each line transect was approximately 1 kilometer long. On each line transect, both direct evidence such as a clear slighting of the species observed or identified vocalization, or indirect evidence, such as scat (for carnivores), pellets (for smaller herbivores and lagomorphs), dung (for large herbivores), pugmarks (for carnivores), hoofmarks (for smaller herbivores), pad marks (for elephants and rhinos), burrows (pangolins) and scrapes (for larger carnivores) were recorded. Species were only identified based on direct evidence or if the indirect evidence was clearly attributed to the given species. The location of all direct and indirect evidence was recorded with a GPS.

Table 3.3-8 provides the number of transects for all segments, and Figure 3.3-5 provides a Fauna Transect Map.

Table 3.3-8: Total Sampling Transects of All Segments

TL Segment	Number of Fauna Transects
India Border to New Butwal Substation	10
New Butwal to New Damauli Substation	29
New Damauli to Ratmate Substation	16
Ratmate to New Hetauda Substation	21
Ratmate to Lapsiphedi Substation	15

Table 3.3-9 provides details of all fauna plots distributed across the different elevation ranges, habitats, forest management regimes, and nationally and internationally recognized areas for biodiversity.

Table 3.3-9: Distribution of Fauna Transects Across ETP Alignment

Category	Sub-categories	Number of Fauna Transects
Elevation Ranges	<1000 m	71
	1000-1500 m	21
	1500-2000 m	8
Forest Management Regime	Community Forest	43
	Leasehold Forests	0
Nationally and Internationally Recognized Biodiversity Areas	Terai Arc Landscape	33
	Chure Conservation Area	19
	Chitwan-Annapurna Landscape	67

Community Consultation

Local community members encountered during field surveys, such as non-timber forest product collectors, livestock grazers, or timber/firewood collectors, were interviewed for presence of species of conservation significance by showing them appropriate field guides (i.e., Menon [2014] for mammals and Schleich and Kästle [2002] for reptiles and amphibians). Figure 3.3-5 shows the location of all transects within each TL segment.

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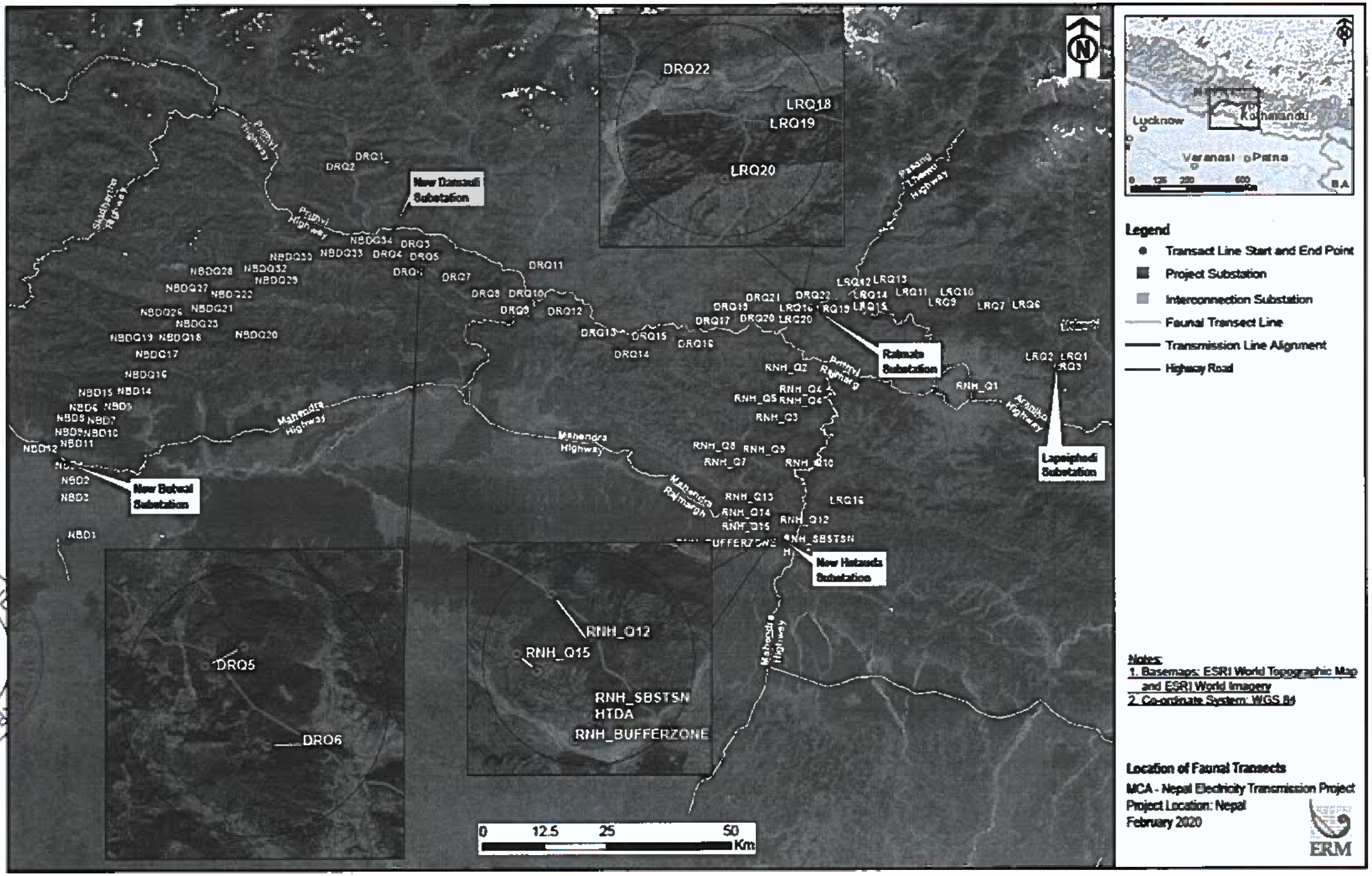

Figure 3.3-5: Location of All Fauna Transects

Camera Trapping

Remote photography and infrared sensors are widely used to sample wildlife populations, especially for cryptic or elusive species (Carbone et al. 2002). Camera trapping surveys were conducted to confirm the presence of species identified by indirect evidence in the line surveys, and to identify other species not identified during the line surveys or reported by local residents, but that could be found along the TL RoW, such as diurnal and nocturnal species.

The specific number and location of the camera traps was determined by the results of the terrestrial line survey described above. The camera traps were installed at multiple locations along the following segments for approximately 10 days from May 3 to May 16, 2019:

- New Butwal to New Damauli Substation Segment—between towers 28–31;
- New Damauli to Ratmate Substation Segment—between towers 76-92; and
- Ratmate to New Hetauda Substation Segment—between towers 83–112.

The details of species targeted by camera traps are presented in Table 3.3-10, including the relevant sections of the TL.

Table 3.3-10: Species Targeted for Camera Trapping

Segment	Target Species	IUCN Status	Nepal Red List Status	Government of Nepal Protected Species	CITES Appendix
New Butwal to New Damauli Substation	Chinese Pangolin	CR	EN	P	I
	Indian Pangolin	EN	EN	P	I
New Damauli to Ratmate Substation	Elongated Tortoise	CR	-	-	II
	Chinese Pangolin	CR	EN	P	I
Ratmate to New Hetauda Substation	Indian Pangolin	EN	EN	-	I
	Leopard Cat	LC	VU	P	II
	Sloth Bear	VU	EN	-	I
	Dhole	EN	EN	-	II
	Tiger	EN	EN	P	I

Source: Consultant Team 2020
Key: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, LC – Least Concern, P - Protected

Eight Cuddeback's E series Infrared Trail Cameras (with motion detection sensors) were used for the surveys. The camera trap locations were selected taking into consideration the following criteria:

- Selection of Transmission line stretches (tower locations) to be surveyed based on the primary data survey and secondary data for likely presence of species of conservational significance (IUCN Red List, Nationally Protected) reported during the terrestrial survey.

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- Reconnaissance survey of the selected stretch of transmission line for possible animal trails/pathways and near water holes within the forest areas.
- Further discussion with the locals to confirm the likely presence of animals within the above identified trails/water holes.
- Selected areas were identified to cover the open canopy as well as dense canopy area in the identified transmission line stretch.
- Identify the camera trap locations where there are secondary signs of movements such as hairs, pug marks, urine smells, etc., and place the cameras so that the maximum portion of the trail is covered.
- Identified camera trap locations should fall within the 1 kilometer range of the transmission line RoW and is easily accessible for regular monitoring.

The cameras were operational for entire nights and most of the days depending upon the time of arming. In order to capture both large and small animals, camera traps were positioned on trees at about 50 centimeters above the ground. All cameras were checked for proper sensor function by taking test pictures. Each camera trap was uniquely coded for identification purposes. The respective codes were written in permanent marker on the housing of each camera trap to avoid confusion. At the time of arming camera traps, the details such as camera trap code, coordinates of the location, and date and time of arming were noted. Camera traps were visited and checked regularly on alternate days. The cameras that were set at remote locations were checked every 3 to 4 days.

The camera traps were shifted to different locations due to any of the following reasons:

- Anthropogenic disturbance/resistance from locals
- Little or no animal activity for at least two camera trap nights
- Detection of fresh signs of target species at other locations

The effort with respect to trap nights for each of the cameras across the surveyed sections is provided in Annex H.

A study carried out west and east of the Madi River to record abundances of the leopard cat (*Prionailurus bengalensis),* large Indian civet (*Viverra zibetha*), and yellow-throated marten (*Martes flavigula*) in the Annapurna Conservation Area (Appel et al. 2013) involved 62 and 308 trap days across 12 and 47 sites, respectively. This trapping effort, which amounted to 5.2 and 6.6 trap days/site, provided adequate presence and relative abundance data of these species. For each of the segments surveyed, New Butwal to New Damauli Substation, New Damauli to Ratmate Substation, and Ratmate to New Hetauda Substation trap nights amounted to 2.5, 3.2, and 2.8 trap nights per site, respectively. Given that the objective was to record presence rather than abundance, camera traps were moved opportunistically based on information on greater species presence and the need for covering larger areas to inventory species; this effort can be considered adequate for the purposes of supplementing indirect evidence data on mammals obtained from transect surveys.

3.1.1.4 Bird Survey

Line transects and vantage point surveys were used to characterize the avian community along the ETP alignment. For both line transects and vantage points, the following binoculars were used for visual identification.

- Opticorn, Countryman BGA HD WP 10X42
- Viking, Navilux 10X42

Line transect surveys were used to record bird sightings (direct and indirect observations [i.e., nests and bird calls]) along a fixed pre-determined survey route. All species were recorded, but attention was given to species of conservation significance, which include CR, EN and VU species (as per IUCN Red List and the Red List for Nepal's Birds), species protected under the *National Parks and Wildlife Conservation Act*, 1973 and restricted range species and species listed under CITES Appendices I. and II. The Field Guide, Birds of Nepal Revised Edition (Baral et al. 2017) was used for all bird identifications. Line transects were determined by choosing locations that covered all identified important habitats within 500 meters of the RoW centerline. Each line transect was repeated to capture temporal differences—5:30 am to 10:30 am for morning transects and 3:00 pm to 6:30 pm for evening transects. For each sighting, the following information was recorded:

- Species scientific and common name
- Viewing location using GPS and geographical coordinates for each sighting
- No. of individuals
- Age/Sex where possible
- Distance on the transect or survey route (every 100-meter point was marked along the permanent transects/survey routes)
- Habitat type in which bird(s) were sighted
- Activity of the sighted bird(s) (roosting, foraging, nesting, etc.)
- For raptors and other birds of conservation significance (endemic and threatened—national and international), the flight height and direction of movement/flight was recorded

Avian vantage point surveys recorded bird activity as close to the TL center line as possible over the course of a single day (5:30 am to 6:30 pm). The vantage point surveys were determined by choosing locations that covered all potential flight paths of bird species during the study (e.g., mass movement from one water body to another). Vantage points were located where a 360 degree view of the surrounding landscape was available so that approach,

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behavior, and enumeration of birds from all directions could be observed (SNH 2014). For each sighting, the following information was recorded:

- Species Latin and common name
- No. of individuals
- Age/Sex where possible
- Direction and height of flight
- Nearest approximate distance from observer
- Activity of the sighted bird(s) (e.g., roosting, foraging, nesting)
- Geographical coordinates for each sighting
- Amount of time the bird was observed

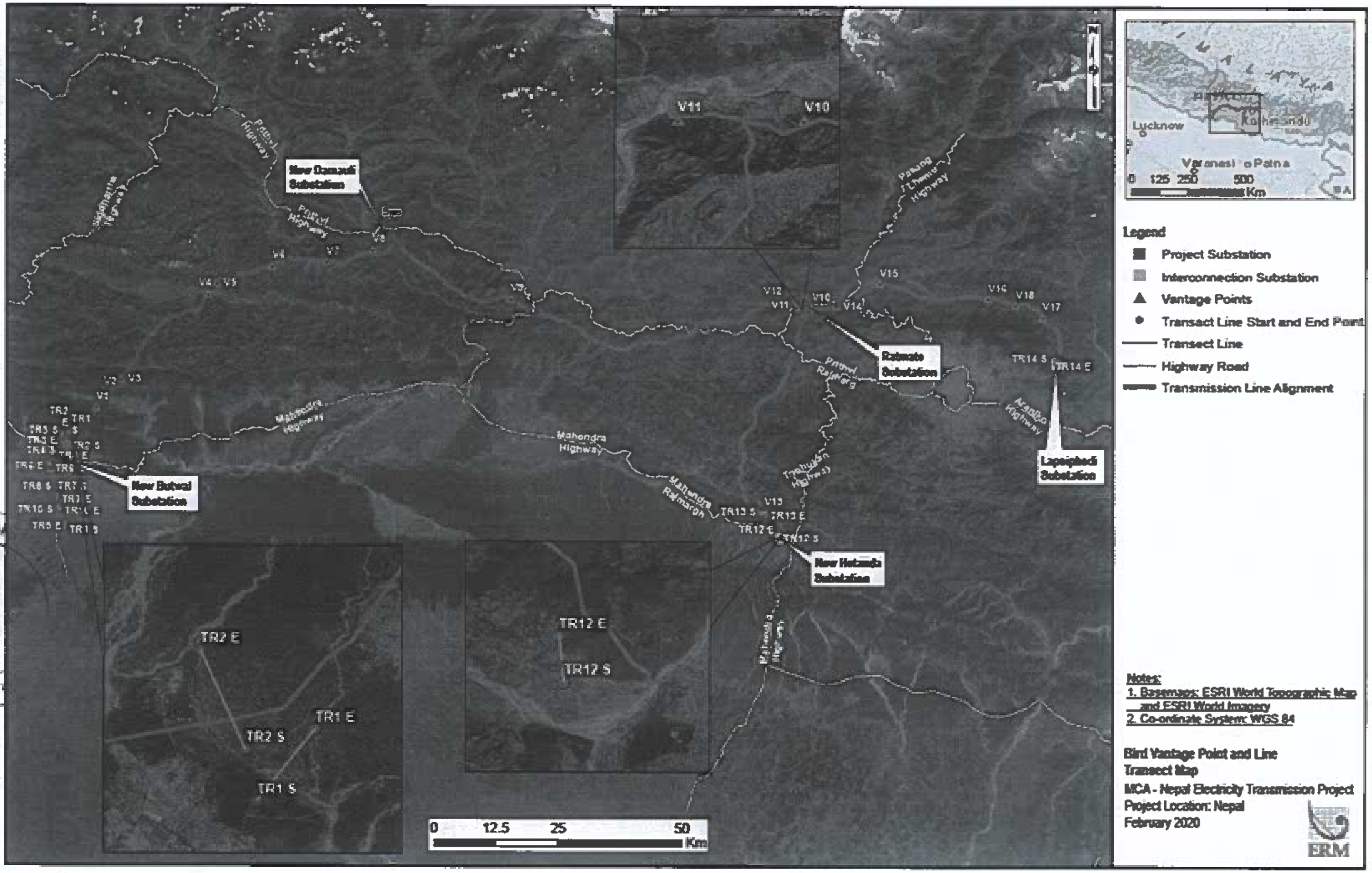
For bird surveys, knowledge of known areas where birds were likely to cross the ETP alignment for migration or access to foraging or breeding sites were used to determine the location of Vantage Points. The location of transect lines was based on known locations of tree nesting birds likely to be impacted by construction activities. These locations were suggested by BCN experts and reviewed by ERM.

Species identification was carried out by a competent set of ornithologists within NESS and BCN with several years of experience in species identification and the ability to use the appropriate regional and national keys for birds. Table 3.3-11 shows the number of transects and vantage points in each segment.

Table 3.3-11: Number of Line Transects and Vantage Points within TL Segment

TL Segment	Number of Transects	Number of Vantage Points	Number of Vantage Point Hours
India Border to New Butwal	7	0	0
New Butwal to New Damauli	4	8	104
New Damauli to Ratmate	0	1	13
Ratmate to New Hetauda	2	1	13
Ratmate to Lapsiphedi	1	7	91

Source: Consultant Team and BCN 2020



Source: Project GIS Analysis and BCN 2020

Figure 3.3-6: Bird Vantage Point and Line Transect Map

3.3.3 Socioeconomic and Cultural Environment

This section describes the field methods used for conducting socioeconomic and cultural baseline studies.

3.3.3.1 Socioeconomic and Cultural Baseline Studies

A socioeconomic and cultural baseline provides a snapshot of the existing socioeconomic and cultural environment. It is against this baseline that the potential changes (or impacts) that may result from a project implementation are evaluated. The socioeconomic and cultural baseline studies have been conducted to collect baseline information of the Project area as per approved ToR as well as MCA-Nepal's commitment to comply with the IFC Performance Standards.

The socioeconomic and cultural baseline studies involved conducting a household level socioeconomic survey, thematic focus groups discussions (FGDs), and key informant interviews (KIIs) in the direct and indirect impact areas. The aim of the baseline survey and fieldwork was to gather relevant information to establish socioeconomic and cultural baseline conditions and to support the preparation of a socioeconomic and cultural baseline for the Project impact area. Table 3.3-12 presents the types of secondary and primary data sources uses.

Table 3.3-12: Types and Sources of Data Used in the Socioeconomic and Cultural Baseline Study

Type	Sources	Baseline Tools
Data on demography, social groups and strata, migration, settlements	• Census data • Relevant and reliable published data/research • HH survey and FGD	• Household survey questionnaire • FGD checklists
Data on sources of income, resource dependence, energy access	• HH survey, FGD, and KII	• Household survey questionnaires • FGD checklists • KII checklists
Data on income, land holdings, expenditure, agriculture, other land-based activities	• HH survey	• Household survey questionnaire
Data on patterns of communities, gender roles, trafficking, substance abuse, child labor, and other social issues	• FGD and KII with communities, especially indigenous people, CFUG, women groups, • FGD and KII with NGOs, community-based organizations, government institutions/departments • Secondary data on relevant thematic issues, for Nepal	• FGD Checklists • KII checklists
Qualitative data on municipality plans, profile, challenges and priorities	• KII with Ward and municipality officials	• KII checklists

Household Survey—Sampling Strategy

Available estimates put the total population in the 98 wards crossed by the proposed ETP TL RoW and substations at about 67,000, based on data of National Population and Housing Census (CBS. 2011) in order to arrive at a statistically valid sample size for the Project RoW, a formula known as Yamene's formula[2] was used, as given below:

$$n = N/(1 + Ne^2)$$

Where:

n: sample size
N: population (in this case households) under study
e: margin of error

Using this formula, the statistically valid sample size for the household survey, at a RoW-wide scale, was determined to be 400 households. Taking into account a margin of non-response error of 10 to 12 percent, the sample size was established as 450 households for the baseline survey. Ultimately, a survey of 499 households was conducted. This sample size is statistically valid at the RoW-wide scale, but the data are not valid if disaggregated to smaller population sizes (e.g., district, municipality, or ward levels).

To ensure proportionate representation of areas, the specific households to be surveyed were selected using a stratified random sampling approach to account for the length of the transmission line passing through each district and the different landscapes through which the TL passes (i.e., Terai, Mid-hills, Mountains). Table 3.3-13 presents the number of households surveyed in different TL segments and different ecological zones.

Table 3.3-13: Sampling Methodology Used in the Socioeconomic Baseline Study

TL Segment	Ecological Region	Number of Households Surveyed
India Border to New Butwal Substation	Terai and Chure Region	40
New Butwal to New Damauli Substation	Mid Hills	34
	Mid Hills and Chure Region	50
	Terai and Chure Region	8
New Damauli to Ratmate Substation	Mid Hills	152
Ratmate to New Hetauda Substation	Mid Hills	11
	Mid Hills and Chure Region	76
Ratmate to Lapsiphedi Substation	Mid Hills	128
Total		499

[2] Commonly used approach to determine relevant sample size. This provides a simplified formula to calculate sample sizes, especially in cases where the population is finite and the population size is known. (Singh, A.S. (2014) "Sampling Techniques and Determination of Sample Size in Applied Statistics Research: An Overview" International Journal of Economics, Commerce and Management. Vol II Issue 11. URL: http://ijecm.co.uk/wp-content/uploads/2014/11/21131.pdf Accessed on 4th September 2019

Focus Group Discussion (FGDs) and Key Informant Interview (KII)

FGDs were conducted with different key stakeholders within the affected wards, municipalities, and districts to collect qualitative data. Table 3.3-14 presents the distribution of FGD samples for the different TL segments and FGD groups. A total of 62 FGDs were conducted with different stakeholders including indigenous people, Dalits, youth, women, CFUG/LFUG, and farmer. KIIs were conducted with different stakeholder groups in affected districts, municipalities, central level agencies, multi-lateral and bi-lateral organizations, and NGOs.

Table 3.3-14: Details of FGDs and KIIs used in the Socioeconomic Baseline Study

District	KIIs	FGDs						Total
		Ethnic Group	Dalit	Youth	Women	CFUG/LHFG	Farmer	
Nawalparasi East	4	0	0	0	0	0	0	4
Nawalparasi West	8	1	0	1	0	1	1	12
Palpa	5	1	1	1	2	3	2	15
Tanahu	8	2	0	1	1	2	2	16
Chitwan	5	1	0	1	0	1	0	8
Dhading	10	1	0	0	4	4	0	19
Makawanpur	8	4	0	0	2	2	0	16
Sindhupalchok	6	1	0	0	0	0	1	8
Nuwakot	9	3	0	2	1	3	1	19
Kathmandu	1	3	0	2	1	1	1	9
National Level KIIs	10	-	-	-	-	-	-	10
Total	74	17	1	8	11	17	8	136

Source: Primary Survey for EIA - Key Informant Interviews (KIIs)

Baseline Survey Tools

The household survey questionnaire, FGD checklists, and KII checklists were adapted from the Hydropower EIA Manual (MoFE 2018), taking into account local sensitivities of the Project Impact Area, existing social and environmental conditions, and discussions with experts and advisors to the Project. The field methodology and tools were pilot tested over one week in January 2019. The pilot testing occurred in two districts - Nawalparasi and Nuwakot - to ensure that the tools would work across different landscapes (i.e., Terai and Mid-hills).

The household survey tool was piloted on eight households and improvements were made to clarify questions and improve functionality. The FGD tool was pilot tested on 13 focus groups across five informant categories. The updated set of household questionnaire, and FGD and KII checklists used in the field survey are presented in Annex I.

Field Survey Teams

The social baseline survey was conducted by four teams, three focusing on the household survey and one focusing on the FGDs and KIIs. The household survey teams each consisted of a Survey Coordinator, two or three Enumerators, and a Translator fluent in Nepali, English, and a local language. The FGD/KII team included a FGD Coordinator and a Translator.

A training workshop was organized prior to the field work to train the Household Survey Coordinators, the FGD/KII Coordinator, Enumerators, and Translators about the baseline study including survey design, methodology, tools, and the role of each member during the survey. Data validation in the field explicitly focused on specific scenario -based trainings for different possible situations of data errors that could arise on the field. Types of data validation errors, both sampling and non-sampling errors, were discussed with teams. Data ethics and confidentiality were discussed during the training. The importance of informed consent and protecting privacy and data confidentiality was emphasized; team members learned the process of reading the consent form, which included a Project summary, the reason why the participants had been chosen for the study, and the importance of their information in detail. It was explained to the team that the participants had the choice to participate in the survey, and the choice of allowing their conversation to be recorded for the FGD. The consent explicitly mentioned that the names of the respondents and participants of FGD would be kept confidential.

Field Survey

Table 3.3-15 presents the actual number of households surveyed, FGDs, and KIIs conducted as part of the socioeconomic and cultural baseline study.

Table 3.3-15: Baseline Study Actual Coverage

Survey Tools	Minimum Unit	Number of Survey/FGDs/KIIs
Household Census	All households in Ratmate Sub-station Site	101
Household Survey	15 in each selected sampling ward within each of the 30 municipalities (450 surveys)	499
FGD with Women's Group	10 within the Project impact area	11
FGD with Indigenous Community and Dalit	12 within the Project impact area	18
FGD with CFUGs, Leasehold Forest groups	12 within the Project impact area	17
FGD with Farmers	6 within the Project impact area	8
FGD with Youth	5 within the Project impact area	8
KIIs with Municipal Officials	1 in each affected municipality	30
KIIs with District Officials	1 in each affected district	3

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Survey Tools	Minimum Unit	Number of Survey/FGDs/KIIs
KIIs with Central Ministry Officials	KIIs with central ministries including Ministry of Federal Affairs and General Administration, Ministry of Forests and Environment, Department of Land Management and Archives, Alternative Energy Promotion Centre	10
KIIs with relevant government departments at local level, autonomous bodies and NGOs	9 KIIs with Nepal Federation of Indigenous Nationalities, 9 KIIs with FECOFUN, 9 KIIs with DFO, and 3 KIIs with trafficking-related NGOs; 1 with NGO	31

Data Management and Storage

The household survey was conducted using an electronic tablet, stored in the *Big Data Survey Mobile Application,* and uploaded to the Project server, which was cloud-based and managed by Bonaventure Systems, on a frequent basis depending on internet access. Table 3.3-16 describes the key activities, roles, and responsibilities for the household survey data management workflow.

Table 3.3-16: Data Management Workflow for HH Survey

Activity	Data Management Resource	Role and Responsibility
Data collection across the TL impact area, in sample locations	Big Data Survey Mobile Application	Enumerators, using programmed tablets; Household Survey Coordinators
Data validation	Tablet	Enumerators and household survey coordinators
Data storage	Microsoft® Azure Cloud Server	Bonaventure System

The data collected through KIIs and FGDs were stored as a checklist and notes, and audio files where recording was approved. The audio files were assigned a code and sent via email to a transcription team in Kathmandu. The translator-transcriber entered data into a pre-structured matrix (Microsoft® Excel) developed to record FGDs (separately for key themes). KIIs were recorded as notes in Microsoft® Word files. There was a unique database for the survey data and another database to store the information collected from the FGDs and KIIs. For the FGD/KII, Table 3.3-17 describes the key activities, roles, and responsibilities for the FGDs/KIIs data management workflow.

Table 3.3-17: Data Management Workflow for KIIs and FGDs

Activity	Data Management Resource	Role and Responsibility
Information collection	KII/FGD checklist and audio recorder	FGD Coordinator
Information storage (in field)	Local systems (laptops)	Consultant Team
Data validation	Translated-transcribed audio files and FGD notes	Consultant Team
Data storage	After validation, Consultant server	Consultant Team

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Security and Backup

The confidentiality of the data was maintained once in the database. The data had user controls and access limitations to ensure security and confidentiality.

- Raw Data Access—raw data access was only given to the Bonaventure System(s) administrator account.
- Microsoft® Excel Data Access–To generate Microsoft® Excel reports from raw data, Bonaventure System(s) administrator account needed to be actively signed in; data could only be downloaded over a secure files transfer protocol.
- Raw data went through a processing app and Microsoft® Excel reports were generated.
- Microsoft® Excel reports were emailed on daily basis to the agreed supervisor email addresses per a pre decided time—every day until the survey was active.

Data confidentiality—measures to ensure data confidentiality and privacy of the respondents were put in place during the survey by using unique household IDs for each region. The responses were identified through their geographic codes and HH ID codes, without revealing the identity of the respondents. In the case of FGDs, the translated documents of the audio files did not contain the names of the participants and contained only the geographical identifiers.

After the entire field exercise was complete and the data securely stored on the server, Bonaventure System transferred the final data (raw data files) to ERM, from JSON format to readable .csv files, which could be used in analysis on software like Microsoft® Excel.

Quality Assurance and Quality Check

The following data quality assurance process was used for the household survey before the initiation of fieldwork:

- Programming the approved tool on the tablets and running tests
- Setting up protocols for data entry, end-of-day checks, upload, and back-end checks
- Selecting survey supervisors and enumerators with adequate training and experience in the field, respectively
- Pre-survey training of enumerators with survey supervisors on the tool, use of tablet, disclosure requirements, and other clarification of terms
- Field protocol for enumerators to note or clarify new issues

The survey tool was pre-tested with survey enumerators and a training was conducted to ensure a high standard of data entry. In the field, de-briefing sessions were made a daily practice, to clarify issues raised by enumerators during field surveys, for clarification by household survey coordinators. When discrepancies were found during regular checks, tablets were not synced until a data check was done with the enumerators and corrections were made.

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To make sure that each household survey form contained sufficient details regarding the household, the following quality control steps were taken at the back end, once the data was collected and uploaded to the server. These checks were conducted on each working day that the survey teams were in the field:

1. Check for data count in the server and match it with count of physical data collection
2. Random check of 5 to 10 forms for necessary fields in the survey questionnaire
3. Checking survey forms (from various enumerators) for any patterns in data entry error
4. Random check of 5 to 10 forms for demographic details
5. Reporting any errors in data entry to the HH survey coordinator

In order to counter the risk of data loss, the team ensured data controls through systems established by the technology solution provider for the survey software application, along with a robust system to ensure physical security of notes and files. The identity of the respondent was coded, and once in the server, electronic collection of data ensured that loss of data was minimized and any error could be traced back to the enumerator for back check. Provisions were made to note the mobile numbers of respondents, in case these were required for clarifications later. During training of the survey enumerators, data protection and security was explained and practiced with mock surveys. During the survey, the household survey coordinators monitored the activities of the enumerators and reported any incident of data loss immediately for corrective action (either a complete resurvey was done, or a re-check and item-wise response was planned and undertaken with the identified household).

After survey completion and the data being uploaded to the server, the following steps were followed, prior to data analysis:

- Data cleaning: Once the data entry was completed and synchronized with the server, the back-end quality assurance process started. The process involved removing dummy/invalid (incorrect survey) entries; spell checking respondent names, settlement name, and other text entries; checking for errors in numerical entries of income, expenditure, and land details.
- Quality Check: Once the data was cleaned, the dataset was analyzed for quality through internal validity check of questionnaires (picked at random), survey filling time, and any emerging patterns in repeated entries for enumerators.
- Gap Assessment: this involved applying the QA-QC process at the back end, once all the data collected through surveys was synced. Through this process, gaps in the data collected were analyzed against the objectives of the baseline study.

The responses were screened for sections and then checked for logical relation in between sections (e.g., positive response to land ownership and cultivation should logically correlate with income from agriculture). Such logical relations were established and then responses were analyzed for inconsistencies.

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3.3.3.2 Cultural Baseline Studies

Cultural heritage includes tangible objects, such as temples, shrines, monasteries, historic sites; unique natural features that embody cultural values, such as sacred groves, religious forests, rocks, lakes, and waterfalls; and intangible forms of culture, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

Cultural heritage baseline studies included FGDs and KIIs with key stakeholders, as well as field visits of cultural sites and inventories.

Focus Group Discussions/Key Informant Interviews

The EIA team conducted consultations with local government and local communities including community forest user groups, leasehold forest user groups, Dalits, women, youth, communities engaged in agriculture, Adivasi Janajati groups, and representatives from the affected municipalities. Through these consultations, the team identified key sites of cultural heritage for avoidance and insights for the development of mitigation measures.

Field Visits

Information on cultural heritage was collected throughout the course of the EIA study, and a focused field visit was conducted in May 2019 to ground truth all features of cultural and religious significance, including all temples, household to community-level shrines, stupas, Chhortens, mosques, churches, graves, Ghats/cremation sites, holly springs, rocks and trees with religious significance, Chautara, and religious forests. A checklist was prepared to ensure that all sites of cultural importance were accounted for, avoided, analyzed for impacted and mitigation measures proposed in case of any impacts.

3.4 STAKEHOLDER CONSULTATION

Stakeholder engagement is fundamental to building trust with the communities. Meaningful engagement with the communities allow you to identify key stakeholders, understand sensitives within each stakeholder groups and develop appropriate engagement mechanism to ensure communities are consulted on a regular basis and are aware of the Project and its impacts, obtain important baseline data from the communities, and establish a two-way communication with the communities. MCA-Nepal developed a Stakeholder Engagement Plan (SEP) early on in the Project to ensure effective stakeholder engagement during the course of the Project as referred in Annex J. Stakeholders consultation was an important means of information collection needed for EIA study. Stakeholder consultation also helped to validate baseline information collected through other means. Major stakeholders consulted during EIA study are as follows:

- **Ministries/Departments:** Ministry of Forests and Environment (MoFE), Ministry of Energy, Water Resources, and Irrigation (MoEWRI), Ministry of Agriculture and Livestock Development (MoALD), Ministry of Federal Affairs and General Administration (MoFAGA), Department of Forest and Soil Conservation (DoFSC), Department of Plant Resources (DPR), and Department of Electricity Development (DoED).

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- **District Level Offices:** District Survey Office (DSO), District Coordination Committee (DCC), Division Forest Office (DFO).
- **Conservation Agencies:** Bird Conservation Nepal (BCN), President Chure-Terai Madesh Conservation Development Board (PCTMCDB), National Trust for Nature Conservation (NTNC), International Union for Conservation of Nature (IUCN), and World Wildlife Fund (WWF).
- **Local Government:** Affected municipalities and wards
- **Federations:** Federation of Community Forests Users Nepal (FECOFUN), and Nepal Federation of Indigenous Nationalities (NEFIN).
- **Local Community**: Local communities, women's group within ETP footprint, youth groups within ETP footprint, farmers group within ETP footprint, Adivasi Janajati youth groups, Dalit groups, and general ETP community.

In addition to the ongoing stakeholder engagement that occurred as part of the overall EIA process, MCA-Nepal also conducted three rounds of formal public meetings:

- Scoping Meetings – were held in each of the 30 affected municipalities in September and October 2018 to inform the potentially affected communities and officials about the Project and to obtain their input on key issues and concerns;
- Final Alignment and EIA Pre-Disclosure Meetings – were held in each of the 30 affected municipalities in June 2019 to share with the potentially affected communities and local officials the tentative transmission line alignment and share the preliminary findings of the biodiversity and social baseline surveys; and
- EIA Disclosure Meetings (Public Hearing) - were held in each of the 30 affected municipalities (1 Sub-metropolis, 11 Municipalities and 18 Rural Municipalities) in November and early December 2019 to share with the potentially affected communities and local officials the findings of the EIA, to answer their questions, and to request the official municipal support of the Project.

3.3.4 Public Hearing

According to EPR 1997 (clause 7(2)), at least one public hearing should be conducted in project areas to solicit public concerns and suggestions prior to the finalization of the EIA. For this Project, the team conducted public hearing in all 30 affected municipalities and rural municipalities. A public notice was published on November 17, 2019 in the Nagarik National Daily Newspaper. The same notice was further disseminated to different government offices, including District Administration Office, District Coordination Committee, Land Revenue Office, Land Survey Office, related forest offices, FECOFUN, NEFFIN, affected municipality/rural municipality offices, and affected ward offices. The same notice was also posted in public places of affected areas such as schools, health posts, community buildings, and nearby markets, tea shops, and other places where people gather, to ensure notice of the meeting was sufficiently widespread to encourage large participation. In addition, information about the public hearing was disseminated through various FM radio stations in all ETP districts in different languages including Tamang, Chepang, Magar, Tharu, Awadhi and Nepali.

During the public hearing, a summary of the EIA report in Nepali language, and fact sheets for each municipality were distributed before the start of the hearing. In addition, a hard copy of the Draft EIA report was also available. A summary of the EIA report with a focus on possible impacts and proposed mitigation measures were presented by experts; and the participants were given the opportunity to ask questions and share their comments. The experts addressed the questions and issues raised to the extent possible, and took detailed notes of their queries and concerns. Each public hearing was concluded after hearing from the local elected officials and invited guests from different organizations. Overall, 1,557 people participated (Male 1278 and Female 279) in the public hearing (refer to Annex J for details).

3.3.5 Grievance Redressal Mechanism

MCA-Nepal has established a Grievance Redressal Mechanism (GRM) for the Project. The GRM allows any stakeholder to submit a grievance for review and response by MCA-Nepal. The grievances can be filed in person, by phone, by letter, or by email at the Project Information Center or Environment Social Performance Community Assistant (ESPCA), or directly with MCA-Nepal. The grievance is reviewed by MCA-Nepal and a timely response is provided. If the complainant is not satisfied with the response, they can appeal the decision, and the grievance will be escalated to Tier-2, which is chaired by the Ward Chair. Similarly, a Tier-3 committee is also formed which will be chaired by the Chief District Officer (CDO) in case the claimant is not satisfied with the response provided by Tier-3 grievance committee. The Consultant Team maintains a Grievance Log that tracks all grievances filed regarding the Project and their ultimate resolution.

3.3.6 Collection of Recommendation Letters and Public Notification

As mentioned above MCA-Nepal organized public hearing programs in each affected municipalities/rural municipalities/sub-metropolis. Following public hearings, recommendation letters were collected from local levels as per EIA requirement. Draft EIA report forwarded by DoED to MoFE through MoEWRI was distributed to all affected local levels, District Coordination Committees of affected districts, National Library, Parliament Secretariat Library, Tribhuvan University library, and NEFIN for making it available to public for comments and suggestions. Draft EIA report was also published in MoFE and MCA-Nepal websites. After the completion of EIA report distribution, a 7-day public notice was published in a national daily informing public where EIA report is available and soliciting their comments/suggestion. EIA report was revised by incorporating comments received from the public prior to resubmission to MoFE.

3.4 IMPACT ASSESSMENT METHOD

MCA-Nepal conducted scoping for the ETP in September and October 2018 and obtained approval of the Scoping Document and ToR from MoFE in April 2019. The scoping process helps to focus the EIA on the important issues, concerns, and impacts. The ToR provides direction to MCA-Nepal and the Consultant Team on the organization and structure of the

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EIA, the methods to be used in conducting the EIA, and the potential impacts that need to be addressed in the EIA.

It should be noted that DoED requested the EIA be structured to discuss Project impacts on a "Segment-specific" basis in order to allow local residents to more easily understand Project impacts in their area. MoFE recommended that the EIA also include a discussion of "Project-wide Impacts" in order to avoid piecemeal and redundant discussion of impacts. Therefore, Chapter 5 (Existing Environmental Condition) is organized by segments; and Chapter 7 (Environmental Impacts) is organized to first discuss the impacts that are common to multiple or all segments (e.g., erosion) in a "Project-wide Impacts" section, followed by an evaluation of impacts on a segment-specific basis.

As identified in the approved ToR and reflected in the baseline survey methods described above, the following aspects (resources) of the environment were scoped into this EIA:

- Physical and Chemical Environment
  - Land Use/Land Cover
  - Topography, Geology, and Soils
  - Water Resources
  - Air Quality and Climate
  - Noise
- Biological Environment
  - Protected Areas and Areas of Biodiversity Importance
  - Natural Habitat, including Forests
  - Flora
  - Fauna
- Social and Cultural Environment
  - Land Ownership and Use
  - Community Resources and Ecosystem Services
  - Community Health, Safety, and Security
  - Community Infrastructure
  - Vulnerable and Disadvantaged Groups

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Section 3.1 above describes the Project Impact Area over which potential Project impacts on the aspects listed above will be evaluated. Sections 3.2, 3.3, and 3.4 above describe the methods that were used to characterize the existing baseline conditions for these aspects. The quantitative, semi-quantitative, and/or qualitative methods used to analyze impacts for each of the specific aspects are described in Chapter 7 (Environmental Impacts).

Once the impacts are quantified, the next step is to determine the significance of the potential impact, as the more substantive impacts warrant more substantive mitigation. The remainder of this section describes the methodology used to evaluate the significance of the identified impacts on these aspects.

3.4.1 Direct and Indirect Impacts

This EIA follows the impact assessment methods described in the Nepal *Hydropower Environmental Impact Assessment Manual* (Manual) (MoFE 2018). Using Method 1, the Manual determines the significance of a potential project impact by taking into consideration its nature, type, magnitude, extent, and duration. These terms are defined in Table 3.4-1.

Table 3.4-1: Definition of Significance Criteria

Criteria	Definition
Nature of impacts on environment/communities	Beneficial—impacts that result in net benefits Adverse—impacts that result in net detriments
Type of impact	Direct—impacts resulting directly from changes caused by the Project Indirect—secondary impacts caused by the Project
Magnitude—the level of impact	Low—a small, but measurable, change from the baseline conditions, typically that would not result in an exceedance of any applicable government standards Medium—a noticeable and readily measurable change from the baseline conditions that may result in an exceedance of any applicable government standards High—a substantial change from the baseline conditions that would result in an exceedance of any applicable government standards
Extent—the areal "reach" of the impact	Site-specific—impacts confined to within the RoW or the boundaries of the substations or ancillary facilities (e.g., laydown areas) Local—impacts extend beyond the Project footprint area to affect resources up to 5 kilometers away from the Project Regional—impacts observed extending more than 5 km away from the Project.
Duration	Short-term—less than five years Medium-term—more than five years and less than 10 years Long-term—10 years or more

Source: Adapted from MoFE 2018 and ERM 2012

The magnitude, extent, and duration criteria each are assigned a numerical value, which are then combined in a risk matrix to characterize the overall impact significance (see Table 3.4-2). Table 3.4-3 defines each of the levels of impact significance.

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Table 3.4-2: Environmental and Social Impact Rating Criteria and Point Values

Magnitude	Extent	Duration
Low (10)	Site-specific (10)	Short-term (5)
Medium (20)	Local (20)	Medium-term (10)
High (60)	Regional (60)	Long-term (20)

Source: Adapted from MoFE 2018 and ERM 2012

Significance	Point Range
Negligible	0 - 40
Minor	41 - 70
Moderate	71 - 99
Major	100 - 140

Table 3.4-3: Definition of Levels of Impact Significance

Level	Definition
Major	A fundamental change altering the baseline conditions, affecting a large area/number of people over a long term, and clearly exceeding applicable standards. Functional recovery is expected to be long term (greater than 10 years) or possibly permanent.
Moderate	A noticeable and readily measurable change from the baseline conditions. Changes are expected to be longer term, affect a large area/number of people, and possibly exceed applicable standards. Functional recovery expected to take longer (e.g., up to 5 years or possibly more)
Minor	A small but measurable change from the baseline conditions. Changes are expected to be temporary and/or only affect a small area/number of people, be within applicable standards (e.g., water quality standards), with a relatively quick functional recovery (e.g., months to a few years)
Negligible	Marginal change in the baseline condition so no discernable effect is expected, the effect is indistinguishable from natural background variation, and functional recovery occurs quickly (e.g., a few months)

The impact significance rating presented in Chapter 7 (Environmental Impacts) are considered "pre-mitigation" impact rating, which means the rating does not take into account the mitigation measures.

The significance ratings presented in Chapter 8 (Enhancement and Mitigation Measures) are "post-mitigation or residual" impact rating, which means the rating takes into consideration all mitigation measures that have been committed to by MCA-Nepal, and their likelihood for success. All impacts are reduced using mitigation measures to the extent practicable, but where the pre-mitigation significance rating is Major or Moderate, mitigation or management measures are specifically proposed such that the post/residual impact significance of all impacts are Minor or Negligible.

3.4.2 Cumulative Impacts

The International Finance Corporation (IFC) defines cumulative impacts as "those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones." Therefore, even though a Project impact may appear minor, it could be significant from a cumulative impact perspective (e.g., the loss of a few individuals of a critically endangered species). The MCA-Nepal Consultant Team evaluated potential cumulative impacts from the ETP using the

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IFC's *Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets* (referred herein as the "IFC Handbook") (IFC 2013). The IFC Handbook focuses on Valued Environmental and Social Components (VECs), which are resources of special value to stakeholders. The IFC Handbook (page 21) describes Cumulative Impact Assessment (CIA) as, "the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible." The IFC Handbook describes a six-step process, which is illustrated in Figure 3.4-1.

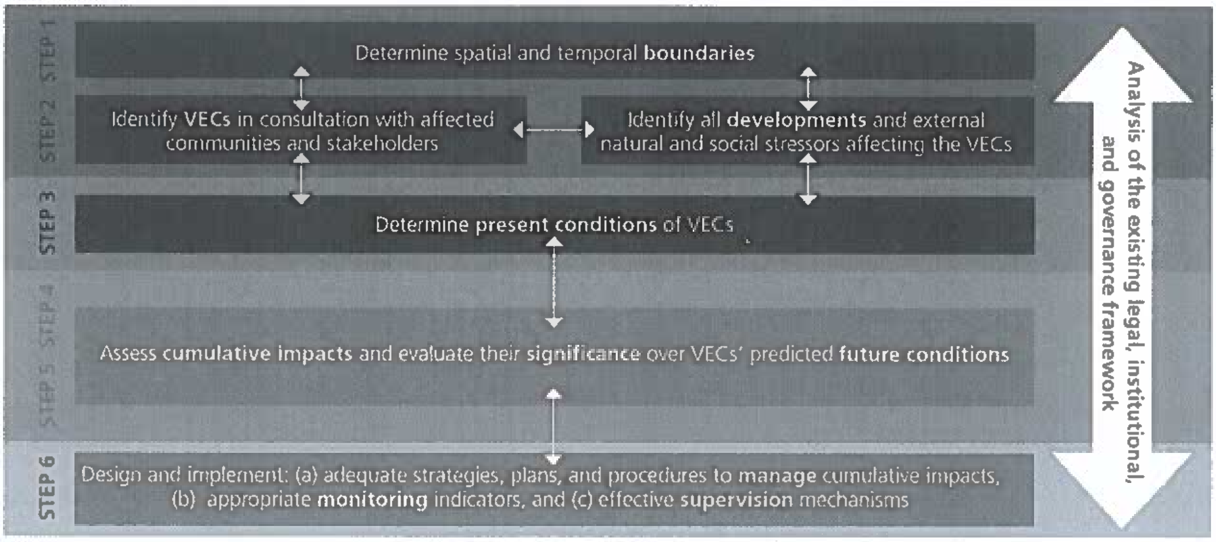

Figure 3.4-1: IFC CIA Process

Other planned projects occurring within the ETP's Direct or Indirect Impact Area were identified, including existing and proposed transmission lines, road/infrastructure projects, and planned municipal projects. Once these activities were identified, the specific resources or receptors that could be cumulatively affected were identified. Based on input from key stakeholders, the key resources, or Valued Environmental and Social Components, or VECs, were identified and evaluated. See Section 7.5 for additional information on the CIA methodology.

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सिंहदरबार, काठमाडौं

3.5 EIA STUDY TEAM

Table 3.5-1 lists the experts/specialists who were involved in the EIA study. Their CVs are included in Annex A.

Table 3.5-1: EIA Team Members and Their Roles in the EIA Study

SN	Name	Role	Role/Expertise
1.	David Blaha	International	International EIA Lead
2.	Selina Pradhan	International	EIA Coordinator
3.	Madhukar Khadka	National	Nepal EIA Specialist
4.	Toran Sharma	National	Geologist & Physical Environment
5.	David Nicholson	International	Biodiversity Lead
6.	Arun Venkataraman	International	Biodiversity Lead
7.	Mukesh Chalise	National	Biodiversity and Wildlife Specialist
8.	Jyoti Gajurel	National	Flora Specialist
9.	Tej Basnet	National	Fauna Specialist
10.	Neena Singh	International	International Socioeconomic & Resettlement Lead
11.	Rabin Dhakal	National	Nepal Socioeconomic and Resettlement Lead
12.	Srijana Bhattarai	International	Social Team/ Stakeholder Engagement Lead
13.	Rutuja Tendolkar	International	Social Team Lead
14.	Sumati Bhatia	International	Social Team Lead
15.	Akshita Mishra	International	Social Team (Socio-anthropologist)
16.	Prajna Singh	International	Social Team
17.	Chandra Tripathee	National	Cultural Heritage
18.	Ramu Subedi	National	Forestry and Benefit Sharing
19.	Salil Devkota	National	Environmental Expert/Advisor
20.	Michael Mangiante	International	GIS Specialist
21.	Jayakrishna Vasam	International	GIS Specialist
22.	Pawan Ghimire	National	GIS Specialist
23.	Bimal Subedi	National	Legal Regulatory Specialist
24.	Mangala Karanjit	National	Communication/Stakeholder Engagement Specialist
25.	Swasti Budhathoki	National	Grievance Coordinator
26.	Hathan Mahato	National	Bird Expert
27.	Hiru Lal Dangaura	National	Bird Expert
28.	Jyotendra Thakuri	National	Bird Expert
29.	K.P Yadav	National	Forestry Expert
30.	N.P Yadav	National	Forestry Expert
31.	Lila Raj Paudel	National	Forestry Expert

In addition, ERM has employed nine Community Liaison Officer (CLOs) at field level in nine Project-affected districts since October 2018. MCA-Nepal has also employed eight on-site liaisons in eight Project-affected districts. The CLOs and on-site liaisons have continually provided information to, and answered questions from, local residents about the Project.

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CHAPTER FOUR
PLANS, POLICIES, ACTS, REGULATIONS, GUIDELINES, AND STANDARDS RELATED TO THE PROPOSAL

This EIA has been undertaken with reference to the provisions of the following policies, laws, rules, guidelines, manuals, and international conventions and treaties. MCA-Nepal reviewed these acts and regulations to ensure compliance with the prevailing law. In addition, international standards and best practices on social and environmental safeguards were reviewed to develop an EIA that identifies all possible risks and impacts from project development and identify appropriate measures to minimize and mitigate the risks to the extent possible. MCA-Nepal will follow all relevant Acts and Regulations of Government of Nepal.

4.1 CONSTITUTION OF NEPAL

The Constitution of Nepal mandates Environment Protection as state policy. The State shall give priority to the protection of the environment and to prevent further damage due to physical development activities by increasing the awareness of the public about environmental cleanliness. The State shall also arrange for the special protection of the forest, vegetation and biodiversity, its sustainable use and ensure equitable distribution of the benefit derived from it.

Article 30 of the Constitution of Nepal has provisioned Nepalese citizens the right to live in a clean and healthy environment, and that they shall have the right to obtain compensation, in accordance with the law, for any injury caused by environmental pollution or degradation.

Article 51(g) of the constitution emphasizes policies relating to protection, promotion, and the use of natural resources, including:

- Protection, promotion and sustainable use of natural resources;
- Conservation, promotion, and sustainable use of forests by mitigating possible risks to the environment from industrial and physical development by raising awareness about environmental protection measures;
- Maintenance of forest area for ecological balance;
- Advance warning and disaster preparedness measures to mitigate risks from disasters;
- Minimization/avoidance of the impact of physical development works on the environment and rare species with due emphasis of conservation; and
- Development of renewable energy to ensure reliable and affordable source of energy.

Article 34 of the constitution emphasizes the right to fair labor practice.

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Article 18 emphasizes the empowerment/advancement of women, Dalits, and Indigenous People (Adivasi Janajati).

4.2 PLANS

4.2.1 Fifteenth Plan, 2076/77-2080/81 BS (2019/20-2023/24 AD)

Nepal started formulating periodic development plans in the late 1950s. These periodic development plans outline the country's development policies and programs for a 5-year or a 3-year period. Nepal has already completed 14 periodic development plans. This plan identifies several constraints within the hydropower sector including inadequate supply during the dry season, unreliable electricity distribution system, lack of transmission line and constraints with land acquisition amongst others. This plan recommends construction of an internal as well as cross border transmission lines to enhance reliable supply of electricity.

Lack of integrated and managed development, haphazard urbanization, inadequate environmental assessments are some of the critical issues identified in this plan. This plan further highlights the need for formulation of national standards for water, air, soil, noise, radioactive, hazardous waste and electrical waste. It recommends mandatory requirement of EIA and EMP for all infrastructure projects.

4.2.2 National Biodiversity Strategy and Action Plan, 2071-2077 BS (2014 to 2020 AD)

These action plans promote conservation of forest biodiversity by promoting people's participation. However, these plans strictly prohibit developmental projects from producing a negative impact on forest habitat. Most of the transmission lines in Nepal are routed through forest. In order to install transmission poles to supply high-voltage electricity, excavation is required in forest areas. The high-voltage wires may have impacts as well. Therefore, these action plans explicitly restrict projects that would hamper biodiversity and natural habitat. These action plans also promote community participation since most of the forests in Nepal are community forests. This Plan is applicable to the ETP because the Project will affect community forests.

4.2.3 President Chure-Terai Madhesh Conservation and Management Master Plan, 2074 BS (2017 AD)

The goal of the Plan is to support poverty reduction; the national goal of a Prosperous Nepal through conservation and sustainable management of the resources in the Chure region; and the improvement of the ecosystem services. This Master Plan is applicable to the ETP because the Project will traverse the Chure-Terai Conservation Area.

4.2.4 National Water Plan (2002-2007), 2062 BS (2005 AD)

The objective of the NWP is to contribute to the overall national goal of economic development, poverty alleviation, and to enhance the standards of living while protecting the natural environment. It aims to provide guidance for developing and managing water resources and water services. It includes short, medium and long-term action plans for the

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water sector including investment and institutional aspects. It includes a provision for environmental action plan on management of watersheds and aquatic ecosystems.

The NWP adopts the following major doctrines:

- Integration to achieve a) efficiency and effectiveness of water management by empowering users b) integration between water use across river basins c) involvement of users to set out priorities and management decisions d) effective data collection for continuous development of the water sector;
- Coordination amongst various stakeholders to ensure sustainable water management;
- Decentralization and capacity building of local institutions;
- Popular participation to ensure all stakeholders are consulted to build consensus on overall development including users group; and
- Equity to include women and vulnerable communities.

This Plan is applicable to the ETP because the Project will affect watersheds and aquatic ecosystems.

4.2.5 Nepal Environmental Policy and Action Plan, 2050 to 2055 BS (1993 and 1998 AD)

This Policy/Action Plan includes the following five policy principles:

- Manage natural and physical resources efficiently and sustainably.
- Balance development efforts and environmental conservation for sustainable fulfilment of the basic needs of the people.
- Safeguard natural heritage.
- Mitigate adverse environmental impacts of development projects and human actions.
- Integrate environment and development through appropriate institutions, adequate legislation and economic incentives, and sufficient public resources.

This Policy/Action Plan is applicable to the ETP because the Project is a development project with the potential to affect the environment adversely.

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4.3 POLICIES

4.3.1 National Environment Policy, 2076 BS (2019 AD)

This Policy has the following objectives:

- Prevent, avoid, control, minimize, and mitigate pollution in these sectors: namely noise, air, water, soil, electromagnetic waves, and chemicals, including radioactive substances.
- Manage solid waste originating from domestic, industrial, and service sectors.
- Mainstream environmental issues in all development activities.
- Conduct research and capacity development in the field of environmental protection and management.

This Policy has proposed to punish, with a fine up to NRs. 5 lakhs, 10 lakhs, and 50 lakhs, for the implementation of any proposal without approval of the 'brief environmental study,' IEE and EIA reports or any act contrary to these approved reports. The concerned agency shall issue directives to comply with the approved reports. This Policy is applicable to the ETP because the Project may cause noise, air, water, soil, and electromagnetic pollution and generate solid waste.

4.3.2 National Climate Change Policy, 2076 BS (2019 AD)

The main goal of this Policy is to improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socioeconomic development path, and supporting and collaborating in the spirit of the country's commitments to national and international agreements related to climate change. The Policy includes the following objectives:

- Focus on increasing capacity on climate change adaptation;
- Promote green economy by adopting low-carbon economic development;
- Develop economic resilience;
- Mobilize national and international financial resources to combat climate change;
- Mainstream climate change into relevant policies, plans, and strategies; and,
- Incorporate gender and social inclusion in climate change mitigation and adaptation programs.

This Policy is applicable to the ETP because the Project requires tree clearance which may greenhouse gas emissions to atmosphere during both Project construction and operation.

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4.3.3 National Land Policy, 2075 BS (2018 AD)

The goal of this policy is to make qualitative transformation in economic prosperity of the nation and living standard of the people through equitable distribution, maximum use and good governance of land. One of the six objectives of the policy, which aims to create favorable environment for land acquisition for development projects and to ensure that land acquisition would not increase cost of development project, is directly relevant for ETP project. This policy also aims to establish a methodology for scientific valuation of land. The policy has devised several strategies and working policies to achieve its objectives which includes: minimization of adverse impacts on local residents as far as possible while selecting land for development projects; provision of basic facilities such as roads, electricity, and drinking water with priority while resettling fully displaced households in a new site; concession on capital gain tax to landowners for lands acquired by the project; and minimization of forest, residential, and agricultural land while acquiring land for the project. There are several other strategies and working policies in this policy which attempts to make land acquisition process for development projects simpler and also ensure that the adverse impact of the project on local people are minimized.

4.3.4 National Forest Policy, 2075 BS (2018 AD)

This Policy aims to strengthen the forest resources of Nepal as follows:

- Manage forest resources sustainably, increase productivity of forest area/sector, and increase overall production from forests.
- Conserve biodiversity, conservation of sources, and equal sharing and distribution of environmental services gained from conservation.
- Encourage the private sector for the development and conservation of the forest sector. The policy also aims to promote forest-based entrepreneurships, diversification, and value addition through marketing, creation, and promotion of green employment.
- Reduce and mitigate the adverse impacts of climate-related hazards and enhance climate change adaptation measures and resilience in Nepal. The policy also promotes good governance, inclusion, and social justice for the conservation of forest resources.
- Enhance the conservation policy, which aims to encourage forest conservation groups to manage the forest in a scientific way to strengthen ecosystems and other environmental services.
- Protect forests, conservation areas, watersheds, biodiversity, and wildlife through sustainable and participatory management and their equitable distribution.
- Provide ownership of the forest area to the federal government, whereas Non-Timber Forest Products (NTFPs) ownership is vested upon the management group or community.

- For national priority projects and national pride projects that have no alternative to forest land use, the federal government will provide forestland use based on the laws, directives, and procedures, as well as compensatory afforestation and restoration of the used forest area.
- Recognize forest area outside of the national forest to include private forest, forest in community areas, forest in institutional land, urban forest, agricultural forest, and family forest, and emphasize assistance and encouragement to increase and promote these forest lands through subsidized interest rates. In addition, assistance will be provided through awareness programs, technology transfer, and capacity building to such forest.

This Policy is applicable to the ETP because the Project will affect the forest resources of Nepal.

4.3.4.1 Land Use Policy, 2072 BS (2015 AD)

This Policy envisions optimum use of the available land based on its capability for sustainable social, economic, and environmental development. The goal of the policy is to:

- Classify land according to its capability for optimum use;
- Manage land fragmentation and urbanization;
- Balance development with the environment; and
- Conserve geographic, cultural, religious, historical, and touristic areas, etc.

This Policy is applicable to the ETP because the Project will affect land use and must take into consideration and mitigate to the extent possible land fragmentation.

4.3.4.2 Land Acquisition, Resettlement, and Rehabilitation Policy for Infrastructure Development Projects, 2071 BS (2015 AD)

This Policy emphasizes that project development agencies will conduct meaningful consultation with project-affected persons, communities, and sensitive groups, particularly:

- Economically vulnerable groups;
- Landless citizens;
- Senior citizens;
- Women and children;
- Indigenous/Janajati groups;
- Differently abled and helpless persons; and
- Persons having no legal rights on the operated land.

This consultation will be done while preparing for land acquisition or for resettlement or rehabilitation planning. It requires completing all the processes, including compensation, resettlement, rehabilitation, and other benefits to the project-affected persons/households prior to physical and economic displacement by the Project.

The land acquisition process, as far as possible, will be undertaken through the process of negotiation with project-affected persons/households in a transparent, free, fair, and justifiable manner.

This Policy is applicable to the ETP because the Project is an infrastructure project that will be subject to the Policy's consultation requirements, especially for the sensitive and disadvantaged groups identified in the Policy, and will involve land acquisition.

4.3.4.3 Rangeland Policy, 2069 BS (2012 AD)

The primary objective of this Policy is to help maintain ecological balance by conserving, promoting, and sustainably utilizing rangeland biodiversity and natural resources. This Policy is applicable to the ETP because the Project will affect some rangeland.

4.3.4.4 National Wetlands Policy, 2069 BS (2012 AD)

The primary goal of the National Wetlands Policy is to conserve and manage wetland resources wisely and in a sustainable way with participation from the local people. The major objectives of the Policy are to:

- Identify wetlands and prepare detailed management plans for each of them;
- Identify local people's knowledge, skill, and practice regarding wetlands; and
- Conserve and manage wetlands.

This Policy is applicable to the ETP because the Project will affect some wetlands.

4.3.4.5 Rural Energy Policy, 2062 BS (2006 AD)

This Policy has been designed to:

- Address energy needs of the rural population and incorporate rural energy policies of the ministries and institutions related to rural development;
- Provide adequate information campaigns and education programs; and
- Promote broad stakeholder involvement to ensure success.

This Policy is applicable to the ETP because the Project will help provide energy to rural populations.

4.3.4.6 Water Induced Disaster Management Policy, 2062 BS (2006 AD)

The Policy includes the following provisions:

- Mitigate water-induced disasters and reduce loss of lives and property.
- Enhance institutional strengthening of Department of Water Induced Disaster Prevention.
- Establish a network with the associated institutions and agencies to cope with potential disasters.

This Policy is applicable to the ETP because the Project may affect water-induced disasters by disturbing steep slopes prone to landslides.

4.4 STRATEGIES

4.4.1 National Conservation Strategy, 2071 BS (2014 AD)

The key strategies included are to:

- Ensure the sustainable use of Nepal's land and renewable resources;
- Preserve the biological diversity of Nepal to maintain and improve the variety and quality of crops and livestock and maintain the variety of wild species, both plant and animal; and
- Maintain the essential ecological and life-support systems, such as soil regeneration, nutrient recycling, and the protection and cleansing of water and air.

In addition, the Strategy has made various provisions for resource conservation and its utilization in an environmental-friendly manner. It has provisions dealing with biological diversity, soil conservation, watershed management, national parks, protected areas, wildlife conservation, and natural heritage. This Strategy is applicable to the ETP because the Project will affect Nepal's land and renewable resources.

4.4.2 Forest Sector Strategy, 2073- 2082 BS (2016 - 025 AD)

This Forest Sector Strategy was developed to achieve the vision of Ministry of Forests and Environment to ensure sustainable forest management, biodiversity conservation, and integrated watershed management for development and prosperity of the country. The strategy has identified eight key strategic pillars to meet its objectives and outcomes, which includes:

- Sustainably managed resources and ecosystem services;
- Conducive policy process and operational environment;
- Responsive and transparent organizations and partnerships;
- Improved governance and effective service delivery;

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- Security of resources used by the community;
- Private sector engagement and economic development;
- Gender equality, social inclusion, and poverty reduction; and
- Climate change mitigation and resilience.

This Strategy is applicable to the ETP because the Project will affect forests and associated biodiversity.

4.4.3 Water Resources Strategy, 2058 BS (2002 AD)

This Strategy outlines social development and environmental sustainability principles related to sustainable management of watersheds and aquatic ecosystems. This Strategy is applicable to the ETP because the Project may affect watersheds and aquatic ecosystems.

4.4.4 Nepal Biodiversity Strategy, 2058 BS (2002 AD)

This Strategy refers to cross-sector coordination for biodiversity conservation for Protected Area conservation, IEE/EIA of development projects to avoid significant impacts on biodiversity, and implement the provisions to minimize the impacts. This Strategy is applicable to the ETP because the Project will affect biodiversity.

4.4.5 Forest Encroachment Control Strategy, 2069 BS (2012 AD)

Forty percent of the land area in Nepal is covered by forest. Nepal's national strategy is to stop this percentage from decreasing. Therefore, the strategy emphasizes that in order to stop the increase of forest encroachment and promote the maximum percentage of forest area, "the forest area" must be the first priority in the National Plan. This Strategy is applicable to the ETP because the Project will involve forest clearing.

4.4.6 Forest Fire and Management Strategy, 2068 BS (2011 AD)

The Forest Fire Management Strategy is aimed at "safeguarding lives and properties, protecting environment and providing livelihood supports to the local communities." The strategy has four pillars for forest fire management in Nepal: 1) Policy (legal and institutional development and improvement); 2) Education (awareness raising, capacity building, and technology development); 3) Participation (involving local community), fire management and research; and 4) Coordination and collaboration (international cooperation, networking, and infrastructure development). This Strategy is applicable to the ETP because the Project has the potential to affect and be affected by forest fires.

4.5 ACTS

4.5.1 Forest Act, 2076 BS (2019 AD)

This Act classifies national forest into government-managed forests, forest conservation areas, community forests, collaborative forests, and religious forests. The Act also aims to promote private, public, and urban forests. Article 42 of the Act empowers the government to permit the use of any part of the national forest for national pride projects, the implementation of a plan or project of national priority, and projects approved by the Investment Board Nepal, if there is no other alternative to forest land and if the environmental assessment conducted as per prevailing Act shows that the use of such forest would not lead to significant adverse impact on the environment. As per Article 42(2), the project needs to make available the equivalent amount of land to the government for forest development. Such lands should be in similar ecological and geographical areas and near the impacted national forest as far as possible. If the project is not able to buy lands, it could deposit the money needed to buy such land in the Forest Development Fund established as per Article 45 of the Act. Article 42 (5) requires the project developers to pay the expenses needed to reforest and maintain reforested area for five years.

4.5.2 Environment Protection Act (EPA), 2076 BS (2019 AD)

This is the main Act guiding environmental assessments and the permitting process of development projects in Nepal. Section 2 of the Act discusses different aspects of conducting an abbreviated environmental assessment, initial environmental examination (IEE), and EIA. Article 3 of the Act mandates an IEE/EIA study for development projects. Article 4 requires a detailed analysis of alternatives and preparation of alternative measures for minimizing adverse impacts of the project on the environment. Article 5 requires approval of terms of reference for an IEE, and a scoping document and terms of reference for an EIA by appropriate regulatory agencies before the preparation of environmental assessment reports. Article 6 requires project developers to follow quality standards specified by the Government of Nepal while preparing environmental assessment reports. Article 7 discusses approval procedures for environmental assessment reports. Article 8 prohibits the implementation of the project without an approved environmental assessment report. Article 10 outlines requirements associated with environmental management plans. Article 11 specifies conditions under which a supplementary EIA is needed.

4.5.3 Environmental Protection Act (EPA) 2053 BS (1997 AD)

The Environment Protection Act (EPA) is the principal regulatory frameworks incorporating aspects of environmental management and conservation in various developmental projects. The law which came into force since June 1997 contains several provisions to internalize environmental assessment system and to maintain a clean and healthy environment by minimizing the adverse impacts on human beings and other life forms and physical objects. The EPA, 1997 makes it mandatory for the proponent not to implement the proposals without approval of IEE or EIA reports as the prescribed for a particular type of project (Section 4). Section 6 empowers the Ministry of Environment,

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Science and Technology (MoEST) to approve the EIA report.

4.5.4 Consumer Protection Act, 2075 BS (2018 AD)

Article 3, 4 and 5 of this act describe about rights of the consumer, regulation of goods and services and quality of goods and serves respectively. Chapter 4 discuss about prohibited activities like unfair trade and business activities. Further this act has provision about determination price of goods or services, provisions to inquiry, inspection and monitoring by monitoring team. In addition, this act has also provision of consumer court.

4.5.5 Right to Employment Act, 2075 BS (2018 AD)

This act provide every citizen shall have the right to employment and also provide every citizen shall have the right to choose employment according to his or her wish. Article 4 (3) has provision of no person shall engage or employ any citizen in employment against his or her will or in employment that he or she does not choose or force or compel him or her to engage in such employment. Article 6 explain about prohibit discrimination due to any identity. Article 7 discuss about no person engaged in employment shall be removed from the employment without reason. Chapter 3 article 10 has provision to open employment service center by government of Nepal. Chapter 5 article 20 describe about unemployment support program by Government of Nepal, provincial government and local level.

4.5.6 National Civil Code and Criminal Code (Muluki Debani Samhita, 2074 BS (2017 AD), Contribution Muluki Aparadh Samhita, 2074 BS (2017 AD))

This Act refers to land acquisition/utilization of land, restriction on illegal encroachment of land, non-obstruction in public places like road, river, or any other public places, and protection of governmental and public property. Chapter 5 elaborates provisions relating to government, public, and community properties. Chapter 14 explains provisions relating to wages, labor, and employment. This Act is applicable to the ETP because the Project will involve land acquisition and will cross public spaces like roads, rivers, and other governmental property (e.g., national forest land), and will also involve hiring employees.

4.5.7 National Criminal (Code) Act, 2074 BS (2017 AD)

Chapter 1, under definition L, clarifies cases on legal right, status, and property. It also relates to compensation, rights and liability, and includes fee, remuneration, salary, allowances, or wages. The Act is applicable to the ETP because the Project will employ Nepalese and non-Nepalese citizens.

4.5.8 Contribution Based Social Security Act, 2074 BS (2017 AD)

This Act is enacted per the social welfare concept in accordance with which the people have the rights to welfare of various kinds as one of their fundamental rights as enshrined in the constitution. The Act will be applicable to industries, businesses, or the service sector as prescribed by the government. Even the self-employed can take part in the Fund. The Social

Security Fund will operate various schemes as per the Act: medical and health protection, maternity protection, accidental protection, old age protection, dependent family protection, and unemployment protection.

4.5.9 Labor Act, 2074 BS (2017 AD)

This Act provides guidance on classification of job postings and prohibition on child labor. It also provides restriction on minors and women, job security, retrenchment and re-employment, working hours, occupational health and safety, welfare arrangements, special arrangements for construction sites, conduct and penalties, settlements of labor disputes, etc. This Act is applicable to the ETP because the Project will involve advertising and hiring employees and occupational health and safety issues.

4.5.10 Local Government Operation Act, 2074 BS (2017 AD)

This Act provides guidance on jurisdiction, roles, and responsibilities of personnel appointed in local bodies in Nepal. This Act is applicable to the ETP because the Project will involve interactions with local government personnel.

4.5.11 Guthi Corporation Act, 2033 BS (1976 AD) as amended 2066 BS (2010 AD))

This Act empowers the corporation to manage and operate the Guthi lands and properties, and stipulates the roles and responsibilities of the corporation. This Act is applicable to the ETP because the Project may affect Guthi lands and properties.

4.5.12 Act Related to Control on International Trade in Endangered Species of Wild Fauna and Flora, 2073 BS (2017 AD)

This is an Act to regulate and control international trade of endangered wild fauna and flora, and enforces adopting Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, to which the Government of Nepal (GoN) is a signatory state. The main objective of this Act is to implement CITES through protection of endangered species and controlling and regulating the wildlife trade. This Act provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level. This Act is applicable to the ETP because the Project will employ workers who, if not properly managed, could engage in activities prohibited by CITES.

4.5.13 Solid Waste Management Act, 2068 BS (2011 AD)

This Act aims to manage solid waste, mobilize resources, and ensure the health of common people by controlling the adverse impact on pollution from solid waste. This Act is applicable to the ETP because the Project will generate solid waste during both the construction and operation phases.

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4.5.14 Right to Information Act, 2064 BS (2007 AD)

The aim of this Act is to make the functions of the state open and transparent in accordance with the democratic system and to make it responsible and accountable to the citizens. It intends to protect the rights of the citizens to be well informed by providing citizens with simple and easy access to information of public importance that is held in public bodies while protecting sensitive information that could have an adverse impact on the interest of the nation and citizens. This Act is applicable to the ETP because the Project will involve construction of a large capital facility for which affected stakeholders have the right to information.

4.5.15 Plant Protection Act, 2064 BS (2007AD)

This Act aims to prevent or control harmful epidemic insect or disease spread in plant or plant products while importing or exporting. By notification in the Nepal Gazette, the GoN may impose restrictions or conditions for the import of plant or plant products. This Act is applicable to the ETP because the Project will employ foreign workers who will need to comply with these requirements.

4.5.16 National Foundation for Upliftment of Aadibasi/Janajati Act, 2059 BS (2002 AD)

This Act prescribes a number of provisions for overall improvement of the Adivasi Janajati by formulating and implementing programs related to social, educational, economic, and cultural development. This Act is applicable to the ETP because the Project will affect Adivasi Janajati people and will involve a community improvement program, which should be consistent with the goals of this Act.

4.5.17 Child Labor (Prohibition and Regulation) Act, 2056 BS (2000 AD)

This Act prohibits engaging children in factories, mines, or similar risky activities, and makes necessary provisions regarding their health, security, services, and facilities while engaging them in other activities. Article 3 sets the minimum age to work at 14 years of age, and Article 4 prohibits child labor by way of persuasion, misinterpretation, or coercion. This Act is applicable to the ETP because the Project will be hiring local workers and needs to put in place measures to prevent use of child labor.

4.5.18 Building Act, 2055 BS (199 AD) and amendment 2066 BS (2010 AD)

Building Act, 2055 BS has the necessary provisions for the regulation of building construction to protect buildings against earthquake, fire, and other natural calamities, to the extent possible. It has provisions relating to the design and approval of the design/map of building, which states, "Any person body or government body shall, in making a building, build it in consonance with the standards set forth in the building code." This Act is applicable to the ETP because the Project will involve the construction of several buildings at the substations and tower laydown areas.

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4.5.19 Water Resources Act, 2049 BS (1992 AD)

This Act ensures the rational utilization, conservation, management, and development of water resources in Nepal. The main objectives of the Act are to define legally the process for determining beneficial uses of water resources, to prevent environmental and other hazardous effects thereof, and to keep water resources free from pollution. The Act strives to minimize the environmental damage to water bodies, especially lakes and rivers. The Act specifies that soil erosion, flooding, landslides, or any significant impact on the environment should be avoided in all uses of water resources. This Act is applicable to the ETP because the Project will involve activities or use materials that have the potential to affect water quality (e.g., disturbance of slopes, use of hazardous materials).

4.5.20 Electricity Act, 2049 BS (1992 AD)

This Act has been enacted to manage the survey, generation, transmission, and distribution of electricity in such a manner that no substantial adverse effect be made on the environment, such as soil erosion, flood, landslide, or air pollution, and to standardize and safeguard electricity services. This Act is applicable to the ETP because the Project will involve the transmission of electricity.

4.5.21 Electricity Regulatory Commission Act, 2074 BS (2017 AD)

The Act's Section 3(1) regulates the generation, transmission, distribution, and trade of electricity. Section 17(1) ensures compliance of licenses with the Act, sub-legislation (rules, order, etc.) or other prevailing laws. Section 37 has the power to issue directions to licensees under the Act. Duty of all to comply with such directions. Section 19(1) has the power to fine licensees not complying with orders or directions.

4.5.22 Soil and Watershed Conservation Act, 2039 BS (1982 AD) and amendment 2066 BS (2010 AD

This Act will guide watershed conservation during project implementation; it stipulates provisions to prohibit actions within any protected watershed area. This Act is applicable to the ETP because the Project could affect protected watershed areas, although the alignment avoids all known protected watersheds.

4.5.23 Land Acquisition Act, 2034 BS (1977 AD)

The Act covers all aspects of land acquisition and compensation to private landowners for land and other assets. Article 3 of the Act empowers Government of Nepal (GoN) to acquire any land at any place for any public purpose, subject to compensation under this Act. As per Article 4, the GoN may also decide to acquire land for other institutions to implement projects in the interest of general public. The institution requesting for land acquisition is required to pay all costs associated with such acquisition. Article 5 had made provision for appointing Officer for Preliminary Action. Article 6 outlines procedures for preliminary action relating to acquisition of land, and Article 7 has made provision for compensation of losses incurred

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during preliminary action. Article 9 of the Act relates to notification of land acquisition. Article 13 makes a provision for compensation rate. The compensation would be paid in cash as per this Act; there is no provision for land-for-land compensation. Article 18 of this Act requires Chief District Officer (CDO) to prepare a list of persons to compensation and issue a notice accordingly for the information of the concerned persons. This Article has also made provision for lodging complaints by unsatisfied persons and grievance redress mechanism. As per Article 27 of the Act, land could also be acquired through negotiation.

4.5.24 Public Roads Act, 2031 BS (1974 AD)

The major provisions of the *Public Roads Act,* 1974 includes:

- Prescribing rules for planned road construction; regulating road width and boundaries within which no house can be built; and
- Maintaining the road environment through plantation along public roads.

The GoN agencies and the public need prior approval from Department of Roads to carry out work on roads and road boundaries. This Act is applicable to the ETP because the Project will involve carrying out work on roads (e.g., potential for temporary road closures when stringing crosses on a public road).

4.5.25 National Parks and Wildlife Conservation Act, 2029 BS (1973 AD) and amendment 2049 BS (1992 AD)

This Act includes provisions to restrict damage to forest products and to block or divert any river or stream flowing through a national park or reserve or any other source of water. It also states that, without permission, no one shall cut, fell, remove, or overshadow any tree, plant, or any forest produce or do anything by which the forest produce may die, burn, or get damaged. This Act is applicable to the ETP because the Project will involve some clearing of forest and trees.

4.5.26 Lands Act, 2021 BS (1964 AD)

This Act provides guidance on land and/or asset acquisition, land ceiling, rights of tenant, exemption from upper ceiling, land use, control of land fragmentation, and plotting. This Act is applicable to the ETP because the Project will involve land acquisition and may affect tenants.

4.5.27 Land Use Act, 2076 BS (2019 AD)

This Act is classified land into 10 categories: agricultural; residential; commercial; industrial; mining and mineral; forest; river, stream, pond and wetland; public use; cultural and archaeological; and others. The land classification is based on the composition and use of the land. The classification has not clearly pinpointed Guthi land, which is religious land in the name of temples or shrines, from the revenue of which the religious ceremonies or festivals associated with the temples or shrines are celebrated and the repairs and maintenance of the temples or shrines are carried out. The Act is introduced based on the condition of land, population growth, requirements of land for various purposes, such as food and habitation and the need for economic development and infrastructure building among others. The main aim of the act is to ensure that land is properly used and managed and that land set aside for one purpose is not used for another. The provincial and local governments are also required to formulate their own land use laws based on the act. This Act is applicable to the ETP because the Project will involve use of land other than the existing use.

4.5.28 Explosive Act, 2018 BS (1961 AD)

This Act emphasizes the need of permission for the use, sale, transportation, and import of explosive items. This Act is applicable to the ETP because the Project may require the use, transportation, and import of explosives for leveling some sites for tower foundations.

4.5.29 Aquatic Animals Protection Act, 2017 BS (1960 AD)

This Act empowers the government to prohibit catching, killing, and harming of aquatic animals.

According to this Act, aquatic animal means any animal living in water. Section 3 has a provision for restriction on methods of catching and killing aquatic animals by using electric current, explosive substance, or poisonous substance with the intent of catching and killing any aquatic animals in any water. The Section 4 provision empowers the GoN to prohibit the catching, killing, and wounding of certain kinds of aquatic animals.

4.5.30 Ancient Monument Preservation Act, 2013 BS (1956 AD)

This Act refers to the ancient monuments and empowers the government to declare any place or area as a monument site/area. It also restricts the transfer, transaction, export, or collection of ancient monuments and archaeological objects or curios without prior approval of the government. Although MCA-Nepal has avoided all known ancient monuments, archaeological sites, and other cultural heritage sites, this Act is applicable to the ETP because the Project may uncover previously unknown archaeological sites, objects, or curios during construction.

4.5.31 Intergovernmental Fiscal Arrangement Act, 2074 BS (2017AD))

This Act provisions the revenue sharing modality and natural resources revenue sharing modality among the different tiers of the government. As the project outcome is relevant to such case, it is applicable to ETP.

4.6 RULES/ REGULATIONS

4.6.1 Environment Protection Rules (EPR), 2077 BS (2020 AD)

EPR (2020) has replaced EPR (1997). These Rules provide a framework and processes for the conduct of environmental studies for development projects including brief environmental

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study, IEE, and EIA. These Rules specify levels of environmental studies needed for projects and outline steps/procedures for the conduct of study, report preparation and approval of study reports. Transmission line projects are required to do IEE only as per EPR (2020).

4.6.2 Labor Rules, 2075 BS (2018 AD)

These Rules stipulate the circumstances in which non-Nepalese citizens may be engaged in work and set guidance on time for deploying minors and women at work; no discrimination in remuneration; and on compensation against injury or grievous hurt resulting in physical disability and in case of death. These Rules are applicable to the ETP because the Project will employ Nepalese and non-Nepalese citizens.

4.6.3 Child Labor (Prohibition & Regulation) Rules, 2062 BS (2006 AD)

In an exercise of the powers conferred by Section 27 of the Child Labor (Prohibition and Regulation) Act, 2056 (1999 A.D), the GoN has framed several rules that apply to ETP because child as a labor requires certificate of eligibility.

4.6.4 Solid Waste Management Rules, 2070 BS (2013 AD)

These Rules specify the procedures for the management of solid wastes. These Rules are applicable to the ETP because the Project will generate and require proper management of solid wastes during both the construction and operation phases.

4.6.5 Environment Protection Rules (EPR), 2054 BS (1997 AD) and amendments

The EPR establishes the process to be followed during the preparation and approval of Scoping determination, terms of reference for EIAs, and the preparation of IEE or EIA reports for proposed projects. It also includes provisions for:

- Compliance with findings included in the IEE and EIA reports;
- Monitoring and environmental auditing;
- Prevention and control of pollution;
- Description of the functions, duties, and powers of Environmental Inspectors;
- Conservation of national endowments;
- Establishment of environmental laboratories;
- Mechanisms for operating the environmental conservation fund;
- Rights to environmental compensation; and
- Other related matters.

As indicated in Chapter 1, these Rules are applicable to the ETP because the Project triggers the requirement for preparation of an EIA and could potentially trigger the need for environmental compensation.

4.6.6 Forest Rules, 2051 BS (1995 AD)

These Rules provide guidance and mitigation measures in the implementation of development projects in any forested area. These Rules are applicable to the ETP because the Project will involve development and clearing within forested areas. Article 65(1) requires project proponents to compensate local community/individuals for any damage/loss caused by the implementation of the project within forest area. Article 65(2) requires project developers to bear expenses incurred in felling, logging, and transportation of trees during project implementation. Annex 7 of the Regulation outlines procedures for the measurement of tree volume and valuation of trees. This rule also provides details of formation and management of community and leasehold forests while building transmission lines in such forests.

4.6.7 Water Resources Rules 2050 BS (1993 AD)

These Rules provide guidance and mitigation measures for aquatic life and the water environment. These regulations are applicable to the ETP because the Project could potentially affect aquatic life and the water environment.

4.6.8 Contribution Based Social Security Regulation, 2075 BS (2018 AD)

The GoN framed the Regulations under Section 69 of the Contribution based on the Social Security Act, 2017. Several protections (e.g., accidental and illness) can apply to the ETP, as the project will employ labor.

4.6.9 Electricity Rule, 2050 BS (1993 AD)

Article 13(g) of this Rule emphasizes that the environmental study report should include the measures to be taken to minimize the adverse effects of the project on the physical, biological, and social environments. It should also elaborate on the utilization of local labor, source of materials, benefits to the local people after the completion of the project, training to local people in relation to construction, maintenance and operation, facilities required for the construction site, and safety arrangements. Article 66(2) of this Rule prohibits construction of houses or growing tall trees within transmission line Right-of Way (RoW). Article 87(1) requires project proponents to compensate landowners for the restriction imposed on the RoW land. Article 88 makes provision for the Compensation Fixation Committee for transmission line RoW land.

4.6.10 Electricity Regulatory Commission Rules, 2075 BS (2018 AD)

Section 41 of the *Electricity Regulatory Commission Act,* 2017 led to the development of the Rules. The rules contain issues relevant to development of standards. The Commission may develop the standards regarding the performance to be abided by the licensee, quality and safety level of the National Grid System and the determination of responsibilities of electricity system operators. While developing the standards pursuant to Sub-Rule (1), the Commission may consult the stakeholders and experts in the concerned area. The have the bearing on the ETP of the project.

4.6.11 Ancient Monuments Preservation Rules, 2046 BS (1989 AD) with amendments

These Rules aim to protect and limit acquisition of ancient monuments and archaeological, historical, or artistic objects and requires approval from the GoN, Department of Archaeology for any construction work. Although MCA-Nepal has avoided all known ancient monuments, archaeological sites, and other cultural heritage sites, these Rules are applicable to the ETP because the Project may uncover previously unknown archaeological, historical, or artistic sites, objects, or curios during construction, which would trigger obtaining approval from the GoN, Department of Archaeology.

4.7 MANUALS AND GUIDELINES

The following manuals and guidelines are applicable to the Project.

4.7.1 Working Procedure and Standards to be followed for the Development Construction in Chure Conservation Area, 2077

The main objective of this Working Procedure and Standards is to encourage environmental friendly development activities for orderly and sustainable development. It has made provision for the approval of removal, collection, and mining of river related products (stones, aggregates, sands, and soils) from chure area. It also outlines procedures for determining scope of environmental studies reports. It has also made provisions for monitoring and evaluation. It includes Standards to be followed for: the construction and maintenance of physical infrastructures; establishment and operation of industries; and removal/collection of river-related products.

4.7.2 Hydropower Environmental Impact Assessment Manual (Ministry of Forests and Environment), 2075 BS (2018 AD)

This manual includes generic information on the procedures for EIA Scoping, Terms of Reference (ToR) preparation, baseline environmental studies, information disclosure, public consultation, prediction and evaluation of impacts, mitigation prescriptions, monitoring, and EIA report preparation in line with the EPA and the EPR.

This Manual is applicable to the ETP because the Project triggers the need for an EIA. The requirements of this Manual have been incorporated into the structure and content of this EIA.

4.7.3 Working Procedure with Standards for the Use of Forest Lands for National-Priority Infrastructures in Nepal 2076 BS (2019 AD)

Article 3 of this working procedure suggest projects to avoid forest land during project selection to the extent possible. Where this is not feasible, projects are expected to minimize the use of forest area. Article 4 suggests conducting appropriate environmental studies prior to application for permission of use of forest land. It also sets out procedures for forest clearance process and permitting for use of forest land. Article 8(3) of this work procedure has provisions to allocate budget for forest land compensation in the total project cost estimate. Article 9 of this Work Procedure allows projects to pay the government in cash in case of its inability to provide compensation in the form of land for used forest land.

4.7.4 President Chure-Terai Madhesh Conservation and Management Master Plan, 2074 BS (2017 AD)

The goal of the plan is to support poverty reduction; the national goal of Prosperous Nepal through conservation and sustainable management of the resources in the Chure region; and the improvement of the ecosystem services.

4.7.5 Community Forest Timber Collection and Sale Guideline, 2073 BS (2016 AD)

- Section 2 provides guidelines for the inventory of the community forests and the demand of the timbers.
- Section 3 provides guidelines for stamping, felling, and transportation of community forests trees.
- Section 4 provides procedures for timber sales for local consumption based on priorities.
- Section 5 provides guidelines for selling the community forest timber outside the Community Forest User Groups.

This Guideline is applicable to the ETP because the Project will affect community forests.

4.7.6 Work Order on National Forest Land Providing to National Pride Project 2074 BS (2017 AD)

This Work Order streamlines the environmental impact assessment process for National Pride projects by pooling public, private, and forest land and procuring construction materials, such as sand and boulders. This Work Order also suggests ways to ease the human resources hiring and procurement process and to ensure that national pride projects get adequate budget for implementation. This Work Oder is applicable to the ETP because the Project is a National Pride project.

4.7.7 Cabinet Decision dated 2074/2/3 (replacing the Guidelines on Land Use of Forest Areas for Other Purposes)

The Cabinet Decision reiterates the use of the forest area only if other options are not available. The projects requiring the forest land area have to make alternative studies to minimize the forest land use area. Development projects of national priority will be allocated with such lands on the decision of the Ministry of Forest and Environment. To compensate the forest area and resource lost the project proponent has to comply with provisions

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stipulated in guidelines. This Cabinet Decision is applicable to the ETP because the Project will affect forest areas.

4.7.8 Forest Products Collection and Sales Distribution Guidelines, 2073 BS, (2016 AD)

These Guidelines specify various procedures and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume, etc. These Guidelines are applicable to the ETP because the Project will involve forest products collection.

4.7.9 National Energy Crisis Reduction and Electricity Development Decade Concept Paper 2072 BS (2016 AD)

The Ministry of Energy has declared the decade 2016-2026 as the National Energy Crisis Reduction and Electricity Development Decade, and issued a Concept Paper on Elimination of Energy Emergency and Electricity Development Decade, 2015 (2072) on February 18, 2016, with the objective to substantially end the power outage within the next one year, completely end power outage (even in the dry season) within the next two years, and to ensure energy security within the next decade. The overall objectives of this Concept Paper are as follows:

- Ensure energy security by reducing power outages within a prescribed timeframe;
- Recognize earthquake, flood, and landslides as a force majeure event and have a provision for the extension of commercial operation date in cases where force majeure is triggered by up to 1 year; and
- Provision appropriate concessions to projects that had to halt their operation due to damaged caused by the earthquake, flood, or landslides.

This Concept Paper is applicable to the ETP because the Project will help improve energy security and its construction and operation are subject to force majeure events.

4.7.10 Criteria for Developmental Activities in Chure Regions, 2072 BS (2015 AD)

The development criteria include the Chure area forest and forest resources for maintaining environmental balance and scientific integrated forest management. These criteria apply for the distribution of forest area in Chure based on slope degree, inventory of forest resources (forest and NTFP), management of community forest having small areas, and components to consider for proper forest management. These criteria are applicable to the ETP because the Project will traverse the Chure Region.

4.7.11 Community Forest Development Program Guideline, 2072 BS (2015 AD)

This Guideline will help to strengthen community forest user groups to manage the community forest in a more scientific way so that the local community will benefit directly or indirectly for their livelihood. This will help conserve and protect the natural resources and

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biodiversity. This Guideline is applicable to the ETP because the Project will affect several community forests.

4.7.12 Non-Timber Forest Products Resources Inventory Guidelines, 2070 BS (2013 AD)

These Guidelines focus on conducting the forest inventory and procedures for any development projects like hydropower or transmission lines. It focuses on making the plots and methods for sampling of the plots. These Guidelines are applicable to the ETP because the Project is a development project and was required to conduct a forest inventory.

4.7.13 Nepal Electricity Authority, Operational Manual of Environmental and Social Impact Assessment (ESIA) for Sub-projects Financed under the Additional Financing of the Power Development Project, Revised, 2066 BS (April 2009 AD)

This Operational Manual highlights the impact of development projects related to climate and the environment. It provides guidelines for the implications of an EIA and social impact assessment. The manual includes all the relevant laws, polices, and guidelines to design projects related to electricity. This Operational Manual is applicable to the ETP because the Project will become part of the Nepal Electricity Authority–managed electricity transmission system of Nepal.

4.7.14 Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystems, 2064 BS (2008 AD)

These Guidelines set water quality standards for the protection of aquatic ecosystems. These Guidelines are applicable to the ETP because the Project has the potential to affect aquatic ecosystems.

4.7.15 Nepal Water Quality Guidelines for Irrigation Water, 2064 BS (2008 AD)

These Guidelines set water quality standards for irrigating fields. These Guidelines are applicable to the ETP because the Project may affect the quality of water used for irrigation.

4.7.16 Nepal Water Quality Guidelines for Aquaculture, 2064 BS (2008 AD)

These Guidelines set water quality standards for aquaculture. These Guidelines are applicable to the ETP because the Project may affect the quality of water used for aquaculture.

4.7.17 Nepal Water Quality Guidelines for Recreation, 2064 BS (2008 AD)

These Guidelines set water quality standards that can be used for recreational purpose. These Guidelines are applicable to the ETP because the Project may affect the quality of water used for recreation.

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4.7.18 Community Forest Inventory Guidelines, 2062 BS (2005 AD)

These Guidelines detail the process and procedures for evaluating the forest stock and its harvesting potential in community forests. These Guidelines are applicable to the ETP because the Project was required to conduct a forest inventory and they were employed in the field surveys and data analysis conducted during the EIA study.

4.7.19 National Health Care and Waste Management Guidelines, 2059 BS (2002 AD)

These Guidelines provide a minimum standard for safe and efficient waste management to protect public health and safety, provide a safer working environment, and minimize waste generation and environmental impacts of waste treatment. These Guidelines are applicable to the ETP because the Project will generate waste.

4.7.20 Department of Electricity Development (DoED) Manuals 2058 BS (2001 AD)

Seven manuals have been prepared by the DoED to cover different components of the EIA, environmental management, and monitoring, such as the Scoping Document, Public Involvement in the EIA process, ToR, the Environmental Management Plan, Water Quality Monitoring Plans and Results, Conducting Public Hearings, and Addressing Gender Issues. These manuals are applicable to the ETP because the Project involves a transmission line, which is subject to DoED regulation.

4.7.21 Community Forest Guidelines, 2058 BS (2001 AD)

These Guidelines establish processes and procedures to identify and build capacity within the community forest user groups, prepare community forest management plans, and implement community forest management plans. These Guidelines are applicable to the ETP because the Project will affect community forests.

4.7.22 Environmental Management Guidelines (Road), 2056 BS (1999 AD)

These Guidelines (prepared by the Department of Roads) ensures that environmental considerations are integrated into the project survey and design, tender documents, contract documents, project supervision, and monitoring. All new and road upgrade developments are mandated to comply with the guideline provisions to ensure that the road developments are environmentally sustainable. Although MCA-Nepal has indicated that it will prohibit the construction contractor from building any new roads, these Guidelines are potentially applicable to the ETP as the construction contractor may need to upgrade some existing roads.

4.7.23 Forestry Sector EIA Guidelines, 2052 BS (1995 AD)

These Guidelines specify the EIA procedures to be followed while undertaking environmental studies that involve forest areas. These Guidelines aim to facilitate the sustainable use of forest resources for socioeconomic development and to meet the basic needs of the communities for forest products. The positive and negative impacts of any development project in the forest area are to be identified and plans must be developed to minimize environmental damage with the goal of conserving genetic resources and biodiversity. Although not a forestry sector project, these Guidelines are applicable to the ETP because the Project will affect forest areas and required forest studies.

4.7.24 EIA Guidelines for Water Resource Sector, 2050 BS (1994 AD)

These Guidelines set the following procedures:

- Identification of positive and negative impacts of water resource over both short-term and long-term periods on natural and human environments;
- Development of mitigation management and monitoring plans; and
- Public hearings and interaction with affected groups, Non-Governmental Organizations, donors, and relevant government agencies.

Although not a water resources sector project, these Guidelines are generally applicable to the ETP because the Project may affect water resources.

4.7.25 National EIA Guidelines, 2050 BS (1993 AD)

These generic Guidelines include procedures for EIA Scoping, ToR preparation, baseline environmental studies, information disclosure, public consultation, prediction and evaluation of impacts, mitigation prescriptions, monitoring, and EIA report preparation. These Guidelines are applicable to the ETP because the Project triggers the requirement for the preparation of an EIA.

4.8 STANDARDS

4.8.1 Nepal Vehicle Mass Emission Standard, 2069 BS (2012 AD)

This standard addresses compliance with Type I to Type V tests for vehicles fueled with gasoline and diesel while importing vehicles for a project. This Standard is applicable to the ETP because the Project may import some construction vehicles.

4.8.2 National Ambient Air Quality Standards for Nepal 2069 BS (2012 AD)

These standards establish limits of ambient air quality parameters around construction sites. These standards are applicable to the ETP because the Project will generate some construction and operation emissions.

4.8.3 National Ambient Sound Quality Standard, 2069 BS (2012 AD)

This standard establishes noise levels for different land use categories and noise-generating equipment. This standard is applicable to the ETP because the Project will use noise-generating equipment during both construction and operation phases.

4.8.4 Exhaust Emission Standards for Diesel Generating Sets 2069 BS (2012 AD)

These standards establish emission standards for exhaust emissions of diesel plants and generating sets. These standards are applicable to the ETP because the Project will use diesel generating sets during construction and as emergency power during operations.

4.8.5 National Indoor Air Quality Standards, 2066 BS (2009 AD)

These standards establish time-weighted (1~24 hour) standards for particulate matter (PM_{10}, $PM_{2.5}$), carbon monoxide (CO), and carbon dioxide (CO_2) for indoor environments. These standards are applicable to the ETP because the Project will involve construction of some buildings at the three new substations.

4.8.6 National Drinking Water Quality Standards, 2063 BS (2006 AD)

These standards establish standards for the quality of drinking water in the project camps and construction sites. These standards are applicable to the ETP because the Project will be providing drinking water at project camps and construction work camps.

4.8.7 Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters, 2058 BS (2001 AD)

This standard establishes tolerance limits of effluent discharged into inland surface waters. This standard is applicable to the ETP because the Project may discharge effluents into inland surface waters if a package wastewater treatment plant is provided at any of the three new substation sites.

4.9 INTERNATIONAL CONVENTIONS AND AGREEMENTS

The following international agreements are applicable to the Project.

4.9.1 United Nations Declaration on the Rights of Indigenous Peoples, 2063 BS (2007 AD)

This Declaration sets forth the individual and collective rights of Indigenous Peoples, as well as their rights to culture, identity, language, employment, health, education, and other issues. It also emphasizes the rights of Indigenous Peoples to maintain and strengthen their own institutions, cultures, and traditions, and to pursue their development in keeping with their own needs and aspirations. It prohibits discrimination against Indigenous Peoples; it promotes their full and effective participation in all matters that concern them, and their right to remain distinct and pursue their own visions of economic and social development. This Declaration is applicable to the ETP because the Project will affect Indigenous Peoples.

4.9.2 United Nations Framework Convention on Climate Change, 2049 BS (1992 AD)

This Convention sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. This Convention is applicable to the ETP because the Project will affect greenhouse gas emissions.

4.9.3 Convention on Biodiversity, 2049 BS (1992 AD)

This Convention contains a series of far-reaching obligations related to the conservation of biological diversity and sustainable uses of its components. One of these obligations is the requirement for environmental study. The purpose of an environmental study in relation to biodiversity conservation is to identify in advance the aspects of the project that are likely to have significant adverse effects on biological diversity at the genetic species and ecosystem level, and the steps to be taken to avoid or minimize significant adverse effects, ensuring that the proposed project complies with existing environmental legislation. This Convention is applicable to the ETP because the Project will affect biodiversity.

4.9.4 Convention on Indigenous and Tribal Peoples (No.169) 2048 BS (1991 AD)

This Convention sets the rights of the indigenous and tribal people to decide their own priorities for the process of development; however, for the national development plans and programs, it mandates consultation with them in the formulation of the plans and programs. It also mandates participation in the decision-making process and resettlement process with full compensation of the resulting loss or injury. This Convention is applicable to the ETP because the Project will affect indigenous peoples.

4.9.5 Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 2029 BS (1973 AD)

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. As part of the EIA, consideration is made of CITES species listed in Appendices I, II, and III. Species listed within these appendices and identified within the Project area have been evaluated to identify management measures, if required. This Convention is applicable to the ETP because the Project will employ workers who, if not properly managed, could engage in activities prohibited by CITES.

4.10 MCC ENVIRONMENTAL AND SOCIAL POLICIES

The United States Millennium Challenge Corporation (MCC) is providing funding to support the ETP. MCC takes an interdisciplinary and collaborative approach to working with its partner countries to integrate internationally accepted principles of environmental and social sustainability into the design and implementation of its programs. In collaboration with MCC, country partners work to achieve sustainable economic development, to minimize environmental and social risks, and to enhance environmental and social sustainability through compact-funded activities.

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The agency's founding legislation prohibits MCC from providing assistance that is "likely to cause a significant environmental, health, or safety hazard." MCC has formally adopted the International Finance Corporation's (IFC) Performance Standards on Environmental and Social Sustainability, and adopted other environmental and social policies applicable to the ETP as briefly described below and presented in Annex K.

4.10.1 MCC Environmental Guidelines (2010 AD)

These guidelines set forth the process for reviewing environmental and social impacts to ensure that the projects undertaken as part of programs funded under Millennium Challenge Compacts with eligible countries are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and, as required by the legislation establishing MCC, are not likely to cause a significant environmental, health, or safety hazard. MCC is committed to program design that reflects the results of public participation during all phases of the program, integrating governmental interests with those of private business and civil society.

4.10.2 International Finance Corporation's Performance Standards on Environmental and Social Sustainability (2012 AD)

The proposed transmission line passes through various rural and urban areas influencing multiple receptors from the natural (air, water, energy, land, forests) and human (community, landowners, asset owners, workers) habitat in more than one-way. An assessment of the project area against IFC Performance Standards will provide safeguards against environmental and social risks; help MCA-Nepal optimize the management of inputs (water, land etc.); result in wider community acceptance of the project; as well as deliver to international standards on the project and its activities. The key themes under the Performance Standards (PSs) include:

- PS 1 – emphasizes the importance of identifying and managing E&S risks and impacts throughout the project lifecycle.
- PS 2 – recognizes economic growth and balances it with the protection of basic worker rights.
- PS 3 – recognizes that project activities may lead to pollution of air, water, and land and identifies opportunities to use them efficiently.
- PS 4 – understands both opportunities brought in for the community and risks posed at them by the project.
- PS 5 – applies to physical and economic displacement resulting from land transactions.
- PS 6 – promotes protection of biodiversity and natural resources.
- PS 7 – ensures that the project processes foster respect of IPs.
- PS 8 – protects cultural heritage and support its preservation.

4.10.3 MCC Gender Policy (2011 AD)

This policy applies to any assistance program funded under a Millennium Challenge Compact and is intended to provide overall guidance to country partners on their responsibilities for the integration of gender in all stages of Compact development and implementation. Consultation is regarded as an essential tool for ensuring meaningful participation of men and women in program development, design, implementation, monitoring, and evaluation. As a result, gender assessment has been undertaken as part of the EIA for the ETP.

4.10.4 MCC Gender Integration Guidelines (2011 AD)

The guidelines provide specific operational procedures and milestones for gender integration in all stages of Compact development and implementation in accordance with MCC's Gender Policy. The MCC Social and Gender Assessment (SGA) staff is expected to ensure there are preliminary gender assessments carried out for all development projects, gender assessments are included in various Terms of References for ESIAs, ESDDs, Feasibility Reports, and their implementation is monitored and evaluated by MCA-Nepal's accountable entities. Accordingly, gender assessment and related aspects were integrated into the ESIA for the Project.

4.10.5 MCC Counter-Trafficking in Persons Policy

This policy provides operational guidance to MCA-Nepal's accountable entities and MCC itself for assessing and managing trafficking in persons (TIP) risks on MCC-funded projects. To assess any existing or potential issues related to human trafficking both due to/ induced by the project activities as well as prevalent in the area independent of the project. The policy also stipulates the inclusion of safeguards to counter existing TIP risks and to prevent potential issues of human trafficking in the project area. MCC has a zero tolerance policy with regard to Trafficking in Persons ("TIP"). These are being included in the EIA for the Project.

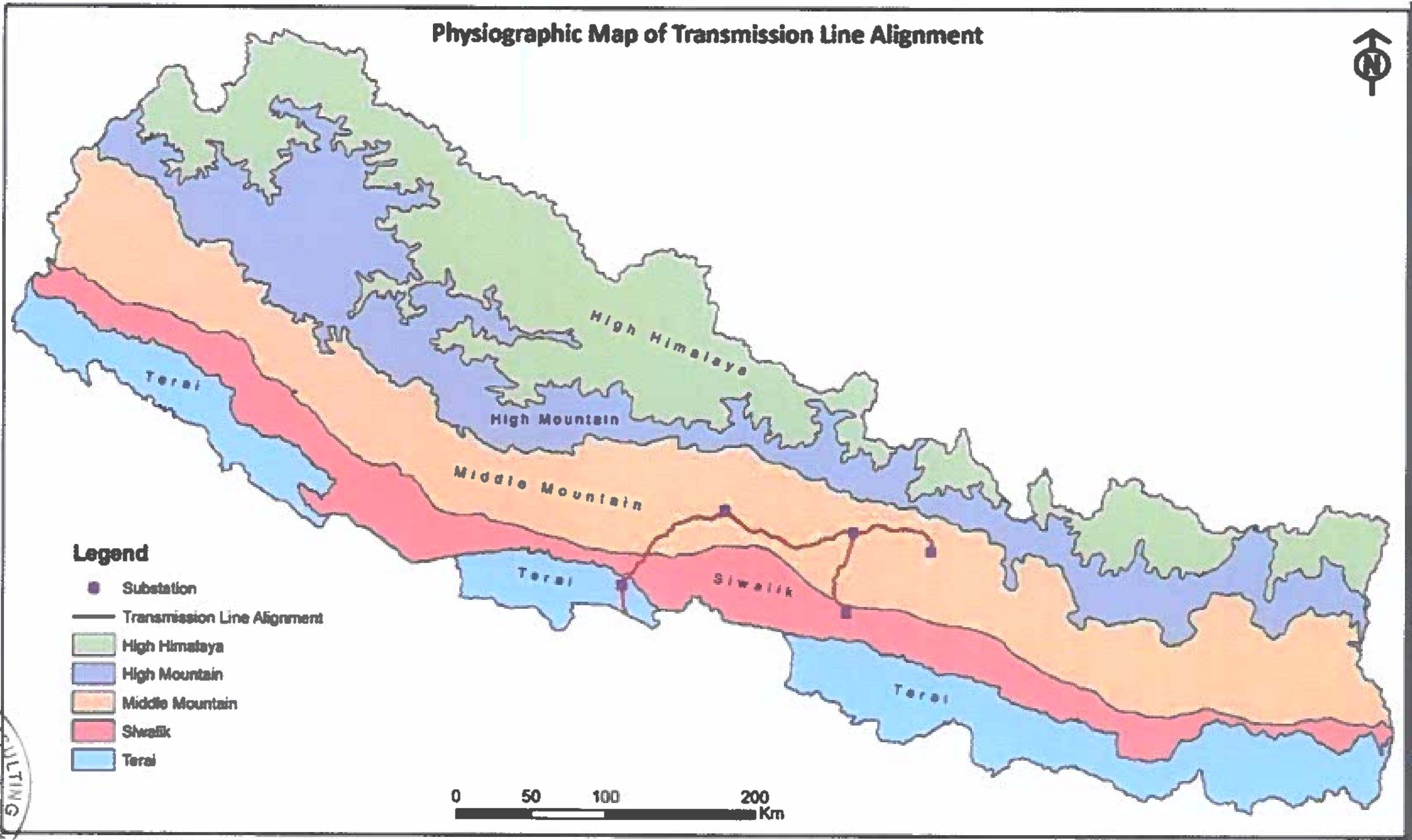
CHAPTER FIVE
EXISTING ENVIRONMENTAL CONDITION

5.1 PHYSICAL ENVIRONMENT

This section describes the existing physical environment through which the ETP will pass, including: Topography, Geology, and Soils; Land Use and Cover; Climate; Air Quality; Water Resources; Noise; and Landscape Values and Visual Amenity.

5.1.1 Physiography

Nepal can be divided into five major physiographic zones: Terai, Siwalik (also referred to as the Chure), Middle Mountain, High Mountain, and High Himalaya (Topographic Survey Branch, 1983). The ETP transmission line (TL) right-of-way (RoW) traverses the Terai, Siwalik, and Middle Mountain physiographic zones while the other two physiographic zones (High Mountain and High Himalaya) are located further north and in higher elevations (Figure 5.1-1).



Source: Topographic Survey Branch Nepal 1983.

Figure 5.1-1: Physiographic Location of the TL Alignment

The Terai physiographic zone comprises flat land (less than 5 degrees slope) extending south of the Siwalik physiographic zone. It is characterized by dynamic alluvial landscapes, including alluvial fans, alluvial plains, and low-lying alluvial floodplains.

The Siwalik physiographic zone, also referred to as the Chure Range, is a young mountain range lying between the Terai plains to the south and the Middle Mountain physiographic zone to the north. The Siwalik zone comprises northwest-southeast trending hills with or without flat lying intermittent alluvial Dun valleys. The Dun valleys, which are large open valleys within the Siwalik hill complex, are dynamic alluvial landscapes with generally gentle slopes, less than ten degrees. In general, the Siwalik Hills are structurally controlled, meaning that geologic structures exert a dominant influence on the form of the landscape. The north-facing dip slopes are gentler (less than 25 degrees) but the south-facing, anti-dip slopes are steep and often vertical. The Siwalik ridge tops are spiked and show evidence of dynamic slope forming processes.

The Middle Mountain physiographic zone is a complex of northwest-southeast trending ridges, including the Mahabharat Range, alternating with the major riverine valleys. The ridge tops are rounded, flanked by middle hill slopes. The upper middle hill slopes are steep (greater than 30 degrees) while the lower middle hill slopes are moderate to gentle (25 degrees to 10 degrees). The foot slopes of the mountains joining the valley floor are invariably steeper (greater than 30 degrees). The major river valleys are characterized by flat terraced landscapes forming two to three levels with vertical terrace breaks.

The locations of the ETP segments in different physiographic zones are identified in Table 5.1-1 which shows the TL length and number of towers that fall within each physiographic zone. The India Border (IB) to the New Butwal (NB) Segment lies entirely in the Terai physiographic zone. The NB to New Damauli (ND) Segment cuts across the three physiographic zones of the Terai, Siwalik, and Middle Mountains. The ND to Ratmate (RTE) Substation and RTE to Lapsiphedi (LAP) segments lie entirely in the Middle Mountain physiographic zone. Most of the RTE to New Hetauda (NH) Substation Segment lies in the Middle Mountain zone and partly in the Siwalik zone.

The NB Substation will lie in the Terai. The ND, RTE, and LAP Substations will be in the Middle Mountain zone and the NH Substation will be in the Siwalik zone.

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Table 5.1-1: Transmission Line Length by Physiographic Zone

TL Segments	Physiographic Zone		
	Terai (No. of Towers)	Siwalik (No. of Towers)	Middle Mountain (No. of Towers)
India Border to New Butwal	18.2 km (55)		
New Butwal to New Damauli	9.0 km (29)	17.9 km (50)	62.6 km (169)
New Damauli to Ratmate			89.7 km (250)
Ratmate to New Hetauda		13.3 km (35)	44.3km (105)
Ratmate to Lapsiphedi			59.0 km (163)
Total	**27.2 km (84)**	**31.2 km (85)**	**255.6 km (688)**

Source: Consultant Team 2020.

5.1.2 Topography

The topography along the TL RoW ranges in elevation from approximately 100 meters above sea level (a.s.l.) (IB to NB Segment) to 1,918 meters a.s.l. (RTE to LAP Segment). The IB to NB Segment is relatively flat ranging only from 100 meters to 120 meters a.s.l., whereas the rest of the four segments show a wide degree of elevation variations across the TL segments, ranging from 115 meters to 1,918 meters in elevation. Table 5.1-2 presents the maximum and minimum elevation levels across different TL segments traversed by the TL RoW.

Table 5.1-2: Minimum and Maximum Elevations across the TL Alignment

Particulars	TL Segments				
	IB–NB	NB–ND	ND–RTE	RTE–NH	RTE–LAP
Minimum Elevation (meters a.s.l.)	100	115	223	416	497
Maximum Elevation (meters a.s.l.)	120	1,380	1,720	1,912	1,918

Source: Generated from Project Digital Elevation Model 2019.

Figures 5.1-2 to 5.1-6 present the elevation variations as the TL segments traverse the landscape.

The topographic variations in short spans showing high relief along the TL RoW (see Figures 5.1.2 to 5.1.6) are the sites vulnerable to accelerated erosion risks such as land creeping, sheet erosion, rill erosion, debris flows, and landslides. Such a risk is most profound in areas where land clearing activities (clearing of standing vegetation) on RoW are likely. Some sections along the TL RoW (refer Figures 5.1.3 to 5.1.6) of New Butwal to New Damauli, New Damauli to Ratmate, Ratmate to New Hetauda, and Ratmate to Lapsiphedi have potential for land erosion risks.

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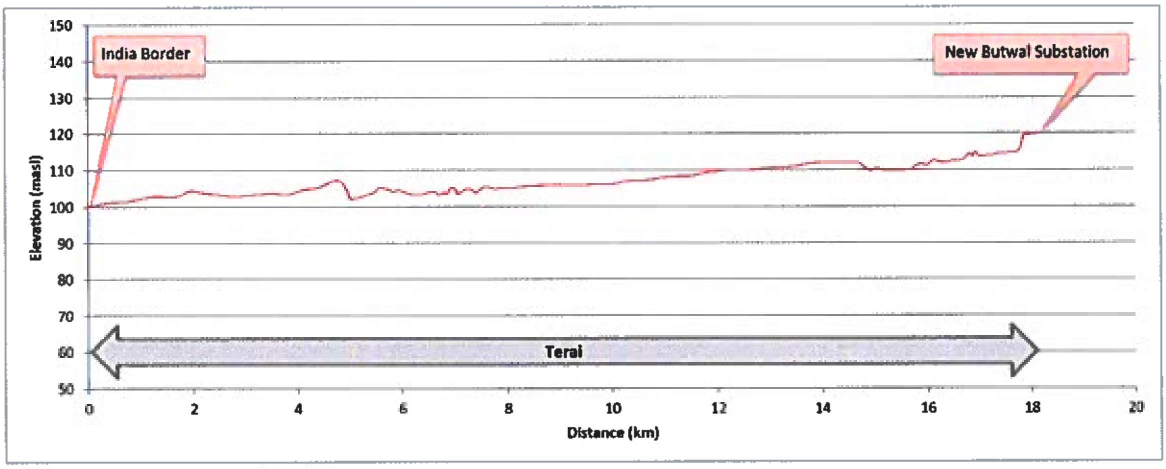
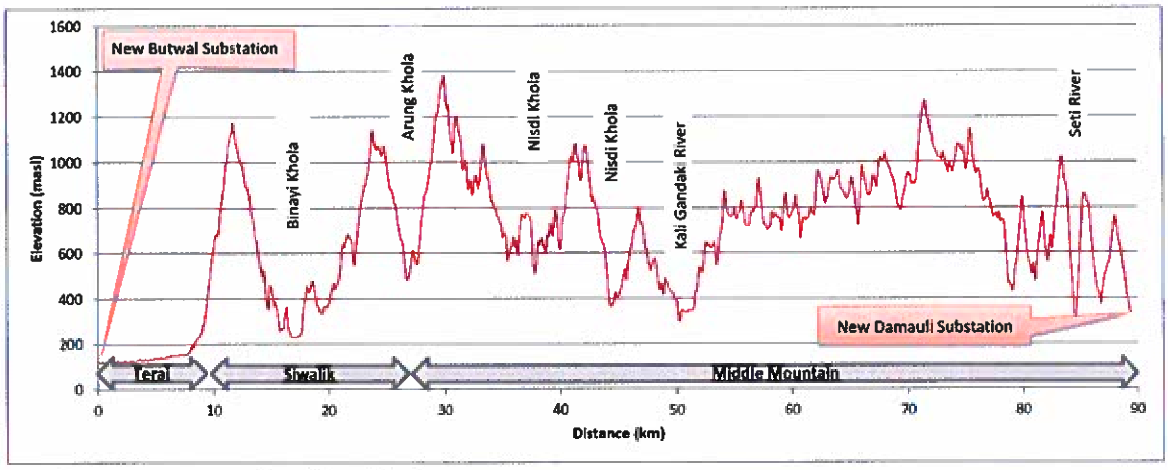


Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-2: Elevation Variation from India Border to New Butwal



Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-3: Elevation Variation from New Butwal to New Damauli

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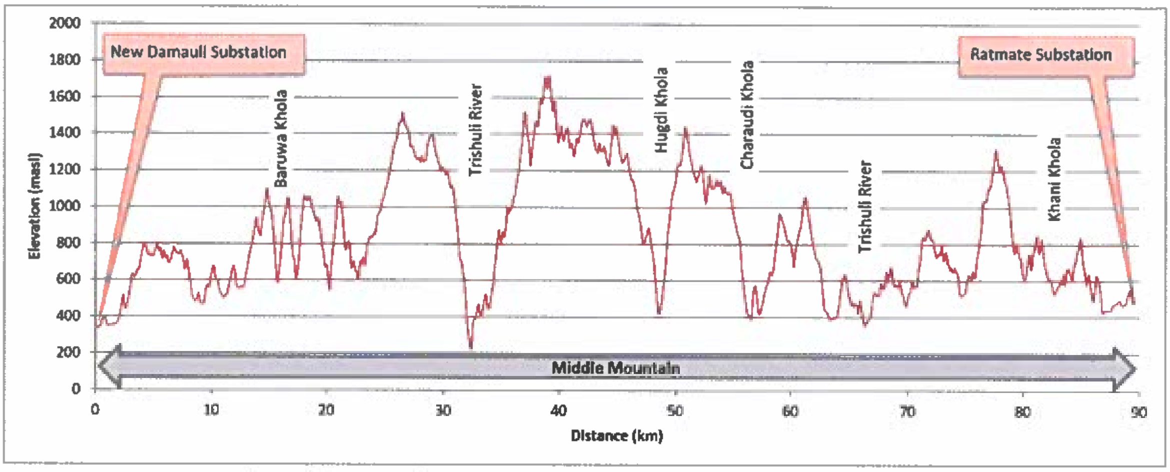
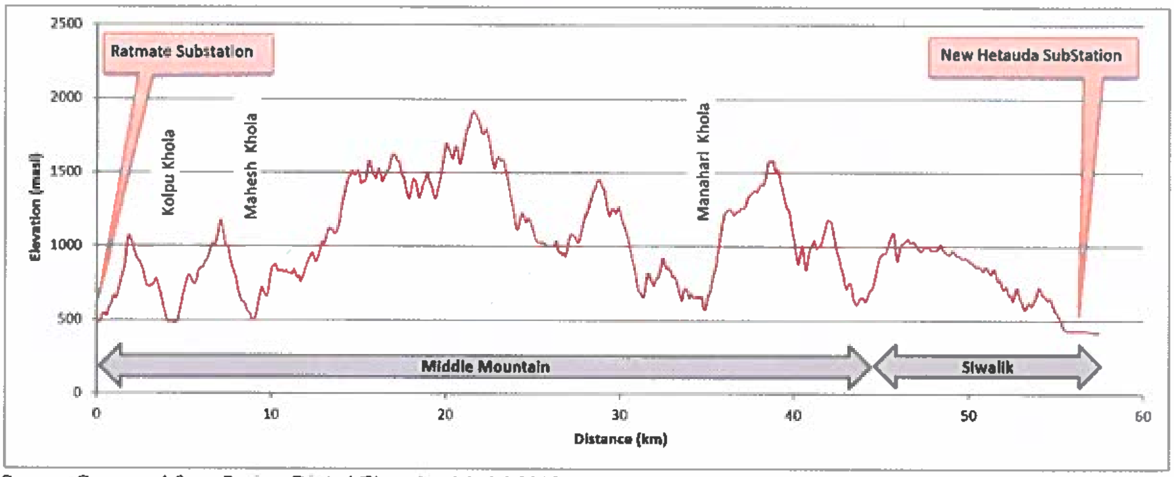


Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-4: Elevation Variation from New Damauli to Ratmate



Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-5: Elevation Variation from Ratmate to New Hetauda

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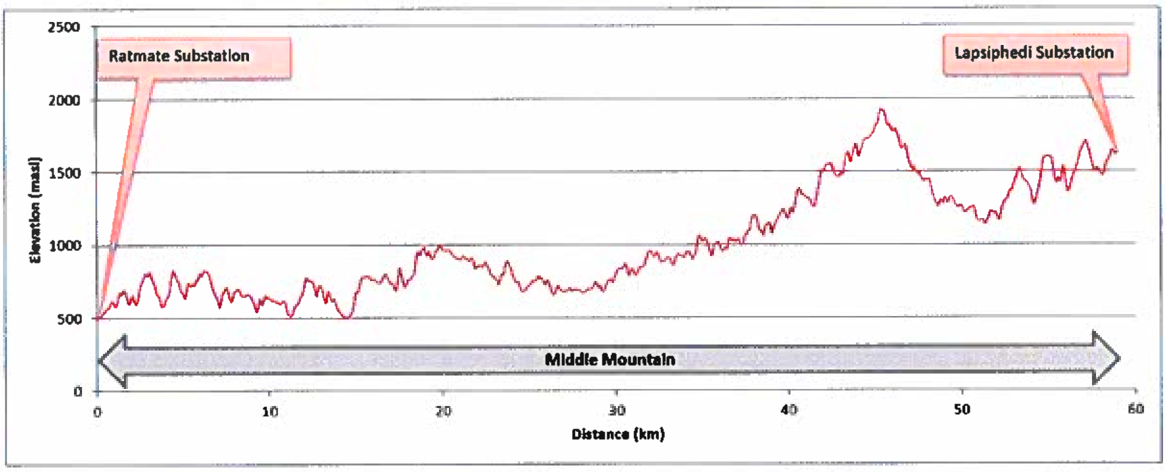

Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-6: Elevation Variation from Ratmate to Lapsiphedi

5.1.3 Slopes

Table 5.1-3 presents the terrain steepness across the different TL segments. The slopes above 30° along the TL RoW are vulnerable to accelerated erosion and these are consistent with the high relief sections discussed in Section 5.1.1.1 (Topography) above.

Table 5.1-3: Slope Variation across TL Segments

Slope degree	TL Segments (Length Percentile)				
	IB - NB	NB - ND	ND - RTE	RTE - NH	RTE - LAP
< 5°	100%	11%	3%	5%	2%
5°–20°	0%	24%	20%	22%	33%
20°–30°	0%	39%	33%	40%	38%
>30°	0%	25%	44%	33%	27%

Source: Generated from Project Digital Elevation Model 2019.

Figures 5.1-7 to 5.1-11 present the slope maps of the TL segments to give a visual perception of the terrain across the TL RoW.

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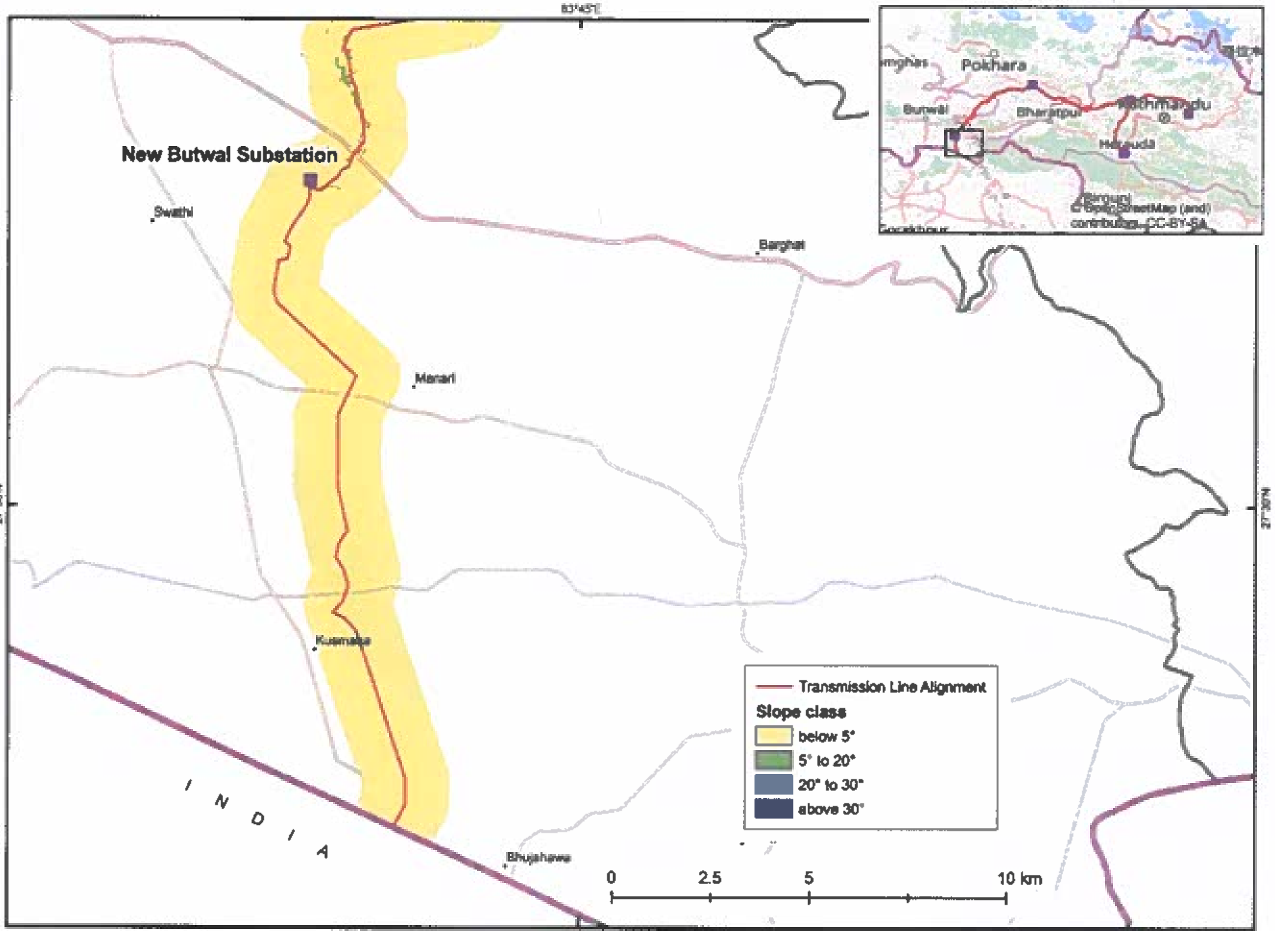
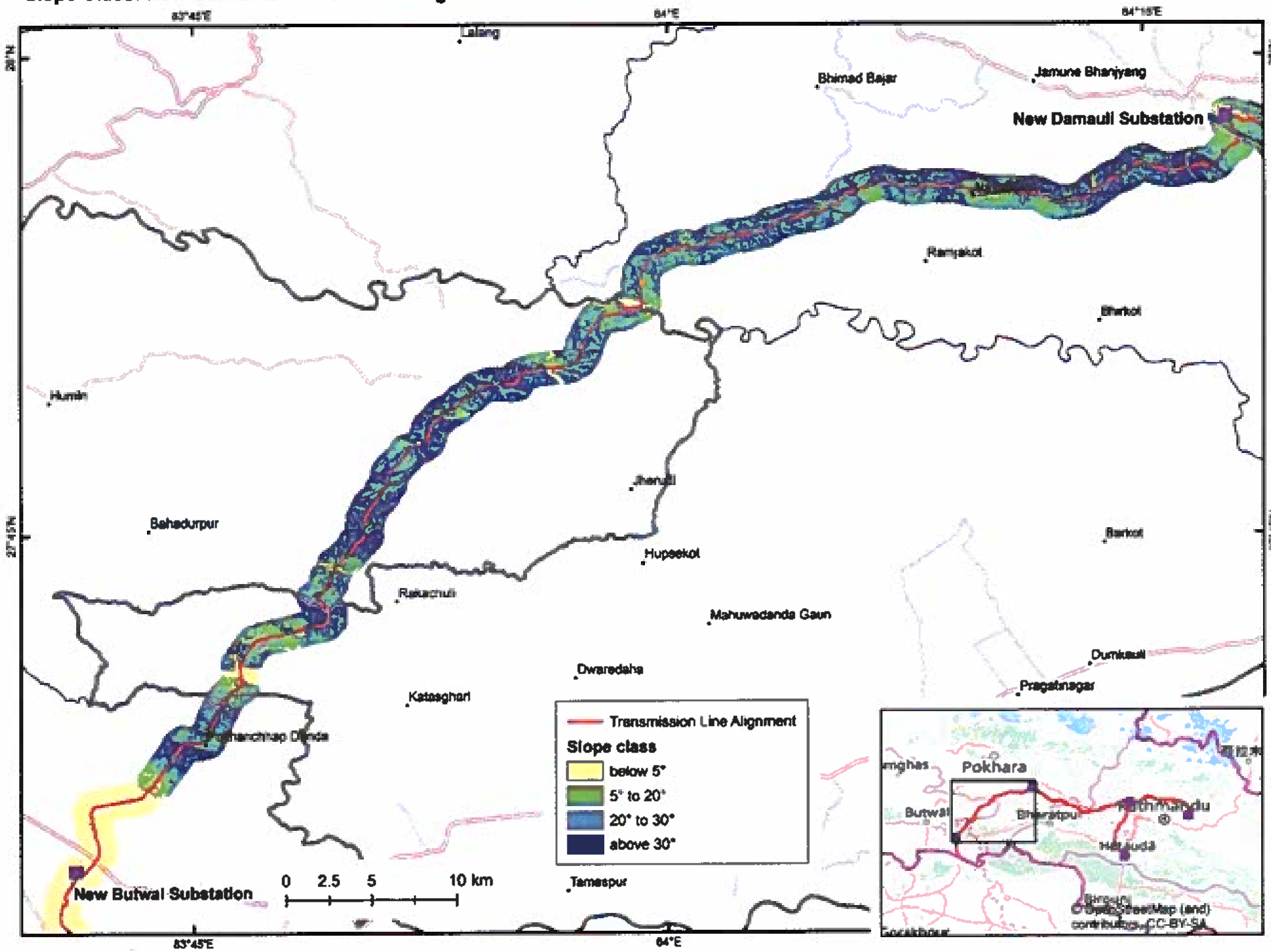
Slope Class: India Border to New Butwal Segment



Source: Generated from Project Digital Elevation Model 2019.

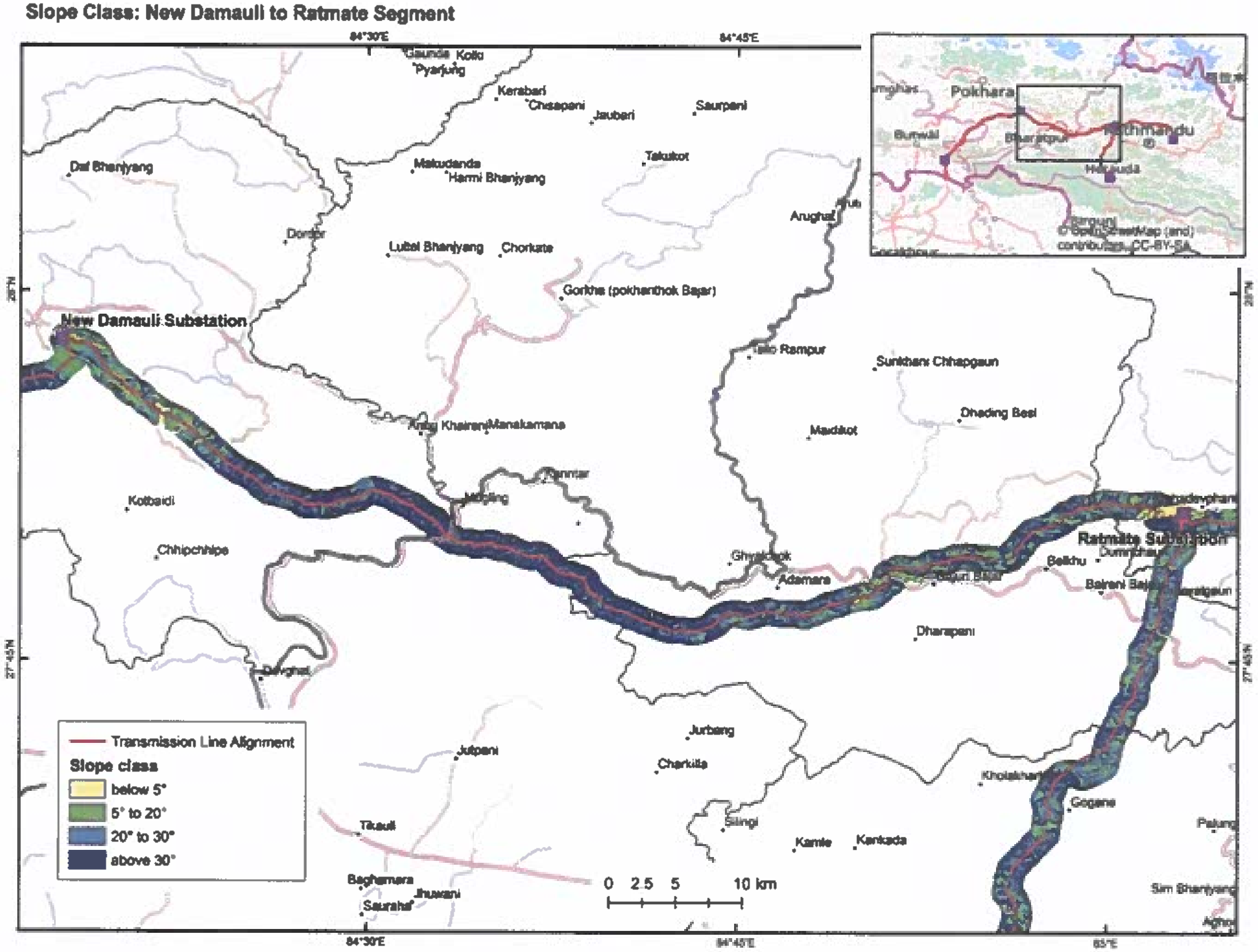
Figure 5.1-7: India Border to New Butwal Slope Variations

Slope Class: New Butwal to New Damauli Segment



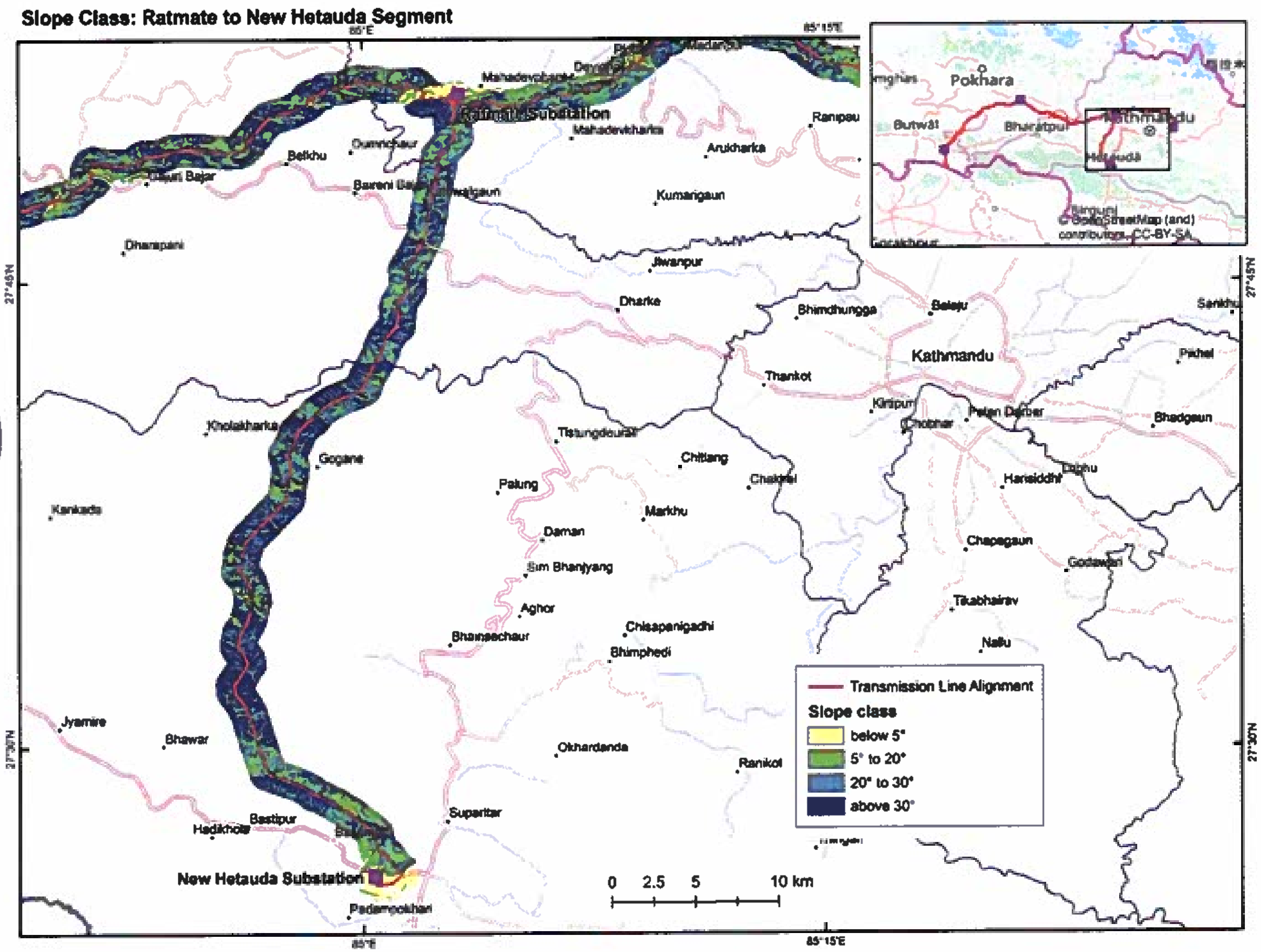
Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-8: New Butwal to New Damauli Slope Variations



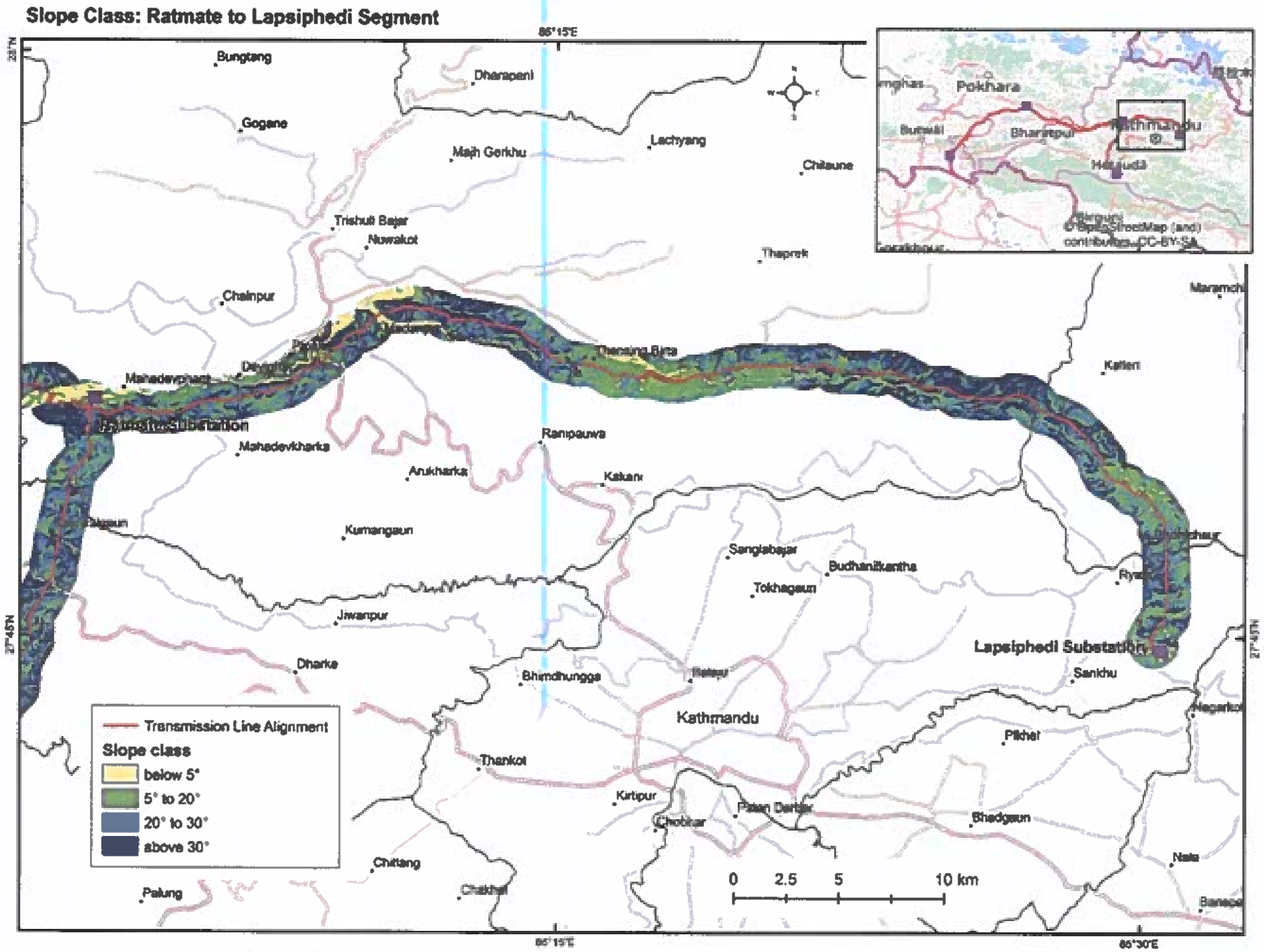
Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-9: New Damauli to Ratmate Slope Variations



Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-10: Ratmate to New Hetauda Slope Variations



Source: Generated from Project Digital Elevation Model 2019.

Figure 5.1-11: Ratmate to Lapsiphedi Slope Variations

5.1.4 Geology and Seismicity

5.1.4.1 Geology

In the regional tectono-stratigraphic geological framework, the ETP passes across parts of the Outer Himalayan zone (Terai), Sub-Himalayan zone (Siwaliks), Lesser Himalayan zone, and the Higher Himalayan zone of Nepal (Dahal 2006) (Figure 5.1-12). The geological zone boundaries more or less match the boundary limits of the physiographic zones described above.

The Outer Himalayan zone is separated from the overlying Sub-Himalayan zone by the Main Frontal Thrust (MFT). This thrust fault is concealed by the thick alluvial fans and its surface manifestation is not always discernible. The Sub-Himalayan zone is separated from the overlying Lesser Himalayan zone by the Main Boundary Thrust (MBT). The Main Central Thrust (MCT)/Mahabharat Thrust (MT) separates the Higher Himalayan zone from the Lesser Himalayan zone. The MCT and MT are used synonymously; the former is used at the northern root areas where Nappe or Clippe structures are not developed, while the latter is used in southern areas where Nappe or Clippe structures are well developed, such as in the Kathmandu area.

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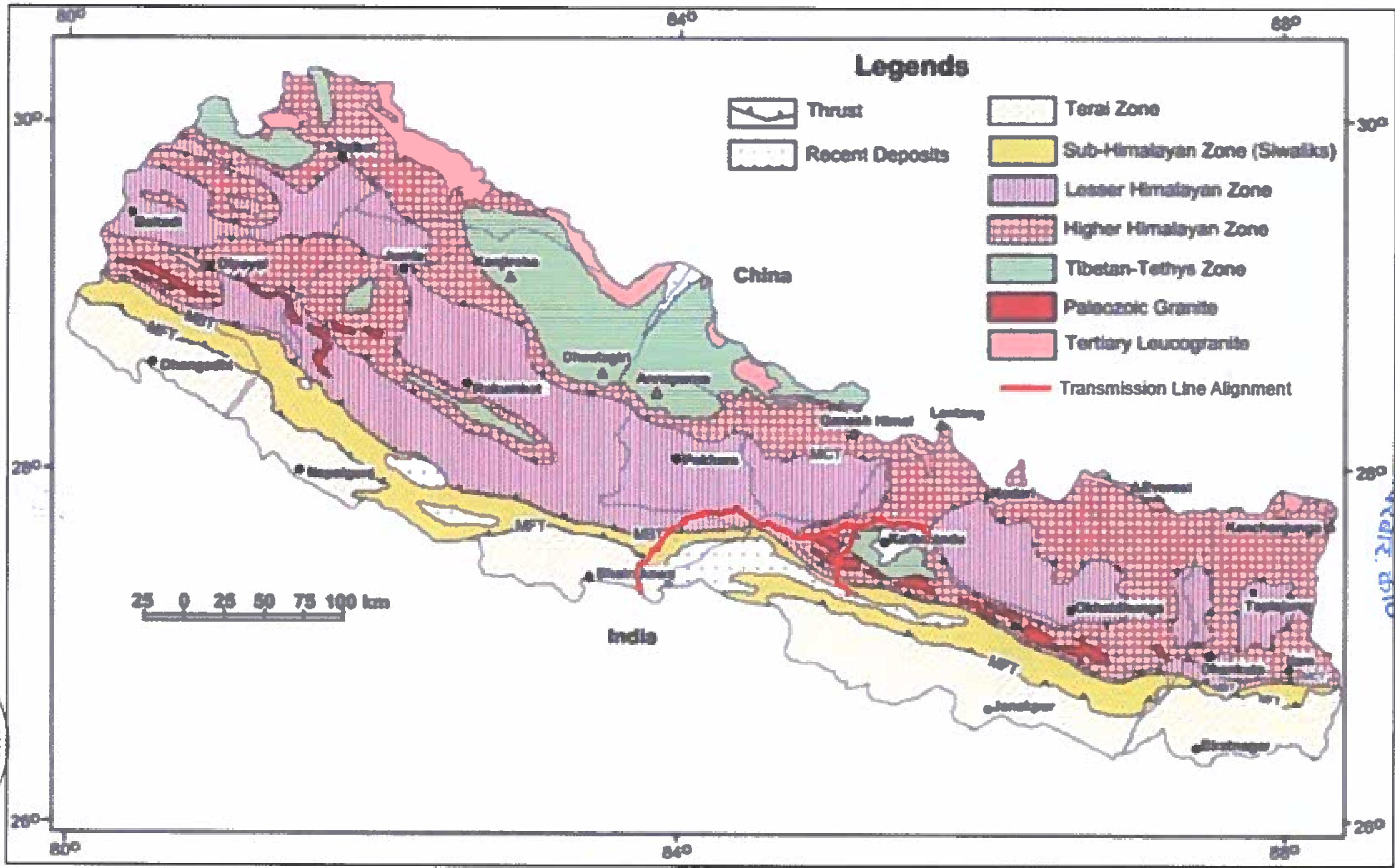


Source: Dahal 2006.

Figure 5.1-12: Geological Map of Nepal

The compiled geological map of the TL segments based on the regional geological maps of the Central Nepal and Western Central Nepal published by the Department of Mines and Geology, Nepal (Tarter et al. 1984; Shrestha et al.1986), is presented in Figure 5.1-13.

The stratigraphy of the rock sequences exposed along the TL segments across the Outer Himalayan zone, Sub-Himalayan zone, Lesser Himalayan zone, and Higher Himalayan zone are presented in Table 5.1-4. The lithological variations of the different geological Formation of the geological Sub-groups and Groups of Outer Himalayan, Sub-Himalayan, Lesser Himalayan and Higher Himalayan zones are presented in detail in the Figure 5.1-13.

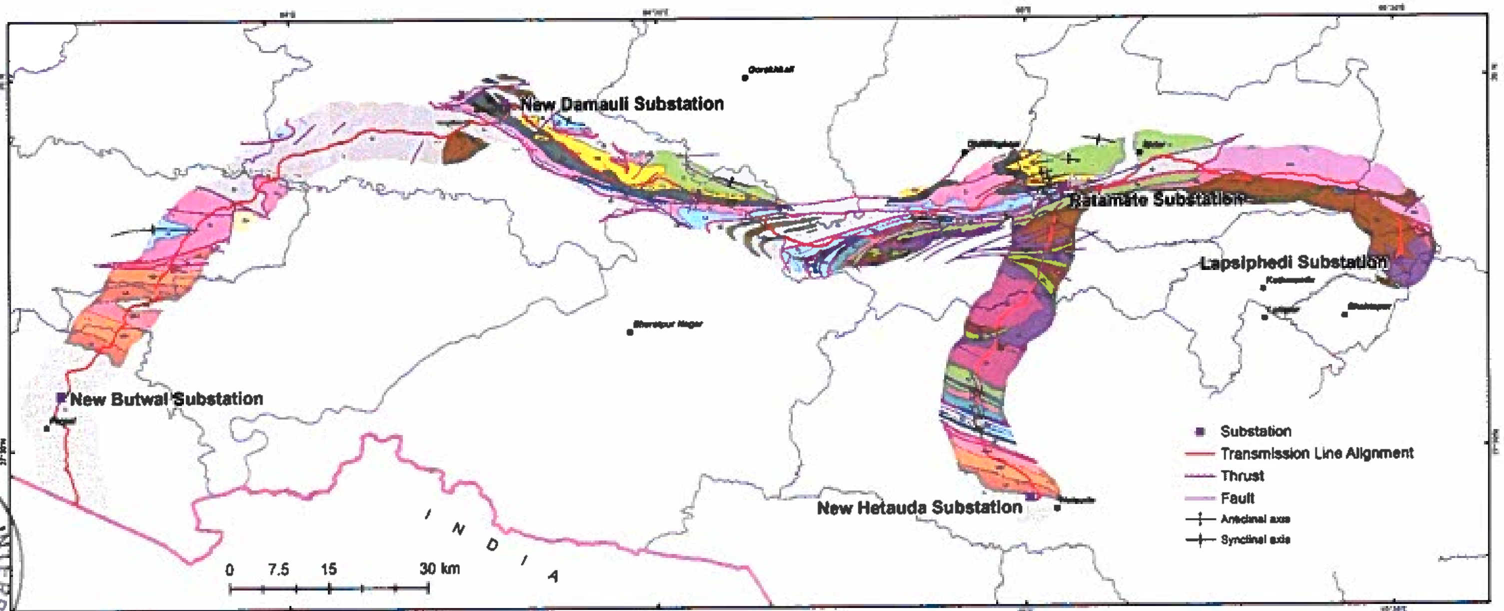
Table 5.1-4: Stratigraphy of the ETP Project Area

Formations	Zones
Gangatic alluvium (Q) (Recent/Quaternary)	Outer Himalayan Zone
Siwalik Group (Middle Miocene–Pleistocene) Alluvial Deposits (Q) Upper Siwalik (US) Upper Middle Siwalik (UMS1) Lower Middle Siwalik (LMS2) Lower Siwalik (LS)	Sub-Himalayan Zone
MBT	
Alluvial Deposits (Q) (Recent /Quaternary) **Surkhet Group (Cretaceous - Eocene)** Suntar Formation (Su) Swat Formation (Sw)	Lesser Himalayan Zone
Midland Group (Upper Pre-Cambrian–Paleozoic) ***Lakharpata Sub-group*** Lakharpata Formation (Lk) with Dunga Quartzite (Du) and Robang Phyllite (Ro) Syangja Formation (sy) Sangram Formation (Sg) Galyang Formation (Gl) with Baitadi Beds (Ba) ***Dailekh Sub-Group*** Naudanda Formation (Nd) Seti Formation (St)	Lesser Himalayan Zone

Formations	Zones
MT	
Alluvial Deposits (Q) (Recent /Quaternary) **Kathmandu Group (Pre-Cambrian–Devonian)** ***Phulchoki Sub-group*** Chandragiri Formation (ca) Sopyang Formation (So) Tistung Formation (Ti) ***Bhimphedi Sub-group*** Markhu Formation (Mr) Sarung Khola Formation (Sk) Maksana Formation (Mk) Tawa Khola Formation (Ta) with Pandrang Quartzite (Pa) Udaipur Formation (Ud) Siprin Khola Formation (Sp)	Higher Himalayan Zone
MCT	
Himal Group (Pre-Cambrian) Himal Group (Hm) **Migmatite / Intrusive rocks** Biotite Tourmaline Granite (Gr) Basic rock (Br) Banded Augen Gneiss (Gn)	Higher Himalayan Zone

Note: For lithological details refer Figure 5.1- 14
Source: Tater et al. 1984; Shrestha et al. 1986.

The geology of the TL segments is depicted in the Figure 5.1-13.



GEOLOGY LEGEND

- Recent: Alluvium, boulder, gravel, sand, silt and clay.
- Upper Siwalik: Coarse boulder conglomerates with irregular bands and lenses of sandstone and thin intercalations of yellow, brown grey sandy clays.
- Upper Middle Siwalik: Medium to coarse grained sandstones, pebbly sandstone with siltstone, mudstone and relict of sandstones.
- Lower Middle Siwalik: Fine to medium grained sandstone with interbeds of siltstone and mudstone. Coaly materials and plant fossils are present.
- Lower Siwalik: Fine grained, hard, grey sandstones interbedded with purple and Chocolate coloured shales nodular maroon clays pseudo- conglomerates.
- Suntar Formation: Fine to medium grained, greenish grey sandstones and purple shales with intercalations of green splintery shales.

MIDLAND GROUP

Lakharpata Sub Group

- Lakharpata Formation: Fine grained, light blue, gray limestones and dolomities with thin intercalation of grey shale, white, pink dolomitic limestones, purple quartzites and green shales at the top. Algal structure and stromatolites are present Dunga quartzites beds. Robang formation Green chlorotic phyllites layers of basic rocks.
- Syangja Formation: White paleorangepinkish or purplish calcarious quartzites and quartzitic limestones with dark grey purple and green shales strongly riple marked quartzites at the base.
- Sangram Formation: Black, dark Grey to greenish grey shales with intercalation of limestones and quartzites.
- Galyang Formation: Dark grey slates intercalated with thin grey calcareous slates and lamilqe of carbonates thick beds of grey siliceous dolomites are found at places (Baitadi beds).

Dailekh Sub Group

- Naudanda Formation: White massive fine to medium grained quartzites with ripple marks interbedded with green phyllites Basic intrutions are noted.
- Seti Formation: Grey greenish grey gritty phyllites gritstones with conglomerates and white massive quartzites in the upper parts basic instrusions are noted.

KATHMANDU GROUP

Phulchoki Sub Group

- Chandragiri Formation: Light fine grained crystaline limestones, partly siliceous thick to massively bedded white quartzites in upper parts. Wavy limestones containing late Ordovician echinoderms.
- Sopyang Formation: Dark Orgillaceous and many slates with thin limestones.
- Tistung Formation: Dull green grey coloured phyllites, pink purplish tinted sandstones with sandy limestones ripple marks, clay cracks, worm tracks are abundent, pebbly beds near base.

Bhimphedi Sub Group

- Markhu Formation: Massive coarse to medium grained crystaline marble changing northward to dark fine biotite schists interbedded with impure marbles and quartzites. Stromatolites are found.
- Sarung Kh. Formation: Fine textured, dark grey to greenish white quartz biotite schists, quartz feldspar biotite schists, occasionally garnetiferous schists interbedded with quartzites and micaceous quartzites with intrusions of pegmatites Ca-Calc. silicate rocks and marble bands.
- Maksena Formation: White fine grained quartzites cross beded.
- Tawa Khola Formation: Corse grained dark grey garnetiferous muscovite biotite quartz schists interbedded with greyish smure quartzites.Pandrang Quartzite member light green quartzites.
- Udaipur Formation: Coarse grained crystaline marbles with intercalations of schists.
- Shiprin Khola Formation: Coarse crystaline, highly garnetiferous muscovite biotite-quartz schists, quartzites green chlorite schists the base.

HIMAL GROUP (PRE-CAMBRIAN)

- Garnet-biotite gneisses kyanite biotite gneisses garnetiferous mica schists, augen gneisses micacious quartzites and thin bands of marbles.
- Biotite tourmaline granites.
- Augen gneisses banded gneisses.
- Basin rocks
- Undifferentiated schists quartzites gneisses and calcareous silicate rocks (cs) of Bhimphedi Sub group and Tistung formation in various stages of migmatization

Source: Tater et al 1984; Shrestha et al 1986.

Figure 5.1-13: Geological Map of TL Segments

India Border to New Butwal Segment

The India Border to New Butwal Segment lies entirely within the Outer Himalayan zone made up of Gangatic Alluvium deposits of the Recent to Quaternary age (see Figure 5.1-13). It comprises of soft and unconsolidated thick alternating layers of clay, silt, and sand with intermittent beds of pebbles, cobbles and boulders.

New Butwal to New Damauli Segment

The New Butwal to New Damauli Segment passes across the rock formation of the Outer Himalayan zone, Sub-Himalayan zone and the Lesser Himalayan zone. Table 5.1-5 presents the rock formations traversed by the TL from north to south (see Figure 5.1-13). The details of the lithological composition of the formations are described in the Geological Legends in Figure 5.1-13 and are not repeated in the table below.

Table 5.1-5: Geological Formations across New Butwal to New Damauli Segment

	Symbol	Formation	Sub-Group	Group
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
	Sg	Sangram Formation	Lakharpata Sub-Group	Midland Group
	Sy	Syangia Formation	Lakharpata Sub-Group	Midland Group
			Thrust Fault	
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
	Sy	Syangia Formation	Lakharpata Sub-Group	Midland Group
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
			Longitudinal Fault	
North	Sy	Syangia Formation	Lakharpata Sub-Group	Midland Group
			MBT	
	LS	Lower Siwalik		Siwalik Group
			Longitudinal Fault	
	MS2	Upper Middle Siwalik		Siwalik Group
	MS1	Lower Middle Siwalik		Siwalik Group
	LS	Lower Siwalik		Siwalik Group
	US	Upper Siwalik		Siwalik Group
	MS2	Upper Middle Siwalik		Siwalik Group
	MS1	Lower Middle Siwalik		Siwalik Group
	LS	Lower Siwalik		Siwalik Group
			MFT	
South	Q	Gangatic Alluvium		Quaternary/Recent

Source: Tater et al. 1984; Shrestha et al. 1986.

In general, rock sequences exposed along the TL alignment are moderately to deeply weathered and fractured for a depth of about 15 to 25 meters from the surface. A total of 7 thrusts/ faults lie across this TL section. Because of such thrust/faults, parts of the rock sequences across the TL segment have been repeated (refer Figure 5.1-13). The thrust and fault structures are the zone of crushing and shearing of rocks. Tower foundations close to these structures are likely to show a high degree of rock shearing and associated risk of land instabilities and erosion.

New Damauli to Ratmate Segment

The New Damauli to Ratmate Segment is represented by the rock formations of Kathmandu Groups of Higher Himalayan zone and the Midland Groups of Lesser Himalayan zone. The Kathmandu Group rock tectonically overlies the Midland Group rocks being separated by the MT. Table 5.1-6 presents the rock formations traversed by the TL segment from east to west (see Figure 5.1-13). Details of the lithological characteristics of the rock formations are presented in Geological Legends (refer Figure 5.1-13) and are not repeated in the table below.

The rock sequences falling across this TL segment are moderately to deeply weathered up to a depth of 15 to 30 meters from the ground surface. A total of 10 thrust / faults locates across this TL segment repeating parts of the geological formations in some sections (refer Figure 5.1-13). The thrust and fault structures are the zone of crushing and shearing of rocks. Tower foundations close to these structures are likely to show a high degree of rock shearing and associated risk of land instabilities and erosion.

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Table 5.1-6: Geological Formations across New Damauli to Ratmate Segment

	Symbol	Formation	Sub-Group	Group
East	Q	Alluvial Deposits		Quaternary/Recent
	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
		Longitudinal Fault		
	Sg	Sangram Formation	Lakharpata Sub-Group	Midland Group
	Sy	Syangia Formation	Lakharpata Sub-Group	Midland Group
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
		Thrust Fault		
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
		MT		
	Sp	Siprin Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Ud	Udipur Formation	Bhimphedi Sub-Group	Kathmandu Group
	Sp	Siprin Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
		Thrust Fault		
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
	Sy	Syangia Formation	Lakharpata Sub-Group	Midland Group
	Sg	Sangram Formation	Lakharpata Sub-Group	Midland Group
	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
	St	Seti Formation	Dailekh Sub-Group	Midland Group
		Transverse Fault		
	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
	Sg	Sangram Formation	Lakharpata Sub-Group	Midland Group
	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
	Sg	Sangram Formation	Lakharpata Sub-Group	Midland Group
		Transverse Fault		
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
West	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group

Source: Tater et al. 1984; Shrestha et al. 1986.

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Ratmate to New Hetauda Segment

The Ratmate to New Hetauda Segment traverses the MT and the MBT along the foot of the southern slope of the Mahabharat Range north of Hetauda. The MBT and MT in this segment lie only a few kilometers apart, with a narrow belt of Lesser Himalayan zone sandwiched between rock sequences of the Siwalik zone in the south and the Higher Himalayan zone in the north.

The rock sequences in the Middle Mountain physiographic zone around Kathmandu and further south are comprised of the Kathmandu Group consisting of the stratigraphically underlying Bhimphedi Sub-Group and overlying Chandagiri Sub-Group (Stoècklin and Bhattarai 1977; Tater et al. 1984; Shrestha et al. 1986). The MT separates the Lesser Himalayan zone rock sequences from the overlying Higher Himalayan rock successions. The rock successions across the TL segment from north to south are depicted in Table 5.1-7 (see Figure 5.1-13). Details of the lithological characteristics of the rock formations are presented in Geological Legends (refer Figure 5.1-13) and are not repeated in the table below.

The rock sequences falling across this TL segment are moderately to deeply weathered up to a depth of 15 to 30 meters from the ground surface. A total of 11 thrust / faults locates across this TL segment repeating parts of the geological formations in some sections (refer Figure 5.1-13). The thrust and fault structures are the zone of crushing and shearing of rocks. Tower foundations close to these structures are likely to show a high degree of rock shearing and associated risk of land instabilities and erosion.

Table 5.1-7: Geological Formations across Ratmate to New Hetauda Segment

	Symbol	Formation	Sub-Group	Group
North	Q	Alluvial Deposits		Quaternary/Recent
	Lk	Lakharpata Formation	Lakharpata Sub-Group	Midland Group
		Longitudinal Fault		
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
		Thrust Fault		
	Br	Basic rock		
	Rb	Robang Formation	Lakharpata Sub-Group	Midland Group
		MT		
	Ta	Tawa Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gn	Banded Augen Gneiss		
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gn	Banded Augen Gneiss		
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gn	Banded Augen Gneiss		

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	Symbol	Formation	Sub-Group	Group
		Longitudinal Fault		
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Mr	Markhu Formation	Bhimphedi Sub-Group	Kathmandu Group
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Mr	Markhu Formation	Bhimphedi Sub-Group	Kathmandu Group
	Ti	Tistung Formation	Phulchokic Sub-Group	Kathmandu Group
	Mr	Markhu Formation	Bhimphedi Sub-Group	Kathmandu Group
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gr	Granite intrusions		
	Ti	Tistung Formation	Phulchokic Sub-Group	Kathmandu Group
	Mr	Markhu Formation	Bhimphedi Sub-Group	Kathmandu Group
	Sk	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Mk	Maksana Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gr	Granite intrusions		
	Ta	Tawa Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Pa	Pandrang Quartzite	Bhimphedi Sub-Group	Kathmandu Group
	Ta	Tawa Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Ud	Udipur Formation	Bhimphedi Sub-Group	Kathmandu Group
	Sp	Siprin Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
		MT		
	Du	Dunga Quartzite	Lakharpata Sub-Group	Midland Group
	Rb	Robang Phyllites	Lakharpata Sub-Group	Midland Group
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
		Thrust Fault		
	Br	Basic rock		
	Du	Dunga Quartzite	Lakharpata Sub-Group	Midland Group
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
		MBT		
	MS2	Upper Middle Siwalik		Siwalik Group
		Thrust Fault		
	MS2	Upper Middle Siwalik		Siwalik Group
	MS1	Lower Middle Siwalik		Siwalik Group
	LS	Lower Siwalik		Siwalik Group

Source: Tater et al. 1984; Shrestha et al. 1986.

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Ratmate to Lapsiphedi Segment

The Ratmate to Lapsiphedi Segment crosses several geological formations of the Lesser Himalayan zone and the Higher Himalayan zone. The MCT separates the rock formations of Lesser Himalayan zone from the overlying Higher Himalayan zone. Table 5.1-8 presents the rock formations across the TL segment from west to east (see Figure 5.1-13). Details of the lithological characteristics of the rock formations are presented in Geological Legends (refer Figure 5.1-13) and are not repeated in the table below.

The rock sequences falling across this TL segment are moderately to deeply weathered up to a depth of 20 to 30 meters from the ground surface. A total of 5 thrust / faults locates across this TL segment repeating parts of the geological formations in some sections (refer Figure 5.1-13). The thrust and fault structures are the zone of crushing and shearing of rocks. Tower foundations close to these structures are likely to show a high degree of rock shearing and associated risk of land instabilities and erosion.

Table 5.1-8: Geological Formations across Ratmate to Lapsiphedi Segment

	Symbol	Formation	Sub-Group	Group
West	Sk	Arung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
	Gn	Banded Augen Gneiss		
		MCT		
	Hm	Gneisses	Himal Sub-Group	Kathmandu Group
	Gn	Banded Augen Gneiss		
	Hm	Gneisses	Himal Sub-Group	Kathmandu Group
		MCT		
	Gn	Banded Augen Gneiss		
	Sh	Sarung Khola Formation	Bhimphedi Sub-Group	Kathmandu Group
		MCT		
	Hm	Gneisses		
	Gl	Galyang Formation	Lakharpata Sub-Group	Midland Group
		Longitudinal Fault		
	St	Seti Formation	Dailekh Sub-Group	Midland Group
	Q	Alluvial Deposits		Quaternary/Recent
	St	Seti Formation	Dailekh Sub-Group	Midland Group
East	Nd	Naudanda Formation	Dailekh Sub-Group	Midland Group
	Q	Alluvial Deposits		Quaternary/Recent

Source: Tater et al. 1983/1984.

5.1.4.2 Seismicity

Nepal lies central in the Himalayan Collided zone with the earth's mantle driving the Indian tectonic plate north into and under the much larger Asian landmass. As a result, Nepal is a high seismic-hazard nation. Nepal has experienced six major earthquakes (1255, 1408, 1505, 1833, 1934, and 2015 AD), with magnitudes equal to or greater than 7.6 since 1255 (Thapa et al. 2017). The Gorkha earthquake in 2015, with a magnitude of 7.8, and its accompanying aftershocks caused a high toll of casualties (more than 8,600 deaths and over 20,000 injuries), significant damage (more than 5 million houses), and monetary losses (approximately 7 billion in U.S. dollars) (GoN 2015). The mapping of active faults (e.g., Nakata 1972, 1982, 1989; Nakata et al. 1984; Dasgupta et al. 1987; Upreti et al. 2000; Nakata and Kumahara 2002; Taylor and Yin 2009; Styron et al. 2010 as cited in Thapa 2018) clearly shows earthquake potential in Nepal and the surrounding region. Figure 5.1-14 shows the spatial distribution of the epicenters of catalogued earthquakes for the period from 1255 to 2015.

The earthquake epicenters are not evenly distributed and show relatively higher earthquake activity in a belt about 50-kilometer-wide through central Nepal compared to the southern portion of the country. The epicenter points also indicate that earthquakes are aligned parallel to the surface traces of the mapped principal faults (MFT, MBT, MCT, and South Tibet Detachment System in Nepal), and are mostly concentrated along the MCT fault.

The ETP RoW lies within this highly active seismic area and its alignment relative to these fault lines is shown in Figure 5.1-15.Giving due consideration to these tectonic and geologic realities as reflected by the seismic activities, the TL tower foundations and sub-stations are designed to withstand the expected earthquake magnitude (Refer to Chapter 2 – Project Introduction). The Project geotechnical and seismic report has been added as Annex R.

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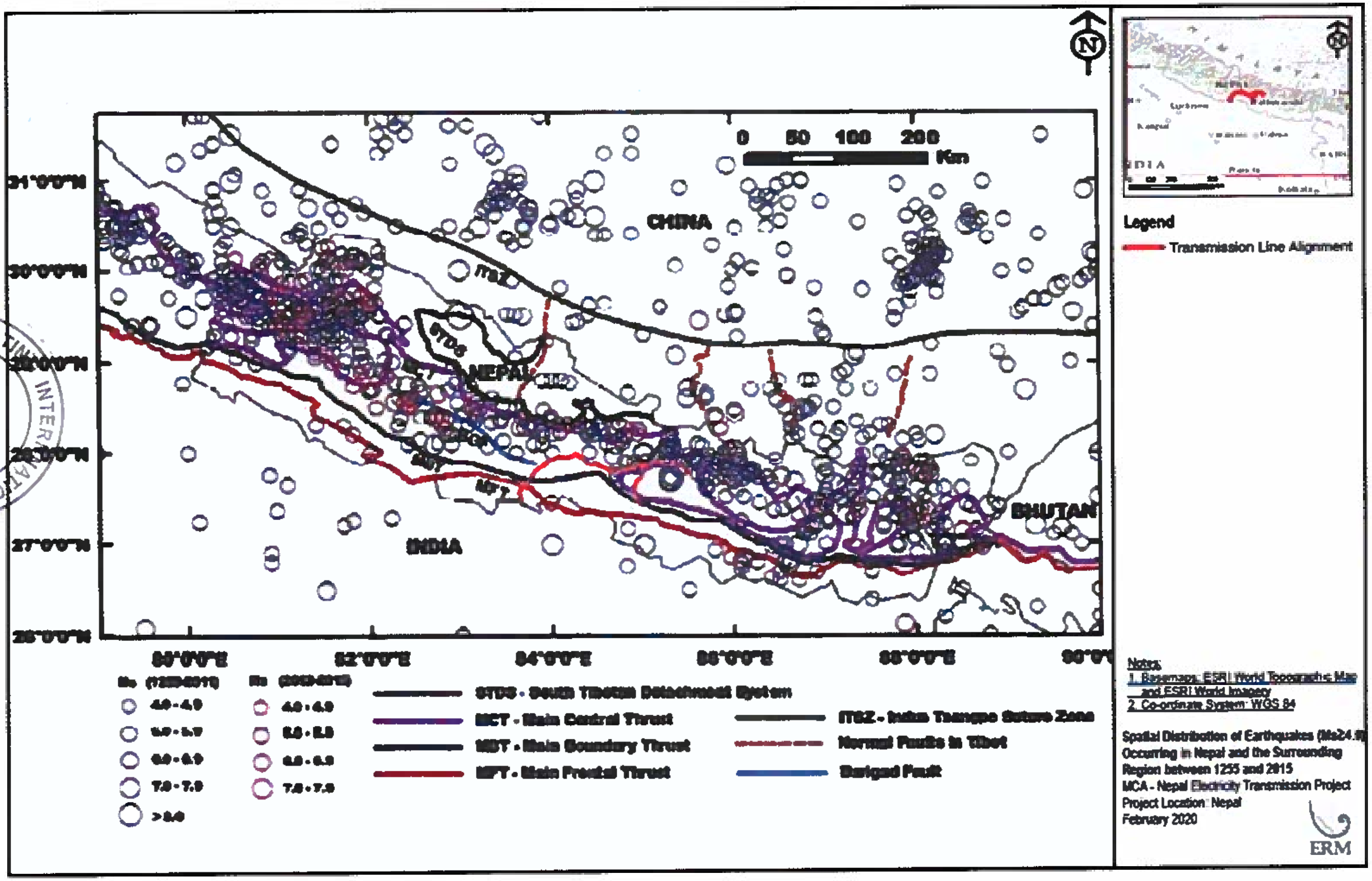
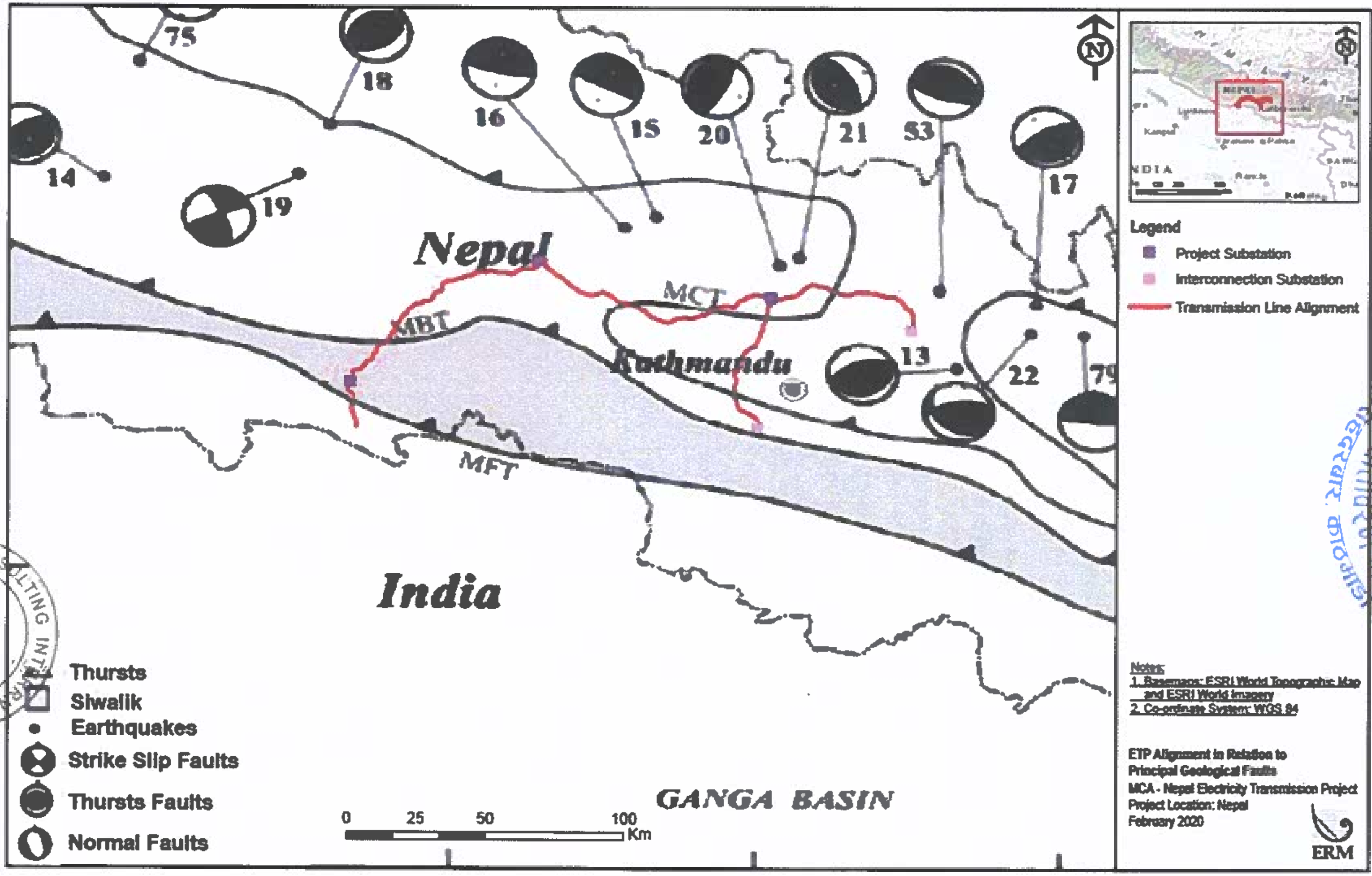


Source: Thapa 2018.

Figure 5.1-14: Spatial Distribution of Earthquakes (Ms≥4.0) Occurring in Nepal and the Surrounding Region between 1255 and 2015



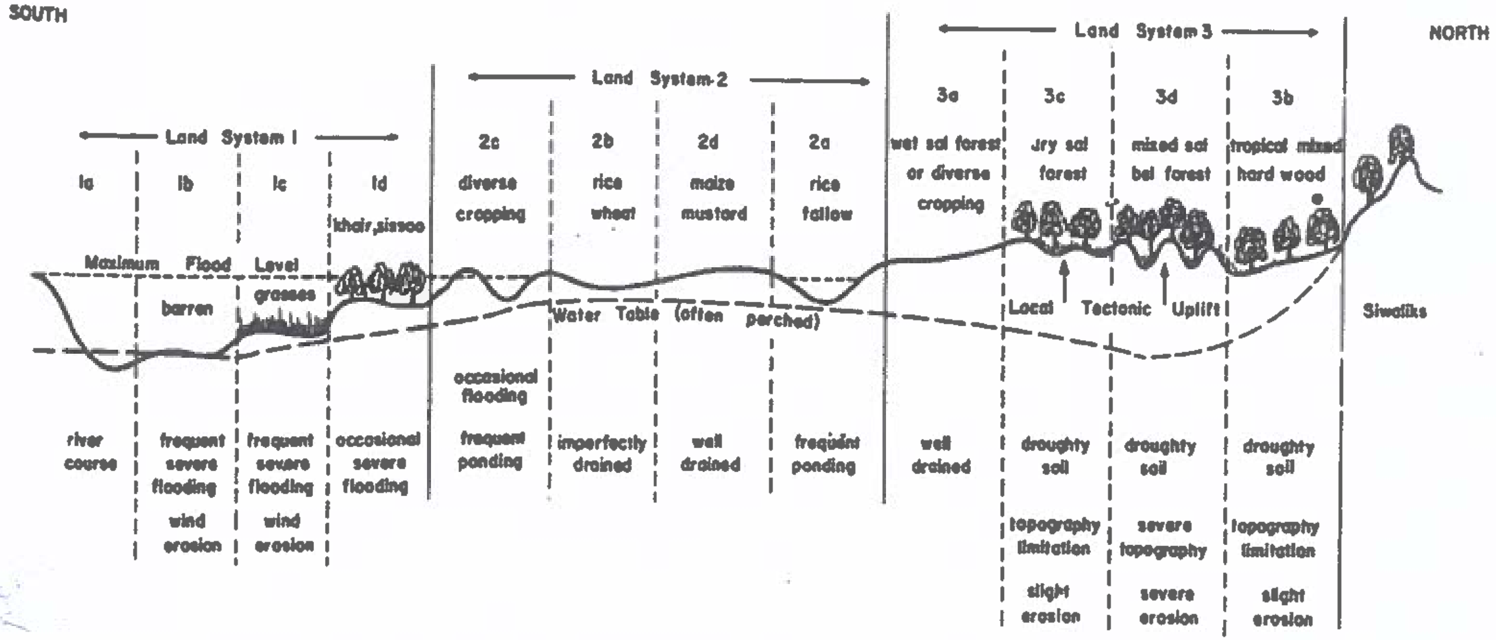
Source: Thapa 2018.

Figure 5.1-15: ETP Alignment in Relation to Principal Geological Faults

5.1.5 Soil

Nepal is a land of extremes, its physiography ranges from alluvial plains in the tropical-low lands, to very rugged and permanently snow and ice covered high mountains. Climatic conditions vary so much that tropical and temperate agriculture occurs a few kilometers apart. In such landscapes, topography is an overruling soil forming factor and is responsible for a large variability in soil characteristics, distribution and soil depth. Traditional soil mapping are not likely to represent the soil types in such terrain. It is therefore, land system classification (Carson et al. 1986; Nelson et al. 1980) based on description of landform and soils have been presented in this section to present soil types across the ETP sites.

Figure 5.1-16 presents the schematic cross section of the typical landforms in the Terai zone, while Table 5.1-9 presents developed soil types, thickness and drainage conditions in the ETP areas of the Terai zone. Geotechnical and geophysical investigations were performed at a spacing of approximately every 18th tower structure along the length of the transmission line as an indicative sample of soil and rock conditions. Efforts were made to minimize use of fertile agricultural land while finalizing TL route. The Project will not affect soil fertility and the D&B contractor is responsible for showing they have successfully stabilized all disturbed areas. The findings of geotechnical investigation, which includes the information collected on soil characteristics, has been added as Annex R.



Source: Carlson et al. 1986.

Figure 5.1-16: Schematic cross-section of the Typical Landforms in Terai Zone

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Table 5.1-9: Soil Types in the different landforms and land units—Terai Zone ETP Area

Land System	Land form	Land Unit	Dominant Soils	Dominant Slopes	Dominant Texture	Seasonal Range of Depth to Water Table	Drainage
1	Active Alluvial Plain (depositional)	1a present river channel	—	—	—	—	—
		1b sand and gravel bars	Ustorthents Psamments	<1°	Sandy/ Cobbly	0 – 2m	subject to severe river flooding
		1c low terrace	Ustifluvents Fluvaquents	<1°	Sandy	0 – 2m	variable; subject to severe river flooding
		1d higher terrace	Ustochrepts Haplaquepts	<1°	Loamy	0 – 4m	variable; subject to occasional river flooding
2	Recent Alluvial Plain "Lower Piedmont" (depositional and erosional)	2a depressional	Haplaquepts	<½°	Fine Loamy	0 – 2m	poor
		2b intermediate position; level	Haplaquepts (Aeric)	<½°	Loamy	0 – 6 m	imperfect
		2c intermediate position, undulating	Haplaquepts Ustochrepts	<1°	variable	dependent on position	variable; low areas subject to flooding
		2d high position	Haplustolls Ustochrepts	<1°	Loamy	1 – 10m	moderately well
3	Alluvial Fan Apron Complex "Upper Piedmont" (erosional)	3a very gentle slopes	Haplustolls Dystochrepts Ustochrepts	<1°	Loamy	1 – 10m	moderately well
		3b gentle slopes	Haplustolls	1–5°	Loamy/ Bouldery	2 – 10m	rapid
		3c undulating	Haplustolls	1–3°	Loamy	2 – 10m	well
		3d highly dissected	Ustochrepts	0–20°	Loamy	>2m	rapid

Source: Carlson et al. 1986.

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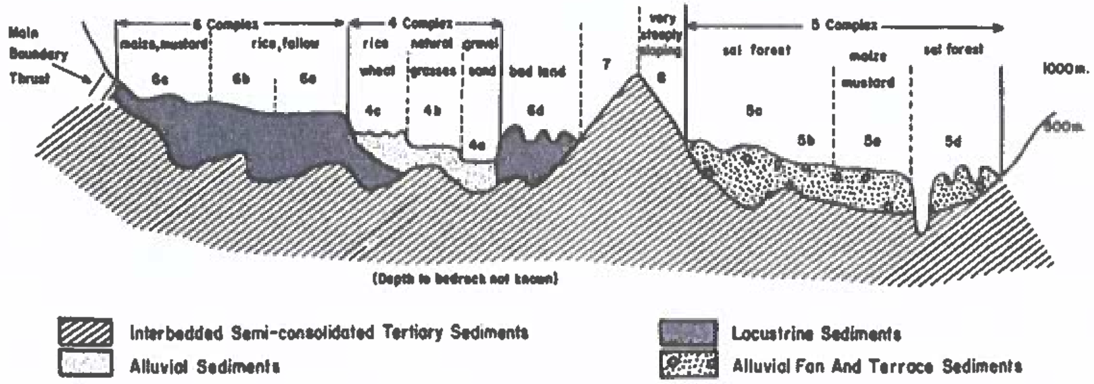
Figure 5.1-17 presents the schematic cross section of the typical landforms in the Siwalik zone while Table 5.1-10 presents developed soil types, thickness and drainage conditions in the ETP areas of the Siwalik zone.



Source: Carlson et al. 1986.

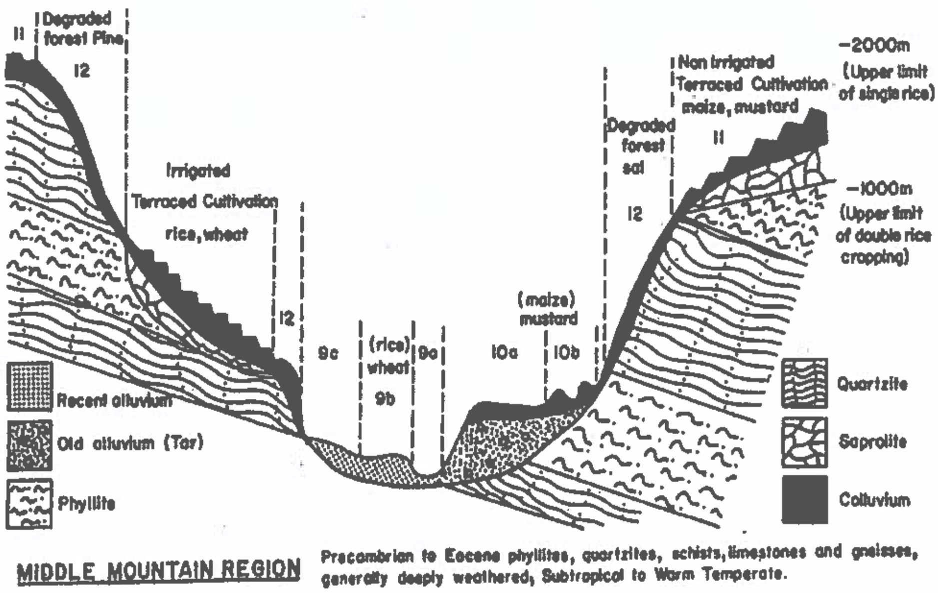
Figure 5.1-17: Schematic Cross-Section of the Typical Landforms in Siwalik Zone

Table 5.1-10: Soil Types in the different landforms and land units—Siwalik Zone ETP Area

Land system	Land form	Land Unit	Dominant Soils	Dominant Slopes	Dominant Texture	Seasonal Range of Depth to Water Table	Drainage
4	Active and recent Alluvial Plains	4a sand and gravel bars	Ustorthents Psamments	<1°	Sandy/ Cobbly	0 – 2m	subject to severe river flooding
		4b low terrace	Ustifluvents Fluvaquents	<1°	Sandy	0 – 2m	variable;subject to severe river flooding
		4c higher terrace undulating	Ustochrepts Haplaquepts	<1°	variable	dependent on position	variable,low areas subject to flooding
5	Fans,Aprons and ancient River Terraces(Tars)	5a very gentle slopes	Haplustolls Dystrochrepts Rhodustalfs	<1°	Loamy	1 – 15m	moderately well
		5b gentle slopes	"	1-5°	Loamy/ Bouldery	2 – 15m	rapid
		5c undulating	"	1-5°	Loamy	2 – 15m	well
		5d rolling	"	0-20°	Loamy	2 – 15m	rapid
6	Depositional Basin (Duns)	6a depressional	Haplaquepts	<1/2°	Fine Loamy	0 – 2m (perched)	poor
		6b non dissected high position	Ustochrepts Haplaquepts	<2°	Fine Loamy	0–6m (perched)	imperfect
		6c gently rolling	"	1-5°	Fine Loamy	2– 15m	variable
		6d highly dissected	Ustochrepts	0-30°	Fine Loamy	>15m	rapid
7	Moderately to Steeply Sloping Hilly and Mount-ainous Terrain		Lithic,Typic and Anthropic Subgroups of Dystrochrepts Ustochrepts	<20°	Loamy Skeletal	no water table <1m to bedrock	well
8	Steeply to very Steeply Sloping Hilly and Mountainous Terrain		Lithic Subgroups of 7 and Ustorthents	>20°	Loamy Skeletal	no water table <50cm to bedrock	rapid

Source: Carlson et al. 1986.

Figure 5.1-18 presents the schematic cross section of the typical landforms in the Middle Mountain zone while Table 5.1-11 presents developed soil types, thickness and drainage conditions in the ETP areas of the Middle Mountain zone.



Source: Carlson et al. 1986.

Figure 5.1-18: Schematic cross-section of the Typical Landforms in Middle Mountain Zone

Table 5.1-11: Soil Types in the different landforms and land units—Middle Mountain Zone ETP Area

Land System	Landform	Land Unit	Dominant Soils	Dominant Slopes	Dominant Texture	Seasonal Range of Depth to Water Table	Drainage
9	Alluvial Plains and Fans (depositional)	9a river channel	Psamments Ustorthents	<1°	Fragmental Sandy	0 – 2m	variable
		9b alluvial plains	Ustifluvents Fluvaquents Ustochrepts	<1°	Loamy/ Bouldery	0 - 2m	well
		9c alluvial fans	Ustochrepts Haplustalfs	1 - 5°	Loamy/ Bouldery	1 - 15m	well
10	Ancient Lake and River Terraces(Tars) (erosional)	10a non-dissected	Typic & Rhodic Haplustalfs Ustochrepts	0-5°	Loamy	> 2m	well
		10b dissected	"	0-5°	Loamy	> 2m	well
11	Moderately to Steeply Sloping Mountainous Terrain		Typic, Rhodic, Udic, Anthropic Subgroups of Ustochrepts Dystrochrepts Haplumbrepts	< 30°	Loamy Skeletal	> 50cm to bedrock	moderately well to well
12	Steeply to Very Steeply Sloping Mountainous Terrain		Lithic Subgroups of 11 and Ustorthents	> 30°	Loamy Skeletal	< 50cm to bedrock	well

Source: Carlson et al. 1986.

5.1.5.1.1.1 India Border to New Butwal Segment

This TL segment lies entirely on the Terai Physiographic zone. The developed soils are Ustorthents, Psamments, Ustifluvents, Fluvaquents, Ustochrepts, and Haplaquepts. Texturally, the soil are, fine loamy, loamy, sandy, and cobbly depending on the landforms, land units, and slope (Refer Table 5.1-9).

The geotechnical investigation found the soils in this segment to consist of medium dense to dense alluvium soil with increasing amounts of sand, pebbles, and gravels with depth. Distinctive silty sand representing alluvial deposit was the prominent soil type in this segment (see Appendix R).

New Butwal to New Damauli Segment

This TL segment traverses through the Terai, Siwalik, and Middle Mountain zones. The soils found in the Terai zone are Hoplustolls, Dystocherepts, and Ustochrepts showing loamy to boulder-like texture depending on the landforms, land units, and slope angle (Refer Table 5.1-9).

The soil types of the Siwalik zone are Ustorthents, Psamments, Ustifluvents, Fluvaquents, Haplaquepts, Hoplustolls, Dystocherepts, Rodustalfs, etc., of fine loamy skeletal, sandy, cobbly, and boulder-like texture depending upon the landforms, land units, and slope angles (Refer Table 5.1-10).

The soil types of the Middle Mountain zone are Ustorthents, Psamments, Ustifluvents, Hoplustolls, Dystocherepts, Rodustalfs, etc., of loamy, sandy, boulder-like, and skeletal textures depending upon the landforms, land units, and slope angles (Refer Table 5.1-11).

The geotechnical investigation found reddish gray colored cohesive clay and silt with weathered gravel and pebbles, with increasing amount of sandy with depth (see Appendix R). New Damauli to Ratmate Segment

This TL segment lies entirely on the Middle Mountain Physiographic zone. The soil types of the Middle Mountain zone are Ustorthents, Psamments, Ustifluvents, Hoplustolls, Dystocherepts, Rodustalfs, etc. of loamy, sandy, boulder-like, and skeletal textures depending upon the landforms, land units, and slope angles (Refer Table 5.1-11).

The geotechnical investigation found reddish-gray to gray colored cohesive clay, silt with occasional occurrences of gravel and pebbles of weathered phyllite, slate, quartzite, and limestone with increasing amount of compacted silty clay with regolith portion with depth.Ratmate to New Hetauda Segment.

This TL segment traverses across the Siwalik and Middle Mountain physiographic zones and are similar to the soils of Siwalik and Middle Mountain zone described in the NB to ND Segment above.

The geotechnical investigation found soils primarily consisting of silt and sand, along with weathered gravel and pebble with depth. The nature of the soil deposit was cohesive in nature and moist to dry (see Appendix R).

Ratmate to Lapsiphedi Segment

This TL segment lies entirely on the Middle Mountain physiographic zone and has soil characteristics similar to Middle Mountain portion of NB to ND Segment above.

The geotechnical investigation found soils typical of colluvial and alluvial soils of river terraces. The general soil profile consisted of reddish to brown colored, slightly cohesive, slightly moist, fine sand with the presence of silt and clay as a top soil, followed by reddish brown colored, highly cohesive, moist clay with the presence of very small rock fragments (see Appendix R).

5.1.6 Slope Stability

As indicated above, the area traversed by the ETP alignment includes areas characterized by high seismicity, rugged topography, complex geological settings, soft soil cover, and high intensity rainfall during monsoon periods, all of which increase the potential for landslides, debris flows, soil erosion, and other mass wasting processes. However, such severe mass wasting processes are of concern only in areas of high steepness of the terrain above 30 degrees, areas of geological instabilities such as sheared zones of thrusts, and faults, weak rocks and structures, and areas located close to the river channels as discussed in the section below. The areas lying outside such characteristics are relatively stable and safer. Field studies show nearly 70 percent of the TL route lies in the relatively stable land areas.

The slope angles across the TL RoW are a key indicator of slope stability. In the Nepal Himalaya, the regolith-covered slopes above 30 degrees by nature are prone to degradation. The angle of repose of the regolith-covered slope is usually 28 degrees, but may vary considerably depending upon the constituent materials. All the slopes above 30 degrees are thus vulnerable to land instability and the slopes between 20 to 30 degrees are moderately vulnerable.

The Terai comprises recent river deposits with groundwater levels at or near the surface and poor drainage conditions; therefore, it is vulnerable to flooding and riverbank erosion particularly during the monsoon season. The loosely consolidated nature of these sediments coupled with high groundwater levels in this zone also makes the ground surface prone to liquefaction during earthquakes.

The Siwalik (portions of NB to ND and RTE to NH) comprises soft, fragile, unconsolidated, and easily eroded mudstones, shales, sandstones, siltstones, and conglomerates which are exposed on moderately to steeply sloping landforms and separated by primary and secondary foliations that are vulnerable to mass wasting. The region receives well over 2,000 millimeters of precipitation annually, often occurring as intense cloud burst events; thus, debris flows, rotational slips, slumps, and block toppling commonly result. Because of the low moisture retention capacity of the Siwalik's soils and rock formations, rainwater drains very quickly to the stream channels, causing flash floods, bank erosion, and heavy sedimentation. These processes cause channel migrations across the alluvial fan deposits to the south of the Chure (IB to NB) with associated widespread flooding and siltation in the Terai. In the Siwalik physiographic zone the slopes even with around 10 degree slope are also vulnerable because of the geological make up.

The Middle Mountain zone, with the barrier mountain range of Mahabharat in the south and low-lying valleys and hill ranges in the north, experiences diverse land degradation processes. The south-facing slopes of the Mahabharat (portions of NB to ND and RTE to NH) receive high rainfall and are susceptible to debris flows and shallow landslides in the steeper section of the slopes. Similarly, the north-facing slopes of Mahabharat in this zone and in the low-lying hills and valleys farther north, the deeply weathered rocks and soils in the steeper slopes (portions of NB to ND, ND to RTE, RTE to NH, and RTE to LAP), are also vulnerable to debris flows and shallow to deep landslides. Stream bank erosion and flooding along watercourses is also common in this zone during the rainy season.

As indicated in Chapter 2 (Project Introduction), the development of the EIA alignment took into consideration slope stability and areas with landslide potential were avoided to the extent possible. As indicated in Chapter 10 (Environmental Monitoring), MCA-Nepal intends to conduct a detailed pre-construction survey of existing instable slopes and landslides. Table 5.1-12 presents a preliminary identification of areas along the TL alignment with visible landslides:

Table 5.1-12: Preliminary Identification of Landslide Areas along the ETP Alignment

TL Segment	Tower Numbers	Landscape Position of Landslide
India Border to New Butwal	none	
New Butwal to New Damauli	Towers 41 – 45 Towers 130 – 133 Towers 234 - 235	Within the RoW Upslope/Within RoW Downslope of RoW
New Damauli to Ratmate	Towers 60- 62 Towers 67 – 68 Towers 77 – 86 Towers 91 – 92 Towers 100 – 102 Towers 115 - 116	Upslope of RoW Upslope of RoW Downslope of RoW Downslope of RoW Upslope of RoW Within RoW
Ratmate to New Hetauda	Towers 20 – 21 Towers 86 – 88 Towers 90 – 91 Towers 130 - 132	Upslope of RoW Within RoW Downslope of RoW Downslope of RoW
Ratmate to Lapsiphedi	Towers 37 – 39 Towers 105 – 106 Towers 112 - 113	Upslope of RoW Upslope of RoW Upslope/Within RoW

5.1.7 Mining and Mineralization

There is no mineralization of economic importance in the rock sequences of the Terai, Sub-Himalayan, and Lesser Himalayan zones along the ETP RoW. However, the extraction of aggregates is a common practice along the river RoWs (i.e. riverbed and floodplain mining) and there is one limestone mine near the RoW in the RTE to NH Segment. While these activities are mostly local and do not involve large-scale mining, the lack of controls over these mining activities could be a potential risk to the land stability where they occur in proximity to transmission towers.

5.1.8 Land Cover

The land cover classifications within the transmission line RoW and substations are categorized into the following five categories based on the dominant land and vegetation cover:

- Built Up/Residential—buildings, structures, and other areas that show signs of human modification (excluding roads and agriculture);
- Cultivated—cultivated and fallow fields including areas that show clear agricultural activity;
- Forests—includes tropical sal forest, subtropical broadleaf schima forest, subtropical conifer pine forest, other wooded lands, open land with trees, and shrub/scrub;
- River and Floodplain—surface water bodies such as rivers, reservoirs, lakes, ponds, and their associated floodplains and wetlands; and
- Barren—large open sandy or rocky spaces that do not belong to any other land cover classes.

The majority of the alignment passes through undeveloped and remote areas, only about 4 percent passes through developed lands such as residential areas. Similarly, water resources such as rivers, lakes, ponds, and wetlands cover only 1.19 percent of the RoW. The dominant land covers within the RoW (for all five segments) are cultivated lands and forest. Overall, approximately 52.85 percent is forest and 41.56 percent is cultivated.

India Border to New Butwal Segment is predominantly (80 percent) cultivated lands, whereas the other four TL segments are a mix of forest and cultivated land. Table 5.1-13 presents land cover pattern within the ETP RoW as well as segment wise breakdown of land cover. Figures 5.1-19 to 5.1-23 present the land cover across the different TL segments.

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Table 5.1-13: Land Cover in the TL Right-of-Way by Segment

Land Cover Type	IB–NB		NB–ND		ND–RTE		RTE–NH		RTE–LAP		Total RoW	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Built Up/ Residential	3.9	4.6	15.4	3.73	17.5	4.01	12.1	4.58	12.3	4.52	**61.2**	**4.16**
Cultivated	68	80.19	155.2	37.54	200.3	45.87	65.5	24.80	122.4	44.98	**611.4**	**41.56**
Forest	10.5	12.38	234.2	56.65	213.2	48.82	183.8	69.59	135.8	49.91	**777.5**	**52.85**
River & Floodplain	2.4	2.83	8.6	2.08	2.2	0.5	2.7	1.02	1.6	0.59	**17.5**	**1.19**
Barren	0	0.0	0	0.0	3.5	0.8	0	0.0	0	0.0	**3.5**	**0.24**
Total	**84.8**	**100.0**	**413.4**	**100.0**	**436.7**	**100.0**	**264.1**	**100.0**	**272.1**	**100.0**	**1,471.1**	**100.0**

ha=hectare
Source: Project GIS Analysis and Sentinel 2 satellite imagery 2019.

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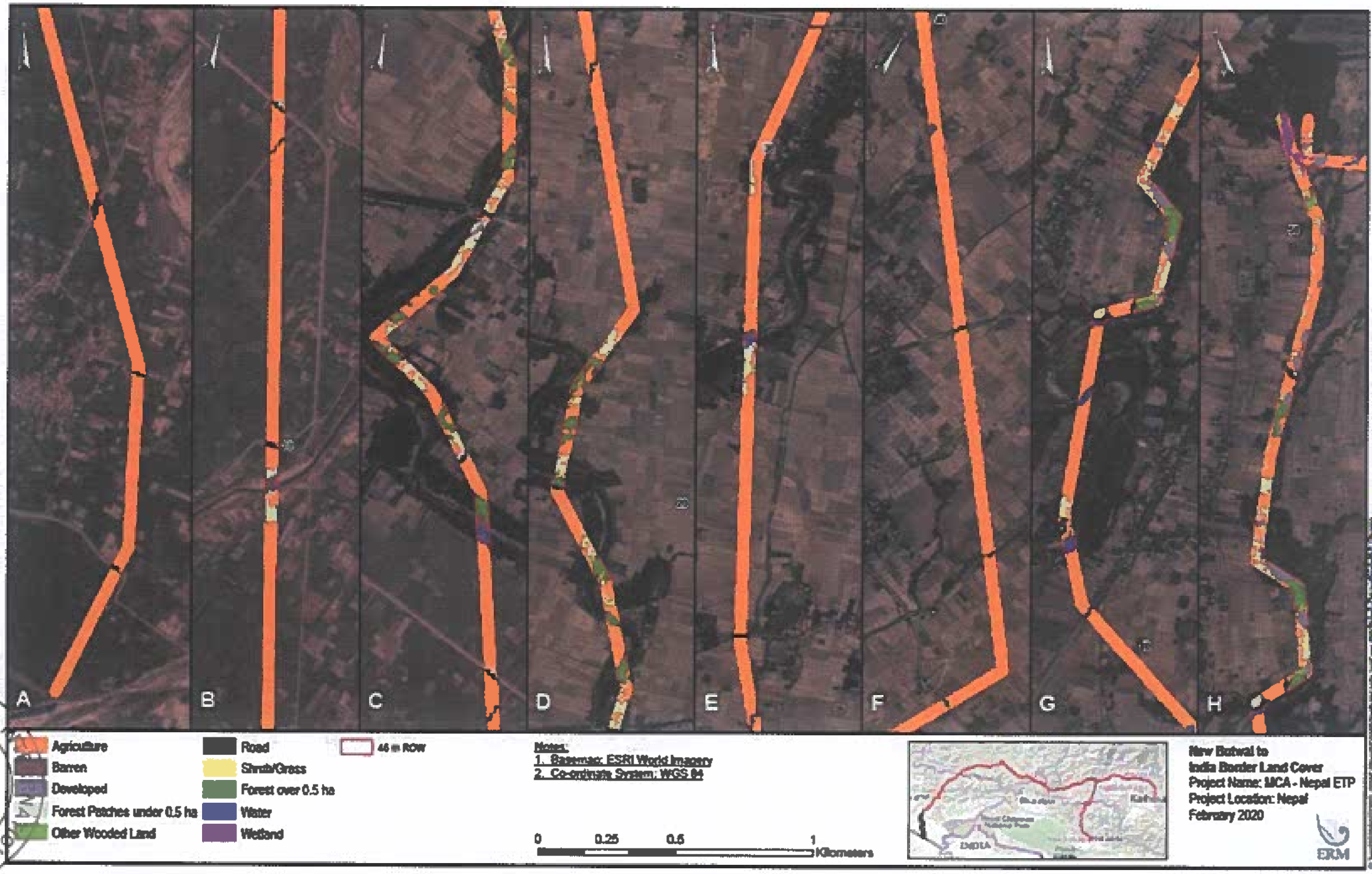

Please note, the land cover extends out 500 meters beyond the 46 meters RoW (with the exception of IB–NB Segment, Figure 5.1-20) because of the map scale

Figure 5.1-19: Land Cover in India Border to New Butwal Segment

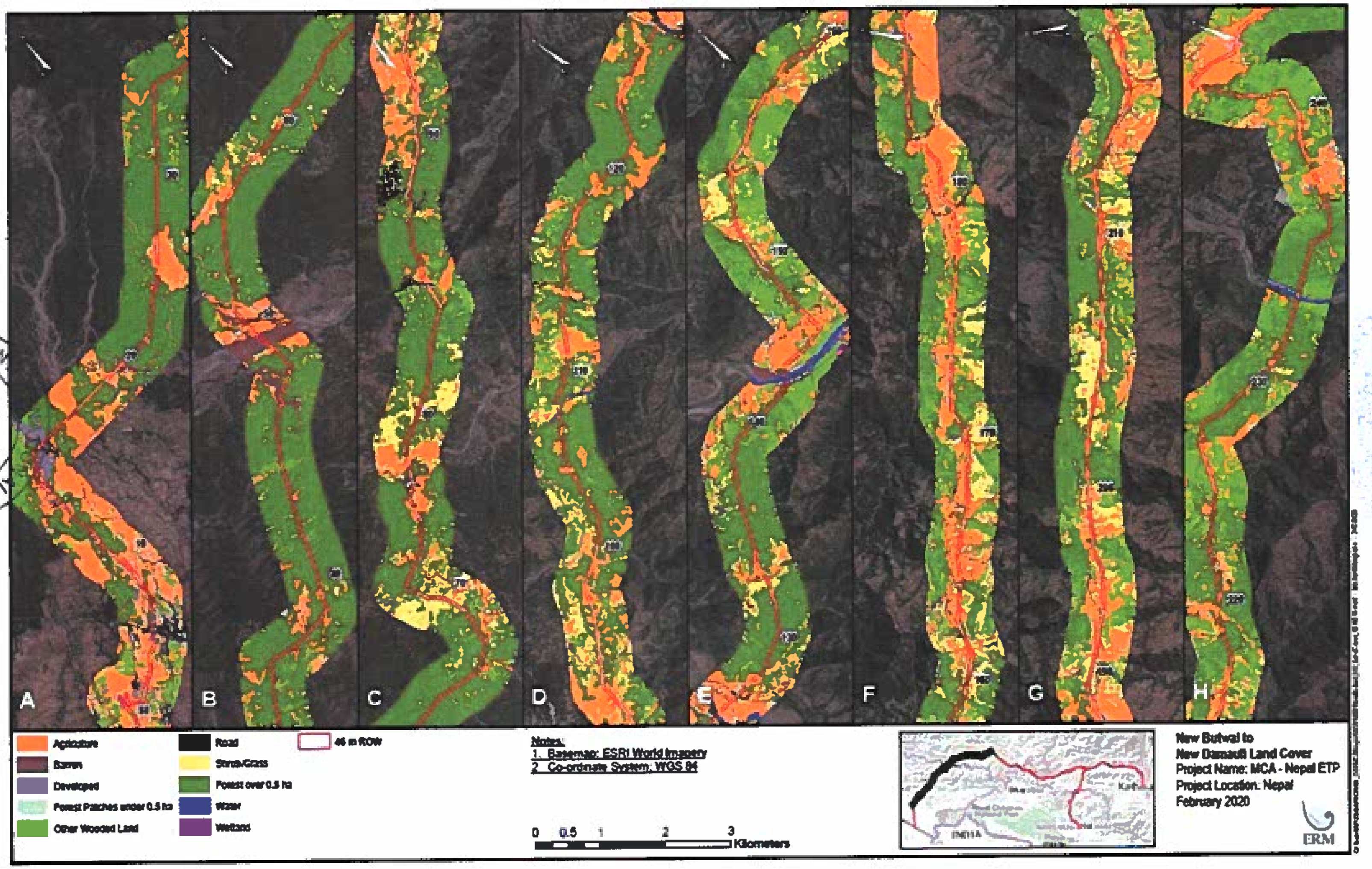

Figure 5.1-20: Land Cover in New Butwal to New Damauli Segment

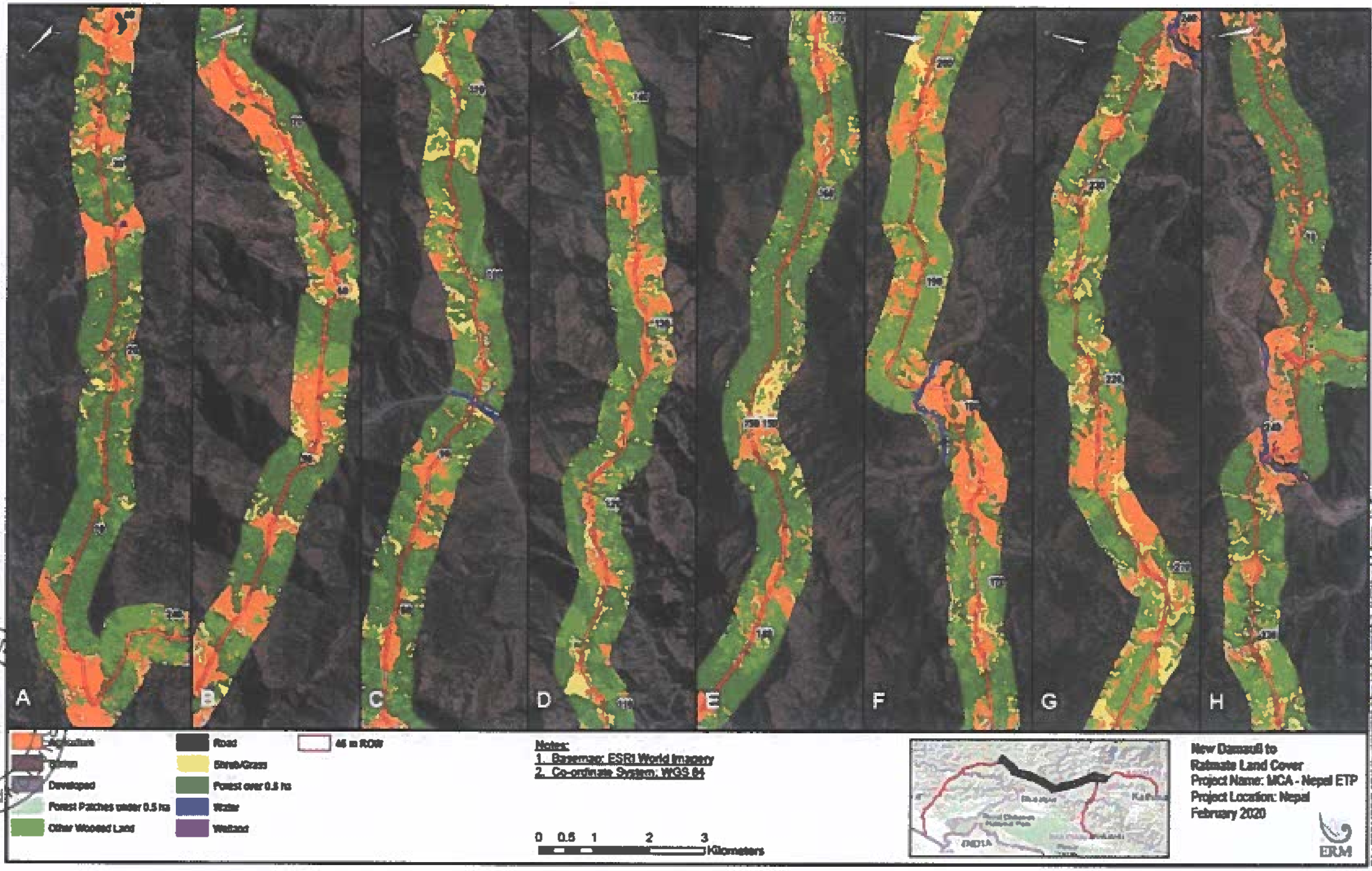

Figure 5.1-21: Land Cover in New Damauli to Ratmate Segment

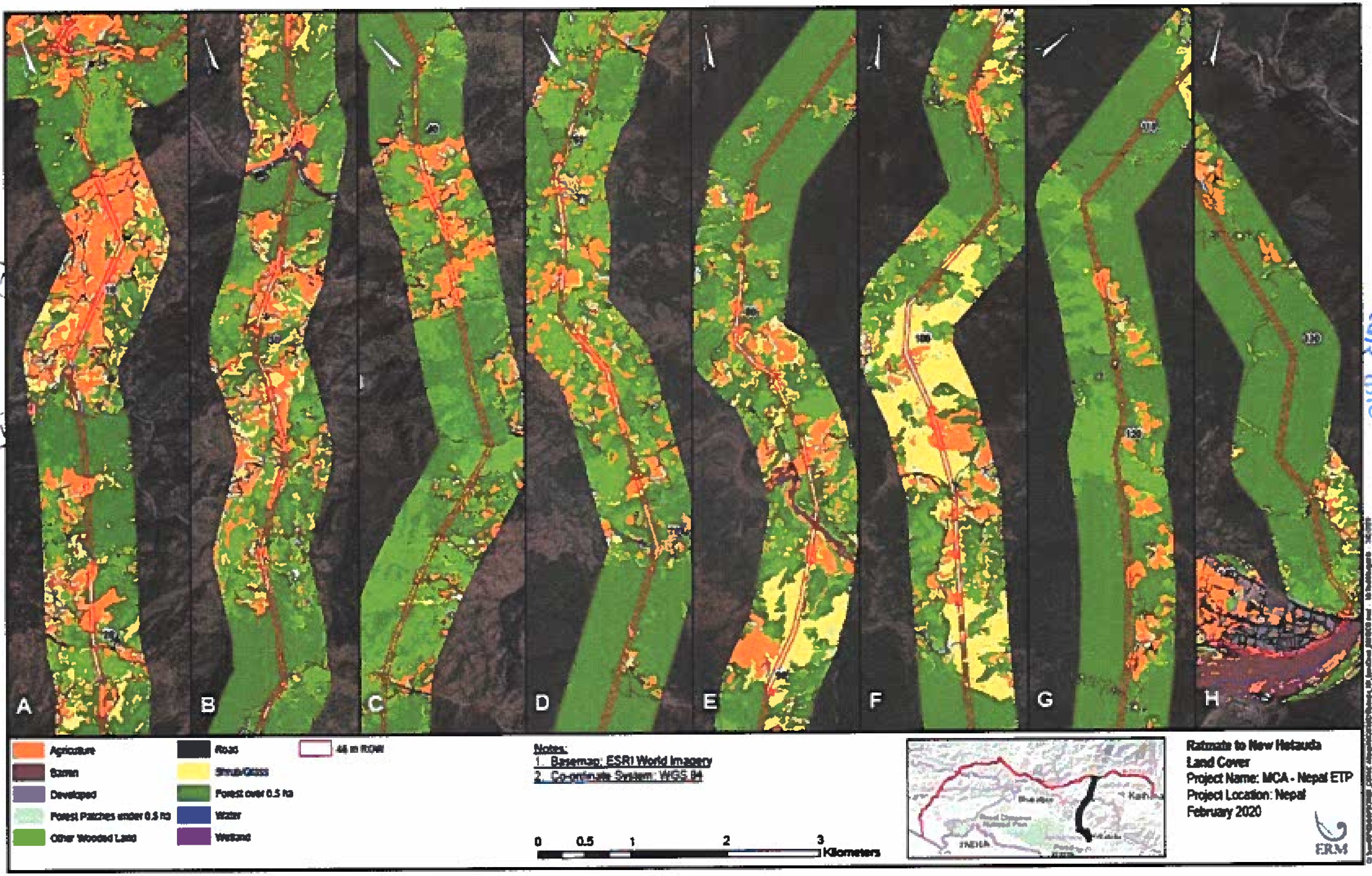

Figure 5.1-22: Land Cover in Ratmate to New Hetauda Segment

Figure 5.1-23: Land Cover in Ratmate to Lapsiphedi Segment

5.1.9 Climate

The climate in Nepal is governed by the east-west trending Himalayan massif and the monsoon-driven wet and dry seasons, with elevation as the principal influence on climatic zones. The ETP traverses two principal climatic zones: tropical (below 1,000 meters a.s.l.) and sub-tropical (1,000 to 2,000 meters a.s.l.) (Dobremez 1972).

The overall climate of the ETP RoW is influenced by the Asian monsoon system, with variations in air temperature and rainfall caused by topographic effects. Precipitation records indicate that local variations in rainfall and timing can be high, with the exposed sides and tops of ridges receiving four to five times more rainfall than nearby valleys in rain shadow areas.

The Terai zone is in the sub-tropical climatic zone, characterized by hot and humid summers, intense monsoon rain, and dry winters. The climate of the Siwalik zone also ranges from sub-tropical to warm-temperate and is characterized similarly. In the Middle Mountains, the climate ranges from sub-tropical and quite dry in river valleys, to warm temperate in upper valleys and cool temperate in the high hills.

In terms of weather, the ETP RoW experiences four distinct seasons. The pre-monsoon season (March to May) is characterized by the highest temperatures. Absolute maximum temperature in these pre-monsoon summer months can exceed 45 degrees Celsius in the Terai and Siwalik. In the valleys of the Middle Mountain zone, temperatures can reach up to 42 degrees Celsius. Along the ridge summits in the Middle Mountain zone, maximum temperatures can reach around 30 degrees Celsius. During April and May, violent lightning and thunderstorms occur with occasional high-speed wind gusts, a characteristic pattern of the pre-monsoon. About 100 to 400 millimeters of precipitation occurs during this season along the ETP RoW, mostly falling in intense, short-duration storms.

This is followed by the monsoon or rainy season (June to September). Nearly 80 percent of annual precipitation, ranging from 1,500 to 3,000 millimeters, occurs in this season. South-facing slopes (windward side) receive more rainfall than north-facing (leeward side) slopes, as the latter are in the rain-shadow. As the monsoon is a low-level wind, the blocking effects of topography are significant.

Because the Siwalik range and the Mahabharat ranges of the Middle Mountain are the first mountain barriers to the northward-moving monsoon clouds coming from the Bay of Bengal, these areas receive heavy precipitation. Sporadic cloudbursts during the rainy season are not uncommon, and 150 to 450 millimeters of precipitation can occur within 24 hours (Figure 5.1-24). Such cloudbursts often trigger debris flows and landslides within the ETP RoW landscapes; these mostly occur between mid-July and mid-September, when the ground is at its wettest and liquefaction more likely.

Average annual relative humidity across the ETP RoW ranges between 65 to 85 percent (Dahal 2006). The relative humidity is usually high (80 to 90 percent) in winter, dropping to between 50 to 70 percent in the summer. Because of the high relative humidity, the summer season is hot and humid in the Terai and Chure and on the valley floors of the Middle Mountain.

A wind atlas for Nepal has yet to be developed; however, Nepal's National Building Code (NBC 104 1994) on wind load has divided the country into two regions: the first generally includes the southern plains (Terai), Kathmandu Valley, and areas below 3,000 meters a.s.l., where the basic maximum wind velocity is considered to be 47 meters per second; the second region lies above 3,000 meters and the basic maximum wind velocity is assumed to be 55 meters per second. The TL route ranges in elevation between 100 meters and just under 2,000 meters a.s.l., and hence falls within the first, lower elevation zone.

Figures 5.1-25, 5.1-26, 5.1-27, and 5.1-28 present the annual mean rainfall, monsoon mean rainfall, post monsoon mean rainfall and winter mean rainfall in the terrain traversed by the TL segments. Mean annual rainfall ranges from 1,500 to 2,500 millimeters. In general, the IB to NB, NB to ND and RTE to NH segments receives more rainfall compared to the other two segments.

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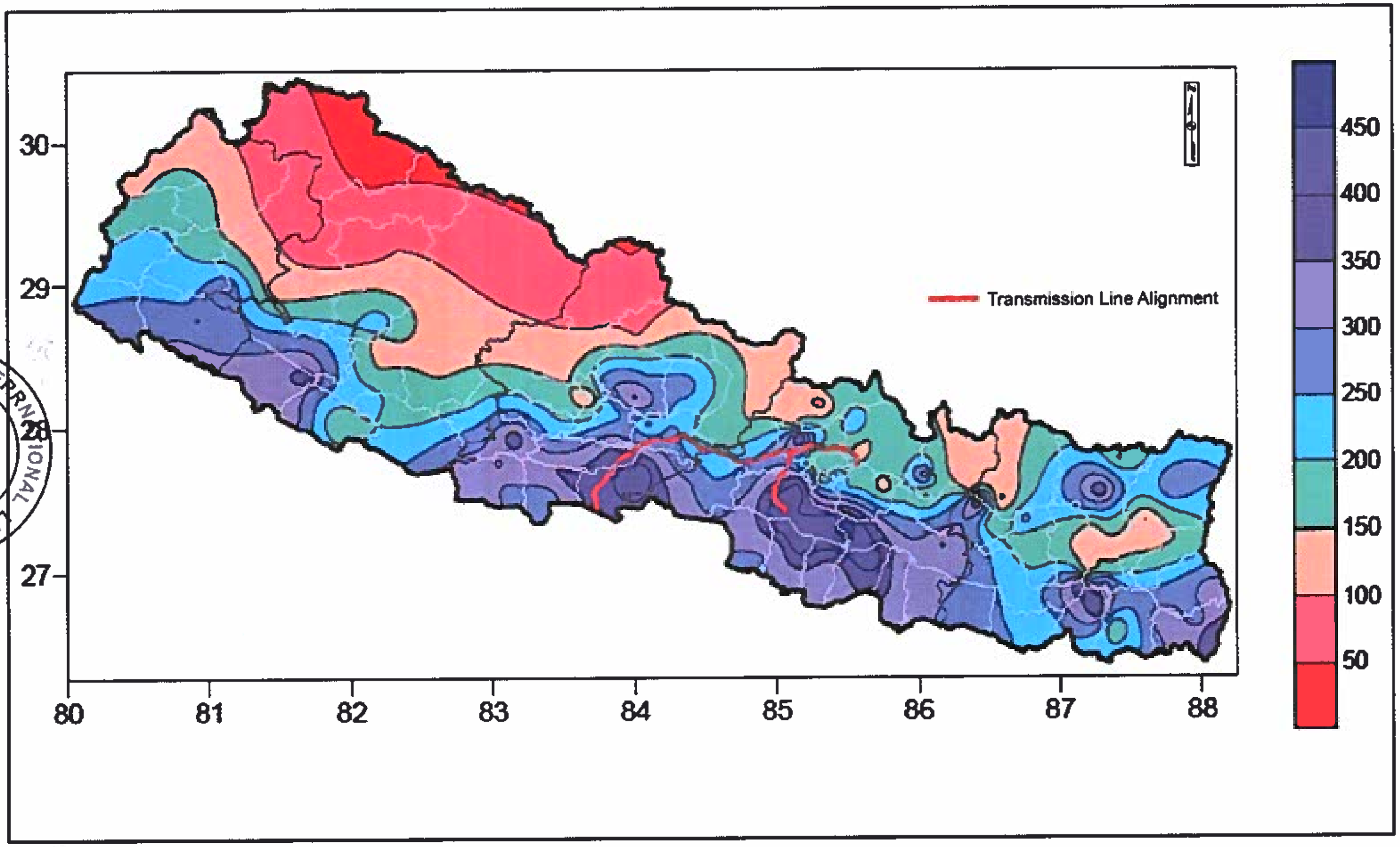
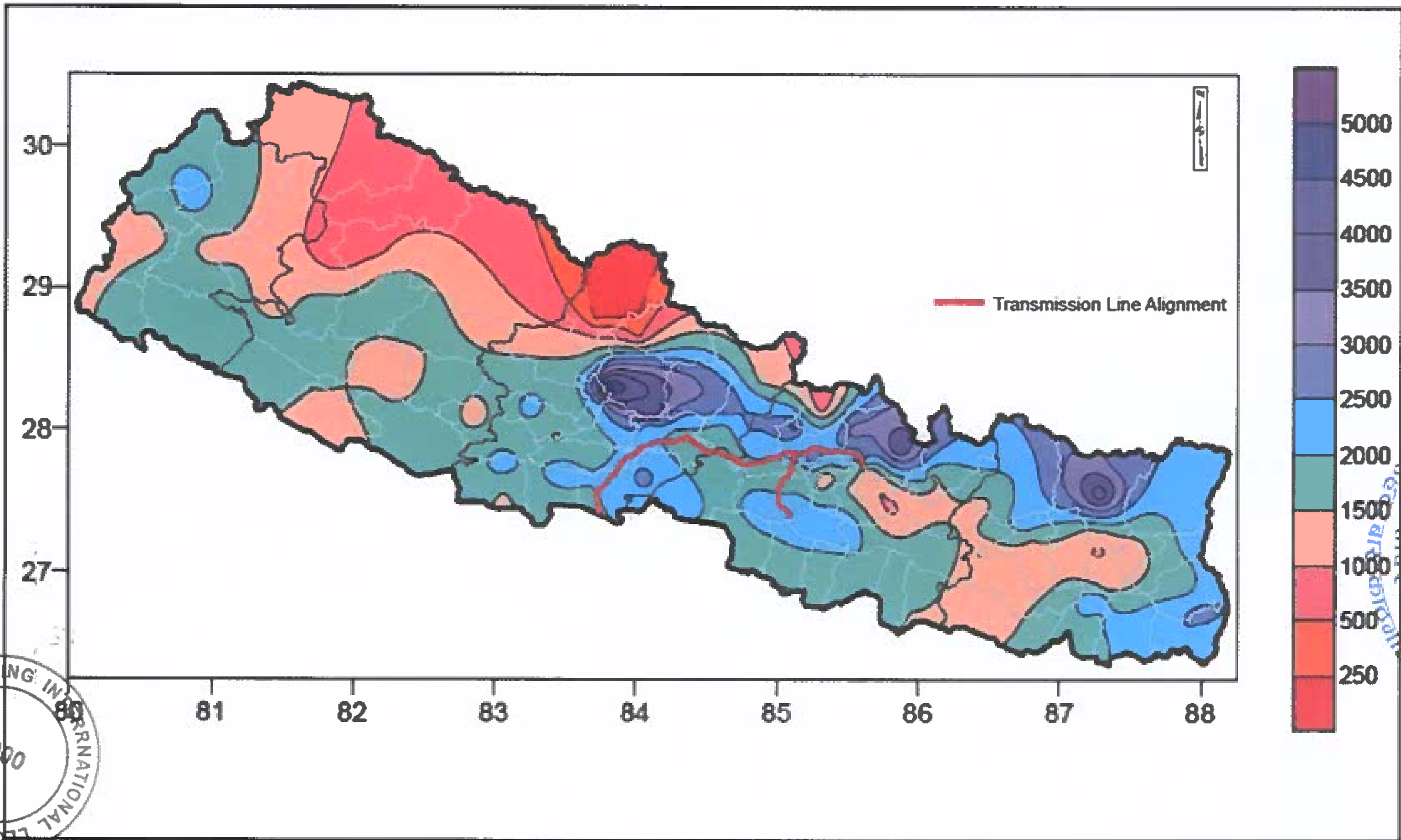


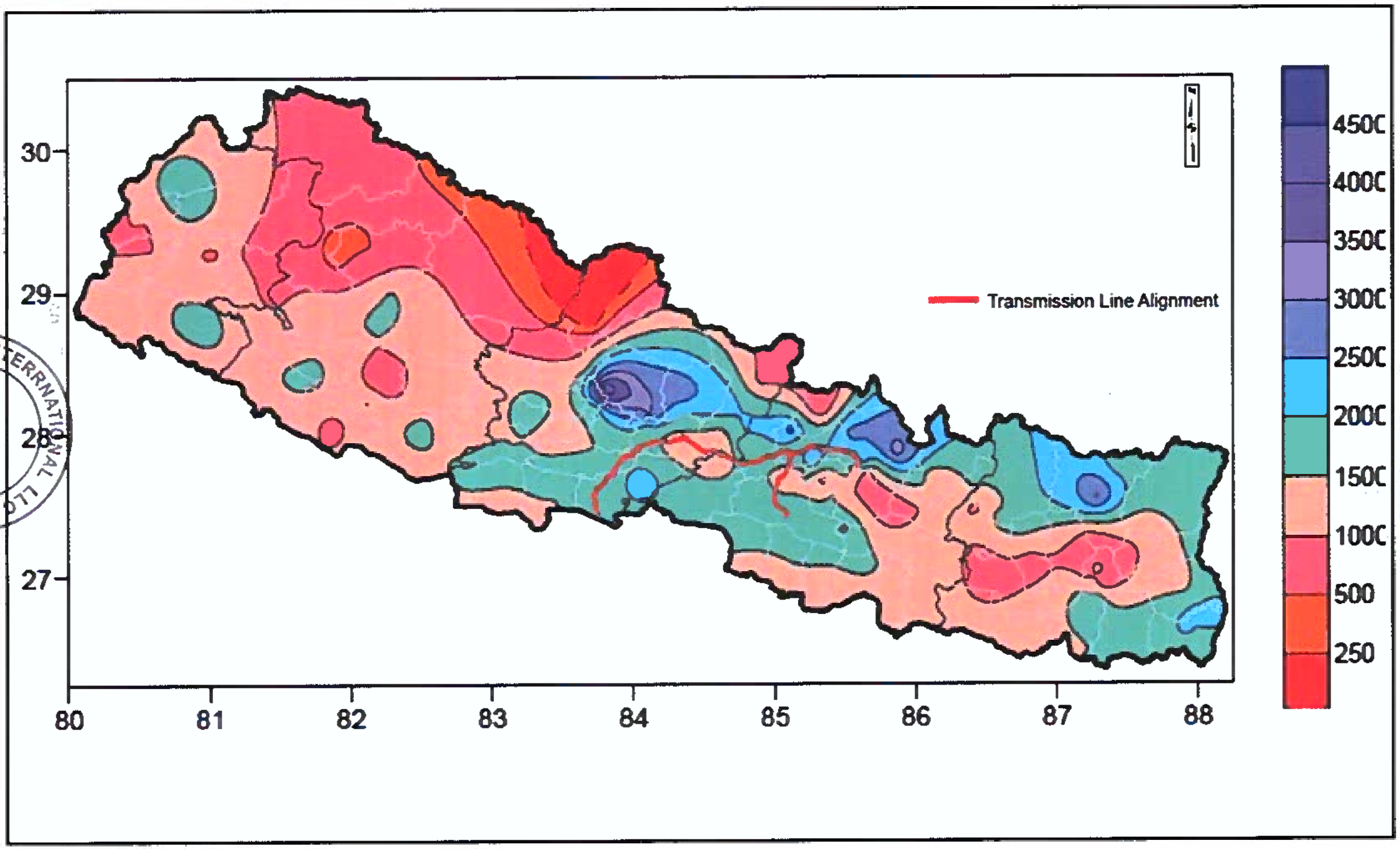
Source: SOHAM-Nepal 2008

Figure 5.1-24: 24-Hour Highest Rainfall (millimeters)



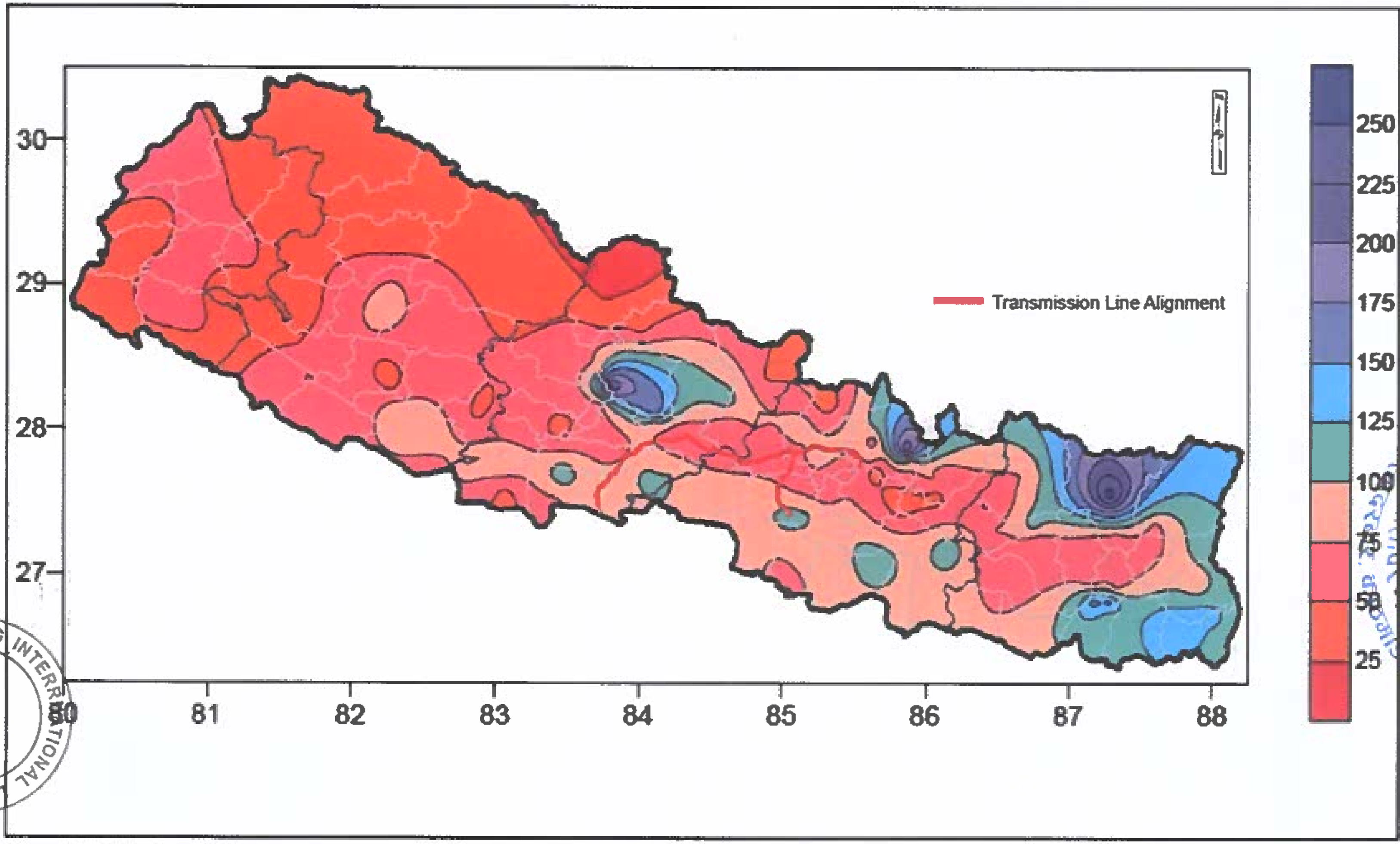
Source: SOHAM-Nepal 2008

Figure 5.1-25: Annual Mean Rainfall (millimeters)



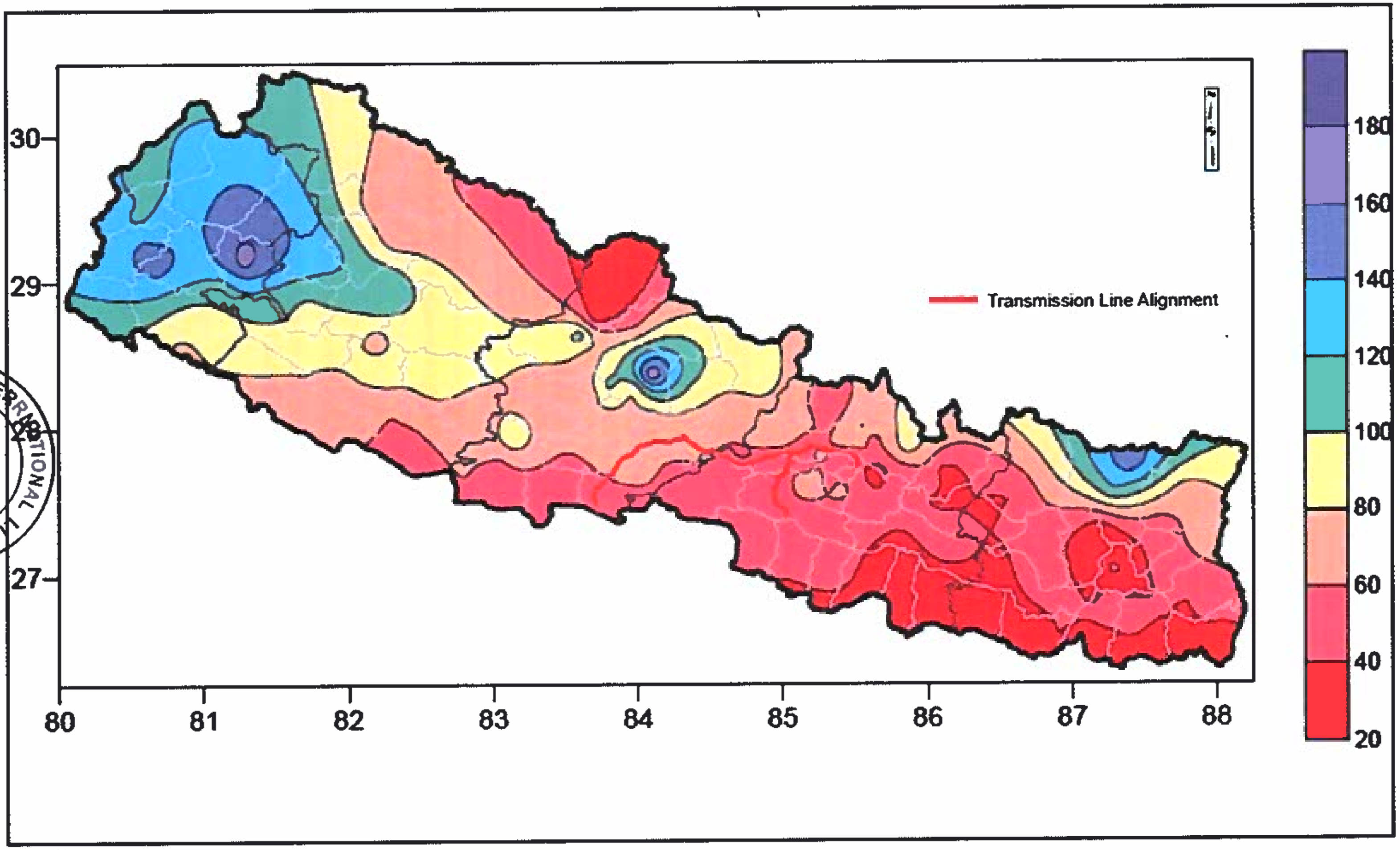
Source: SOHAM-Nepal 2008

Figure 5.1-26: Monsoon Mean Rainfall (millimeters)



Source: SOHAM-Nepal 2008

Figure 5.1-27: Post-Monsoon Mean Rainfall (millimeters)



Source: SOHAM-Nepal 2008

Figure 5.1-28: Winter Mean Rainfall (millimeters)

Segment-Specific Climate

The ETP segments crossing the Terai and Siwalik physiographic zones (all of IB to NB Segment, and portions NB to ND and RTE to NH Segments), lie in the sub-tropical climatic zone.

The entire segments of RTE to LAP and ND to RTE, and portions of TL RTE to NH and NB to ND segments, which cross the Mahabharat mountain ranges, show a rapid shift in climatic zone, from sub-tropical on the valley floors to warm and cold temperate along the elevated mountain ranges.

Recorded annual mean temperatures shows higher values in the Siwalik compared to the Middle Mountain zone (Table 5.1-14). As the records represent the valley locations, the average annual mean temperatures on the elevated ridges is expected to be lower by 2 to 3 degrees Celsius than the valley locations in this zone.

Table 5.1-14: Average Annual Mean Temperature and Annual Precipitation from Meteorological Station Data

ETP Segment	Meteorological Stations	Physiographic Zone	Average Annual Mean Temperature (years)	Average Annual Precipitation (years)
IB–NB	Parashi, Nawalparashi (Station No. 708)	Terai/Chure	31.5 °C (2012 – 2019)	1,715.6 mm (1971 – 2019)
NB–ND	Damauli, Tanahu (Station No. 817)	Middle Mountain	30°C (2004 – 2019)	1,683.3 mm (1974 – 2019)
ND–RTE	Nuwakot, Nuwakot (Station No. 1004)	Middle Mountain	27.4°C (1956 – 2019)	1,796.4 (1956 – 2019)
RTE–NH	Hetauda, Makawanpur (Station No. 906)	Terai/Chure	29.3°C (1966 – 2019)	2,400.8 (1966 – 2019)
RTE–LAP	Sankhu, Kathmandu (Station No. 1035)	Middle Mountain	N/A*	1,922.9 (1971 – 2019)

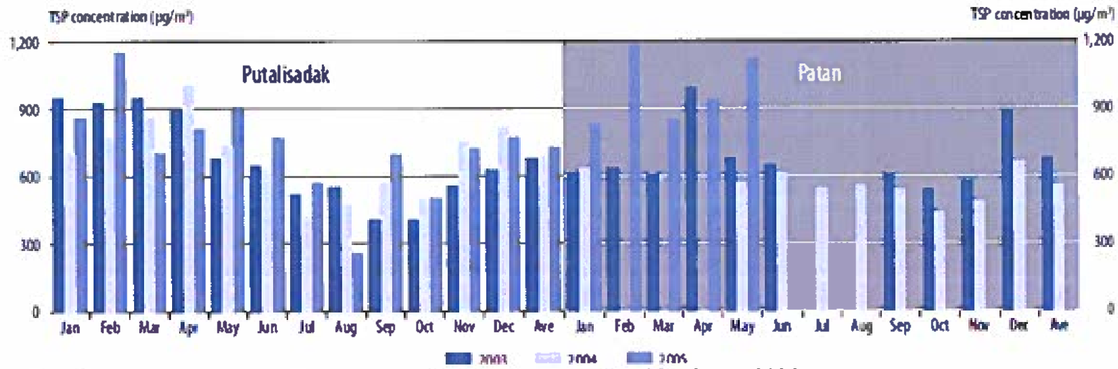
Source: Nepal Department of Hydrology and Meteorology, Government of Nepal 2020
*N/A: Temperature data not available for Station No. 1035.

5.1.10 Air Quality

Overall, Nepal's air quality is good, other than in population centers where vehicle and industrial emissions, as well as the combustion of biomass and fossil fuels result in elevated levels of pollutants, with particulate matter being of particular concern. In rural areas near settlements, re-suspension of dust from the mostly unpaved roads also results in elevated particulate levels. However, as the TL alignment traverses open rural areas consisting of forest and agricultural lands for the great majority of its length, baseline air quality conditions are expected to be good.

Forest fires, particularly in the winter and spring/summer months in the Chure and Middle Mountain regions, create hazy conditions throughout that section of the ETP RoW. In the Terai zone, the cold wave (sit lahar) causes reductions in ambient air quality for periods of 15 to 20 days during the winter months, resulting in low to very low visibility conditions.

Available ambient air quality monitoring data near the ETP RoW is limited to urban areas, primarily in the Kathmandu Valley. An indication of the particulate levels encountered is shown in Figure 5.1-29, which in addition to indicating the relatively high monthly average concentrations of total suspended particulates (TSP, data from 2003 to 2005), illustrates the considerable reduction in particulate levels during the monsoon season.



Source: Asian Development Bank and the Clean Air Initiative for Asian Cities Center 2006

Figure 5.1-29: Average Monthly TSP Concentration at the High Traffic Setting—Kathmandu Valley

Other urban areas, such as Butwal and Bhairahawa (approximately 25 – 30 kilometers to NB Substation) in the Terai physiographic zone, also show high TSP and particulate matter 10 micrometers or less in diameter (PM_{10}) concentrations (see Table 5.1-15).

Table 5.1-15: TSP and PM10 Concentrations at Butwal and Bhairahawa Urban Centers (based on 8-hour day time period averaging time)

Particulars (ug/m³)	Nepal Standard	Bhirahawa	Butwal
TSP	230	926	1,150
Respirable Particulate Matter (PM_{10})	120	865	1,077

Source: Central Bureau of Statistics 2013; NAAQS Nepal 2003

TSP, PM_{10}, and PM 2.5 levels close to rural settlements near the Kathmandu—Pokhara Highway also show elevated concentrations (see Table 5.1-16).

Table 5.1-16: TSP, PM10, and PM2.5 Concentrations at Benighat Area (based on 24 hours averaging time)

Particulars (ug/m³)	Nepal Standard	May 2013		December 2013	
		Majhitar	Kalleri	Majhitar	Kalleri
TSP	230	225	171	422	386
Respirable Particulate Matter (PM_{10})	120	209	140	347	360
Respirable Fine Particles ($PM_{2.5}$)	40	154	83	46	138

Source: Budhigandaki Hydroelectric Development Committee 2015

While the seasonal trends are similar to those of the Kathmandu Valley, the pollutant concentrations in the rural areas along much of the ETP RoW are expected to be much lower. Table 5.1-17 presents the TSP, PM10, and PM 2.5 level collected at the RTE, ND and NB substations by the Consultant Team. Air quality sampling was not conducted at the NH or LAP substations as these are existing substations to which the Project will only be connecting.

Table 5.1-17: TSP, PM10, and PM2.5 Concentrations at Ratmate, New Damauli and New Butwal Substations (based on 24 hours averaging time)

Particulars (ug/m³)	Nepal Standard	January 2020		
		New Butwal Substation	New Damauli Substation	Ratmate Substation
TSP	230	159.5	44.2	58.9
Respirable Particulate Matter (PM_{10})	120	157.1	34.4	48.9
Respirable Fine Particles ($PM_{2.5}$)	40	152.2	24.6	36.8

Source: Consultant Team 2020

At the New Butwal Substation, the collected air quality samples exceeded the Nepal standards for PM 10 and 2.5, which is attributable to the ongoing construction (e.g., crusher) of the NB 220 kilovolt substation by Nepal Electricity Authority, the adjacent brick kiln operation, windblown dust from nearby agricultural land, and vehicular traffic. At the New Damauli Substation, the collected air quality sample complied with the Nepal standards, although some windblown dust from nearby agricultural land was observed. At the Ratmate Substation, the collected air quality sample complied with Nepal standards despite the presence of a nearby brick kiln, ongoing construction of the nearby road to China, and windblown dust from agricultural land.

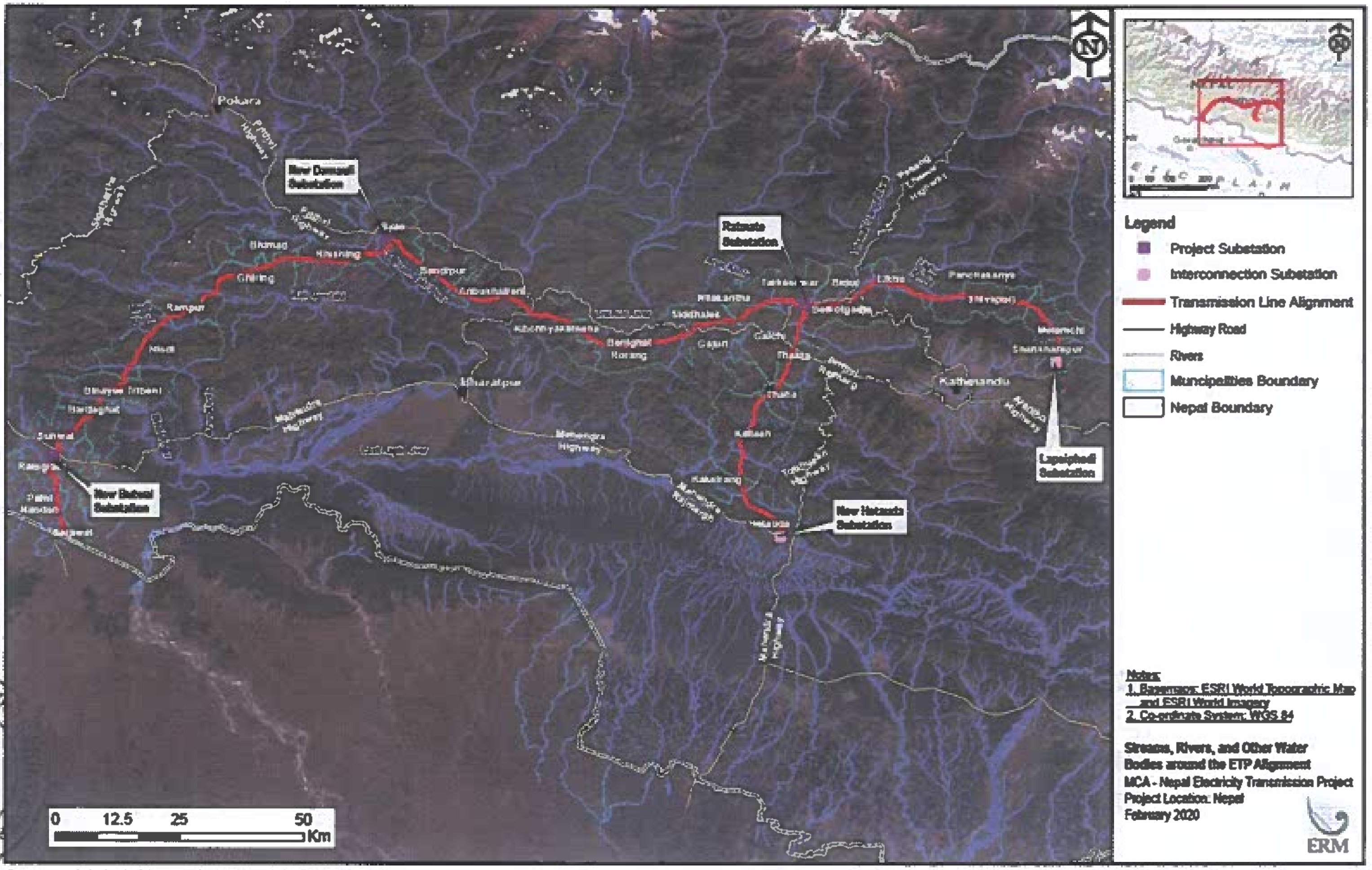
5.1.11 Water Resources

There are over 6,000 rivers and streams in Nepal, with an estimated total river/stream length of 45,000 kilometers. Surface water, including springs, is the major source of drinking water throughout the country, although groundwater is the main source in the Terai region and Kathmandu Valley. Population growth and development pressures are causing the level of groundwater in the Terai and Kathmandu Valley to drop as a result of reduced recharge and over-extraction.

The water resource characteristics of the topographic zones traversed by the ETP alignment are:

- Terai—contains many small and usually seasonal rivers, most of which originate in the Chure.
- Siwalik (or Chure)—are the source of a large number of smaller rivers, which are generally shallow and mostly dry up during the dry season. These rivers are used by small-scale farmers for seasonal supplementary irrigation, but are subject to changes in their courses and sediment patterns. The Siwalik is also the source of much of the ground water recharge for the Terai.
- Middle Mountains—are the source of the rivers like Babai, Bagmati, Kamala, Kankai, and West Rapti, which are all perennial. Examples of such rivers along the ETP RoW include Likhu, Dhande Khola, Belkotgadi Khola, East Rapti River, and Nisdi River.

The proposed ETP will cross 54 water bodies ranging from streams less than 50 meters wide (measured from bank to bank), to small rivers from 50 to 100 meters wide, to large rivers over 100 meters wide, as illustrated in Figure 5.1-30 below (also see Table 2.6-3).



Source: Digital Chart of the World 1992

Figure 5.1-30: Streams, Rivers, and Other Water Bodies around the ETP Alignment

Segment-specific Water Resource

The summary of water body crossings are provided below (also see Table 2.6-3)

- India Border to New Butwal Segment: 10 water crossings.
- New Butwal to New Damauli Segment: 23 water body crossings, including the Kali Gandaki and Seti rivers.
- New Damauli to Ratmate Segment: 10 water body crossings, including three crossings of Trishuli River.
- Ratmate to New Hetauda Segment: 6 water body crossings, including a crossing of the East Rapti River.
- Ratmate to Lapsiphedi Segment: 5 water body crossings, all of which are streams.

Table 5.1-18 presents the average monthly flow of the Trishuli River at the Super Trishuli Hydropower Project as indicative of seasonal flow characteristics of rivers and streams in the Project area. The Trishuli River at the Super Trishuli Hydropower Project is downstream to the Project, but is in close proximity to where the ETP route crosses the Trishuli River. As Table 5.1-18 shows, flows are high during the monsoon season (i.e. June to September), then gradually decrease during the dry season (October to February), before starting to increase in the spring (March to May) as snow melts and rainfall begins to increase. Although the ETP will span all of the rivers and streams crossed, the importance of these data to the ETP is to ensure that the transmission towers avoid the high flow and floodplain areas to the extent possible.

Table 5.1-18: Monthly Average Trishuli River Flow at Super Trishuli Hydropower Project

Month	Mean Monthly Flow (1977-2006)
January	121 m^3/s
February	106 m^3/s
March	115 m^3/s
April	169 m^3/s
May	299 m^3/s
June	693 m^3/s
July	1,376 m^3/s
August	1,529 m^3/s
September	1,041 m^3/s
October	471 m^3/s
November	246 m^3/s
December	159 m^3/s

Source: Super Tishuli Hydropower Project Detailed Project Report 2014

5.1.12 Noise

There are no permanent-noise monitoring stations in Nepal, and relatively little historic noise data available for the ETP route, as most noise studies that have been conducted in urban locations. Background noise levels are expected to vary along the route, depending on the influence of existing natural sounds (such as windblown vegetation or animals) and anthropogenic sources (vehicle traffic), but for the majority of rural locations, ambient and background noise levels are expected to be between approximately 35 and 55 A-weighted decibel (dBA). Traffic on public roads, commercial areas, and industrial development, result in far higher ambient noise levels (e.g., 50–85 dBA) when compared to the rural areas along the ETP alignment.

Segment-Specific Noise

The primary source of noise with TL projects is associated with the substations. Noise monitoring was carried out at 15 locations (i.e., the five substation locations and two other locations at settlements near each substation) continuously for 24 hours. Equivalent noise levels (Leq) were calculated for each hour as well as over day and night time (Leq_{Day} and Leq_{Night}) at each ambient noise monitoring location. Table 5.1-19 presents a summary of the noise monitoring results along with Nepal and World Bank standards as a reference.

Table 5.1-19: Summary of Ambient Noise Monitoring Results

Station No.	Monitoring Location	Hourly Leq in dB(A)		Leq in dB(A)	
		Leq max	Leq min	Leq day	Leq night
B1	NB Substation site	74	42	62	47
B2	Badera, Sunwal-3, Nawalparasi (Northwest of NB Substation)	77	42	69	59
B3	Bhumahi, Sunwal-12, Nawalparasi (Southeast of NB Substation)	73	43	66	55
D1	ND Substation site	64	37	54	54
D2	Charkune, Vyas-1, Tanahu (Northwest of Damauli Substation)	59	36	49	54
D3	Pokharibhanjyang, Vyas-13, Tanahu (South of Substation)	59	35	36	54
R1	RTE Substation site	62	50	56	56
R2	Khalte, Belkotgadi-07 (Northeast of RTE Substation)	76	51	69	55
R3	Khalte, Belkotgadi-07 (Southwest of RTE Substation)	71	51	64	58
H1	NH Substation site	67	40	57	46
H2	Thaha Chowk, Hetauda-11 (East of Hetauda Substation)	66	39	59	54
H3	Shanti Chowk, Hetauda-11 (Northwest of Hetauda Substation)	72	51	64	57
L1	LAP Substation site	64	43	58	57
L2	Settlement Northwest of LAP Substation	76	53	67	72

Station No.	Monitoring Location	Hourly Leq in dB(A)		Leq in dB(A)	
		Leq max	Leq min	Leq day	Leq night
L3	Settlement Southeast of LAP Substation	81	55	77	77
Nepal Standards	Silence Zone			50	40
	Industrial Area			75	70
	Business Area			65	55
	Rural Residential Area			45	40
	Urban Residential Area			55	45
	Mixed Residential Area			63	40
World Bank Standards	Residential, Institutional, and Education Areas			55	45
	Industrial and Commercial Areas			70	70

Source: Consultant Team 2020

Based on the analysis of the ambient noise monitoring data, the following observations can be made:

India Border to New Butwal Segment

Three monitoring locations were selected near the NB Substation, with one within the substation area and the other two at nearby settlements. The area around the proposed NB substation includes a mix of low-density residential uses as well as a brick kiln industrial facility. Noise levels were higher than the World Bank and Nepal noise standards, which is primarily attributable to operation of the brick kiln and ongoing construction activities for a separate 220 kilovolts TL at the NB Substation (B1), as well as vehicular traffic and nearby markets (B2 and B3).

New Butwal to New Damauli Segment

Three monitoring locations were selected near the proposed ND Substation with one within in the proposed substation area and the other two at a nearby settlement and a school (Jana Jagriti Ganga Madhyamik Vidyalaya). Noise levels were higher than the World Bank and Nepal standards, which is attributable to anthropogenic sources of noise, such as vehicular noise.

New Damauli to Ratmate Segment

Three monitoring locations were selected near the proposed RTE Substation with one within in the proposed substation area and the other two at a nearby settlements. Noise levels were higher than the World Bank and Nepal standards, which is attributable to an operating brick factory and vehicular noise.

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Ratmate to New Hetauda Segment

Three monitoring locations were selected near the NH Substation with one within in the proposed substation area and the other two at a nearby settlements. Noise levels were higher than the World Bank and Nepal standards. Anthropogenic sources of noise and vehicular movement are the major noise sources in the area. Some noise was generated from small-scale commercial activities (e.g., vehicle repairing workshops, metal cutting workshops) present along the East-West Highway.

Ratmate to Lapsiphedi Segment

Three monitoring locations were selected near the LAP Substation with one within in the proposed substation area and the other two at a nearby settlements. Noise levels were higher than the World Bank and Nepal standards, which is attributable to anthropogenic sources of noise, such as vehicular noise.

Rural Areas Along the Transmission Line Route

Noise monitoring in other rural areas of central Nepal (Benighat Rorang Rural Municipality), which are representative of conditions found along the transmission line route as distinct from the substations, found daytime noise levels (L_{eq} day) of 43 dBA, and nighttime noise levels (L_{eq} night) of 44 dBA (NESS, 2020).

5.1.13 Landscape Values and Visual Amenity

Nepal is home to the largest mountain range in the world, the Himalayas to the north, which create some visually stunning landscapes. The ETP passes well south of the Himalayan range, primarily in the Middle Mountains physiographic zone (see Figure 5.1-1). This area consists of forested mountains, quaint villages, scenic rivers and gorges, some historic sites, and occasional views of the Himalayas. The sites and landscapes in proximity to the ETP that offer special scenic, cultural, recreational, or touristic value is included in Figure 5.1-31.

Figure 5.1-31: Important Visual Landscapes and Sites near the ETP

- Historic towns—the ETP passes in close proximity to two historic towns, namely Bandipur and Nuwakot. These historic towns invite tourists to experience the Himalayan ranges scenery, hiking and rich culture. Bandipur is a well-preserved town with temples, shrines, sacred caves, and Newari architecture (Figure 5.1-32). Nuwakot is an important hill town that once served as a regional capital and an important trading hub before unification of Nepal. It has a seven-story Durbar, which was built in the 18th century, although damaged by the 2015 earthquake (Figure 5.1-33).

- Recreation areas—the ETP crosses three rivers that are used for recreational boating, the Trishuli, Seti, and Kaligandaki.

- National parks—the ETP passes near the Shivapuri—Nagarjun National Park, which is known for its forested landscapes and scenic views of the Himalayan range.

5.1.14 Market centers with future growth potential near TL Alignment

Table 5.1-20 presents major market centres with future expansion potential. The expansion of these markets will increase the value of land to be acquired for tower foundations and for land needed for RoW.

Table 5.1-20 Market centers with future growth potential near TL Alignment

TL Segment	Nearest Towers	Market Centers	Approximate distance
India Border to New Butwal	41 32	Karagar, Ramgram-13 Pathkhauli, Ramgram-17	500 m 240 m
New Butwal to New Damauli	6	Badera, Sunwal 13	75 m
New Damauli to Ratmate	183	Gajuri-2	205 m
Ratmate to New Hetauda	T5	Hetauda SMC-11	190 m
Ratmate to Lapsiphedi	156 40	Nanglebharae, Shankarapur-1 Malakot, Likhu-3	60 m 160 m

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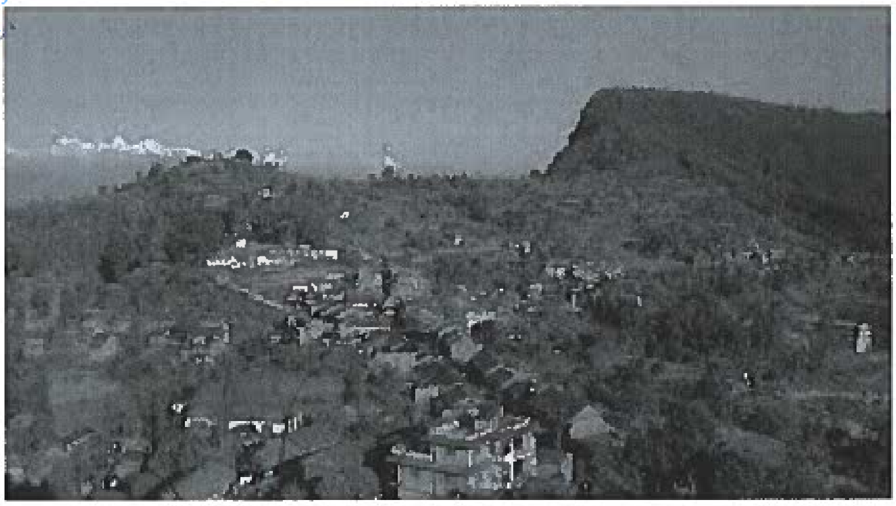

Figure 5.1-32: Bandipur

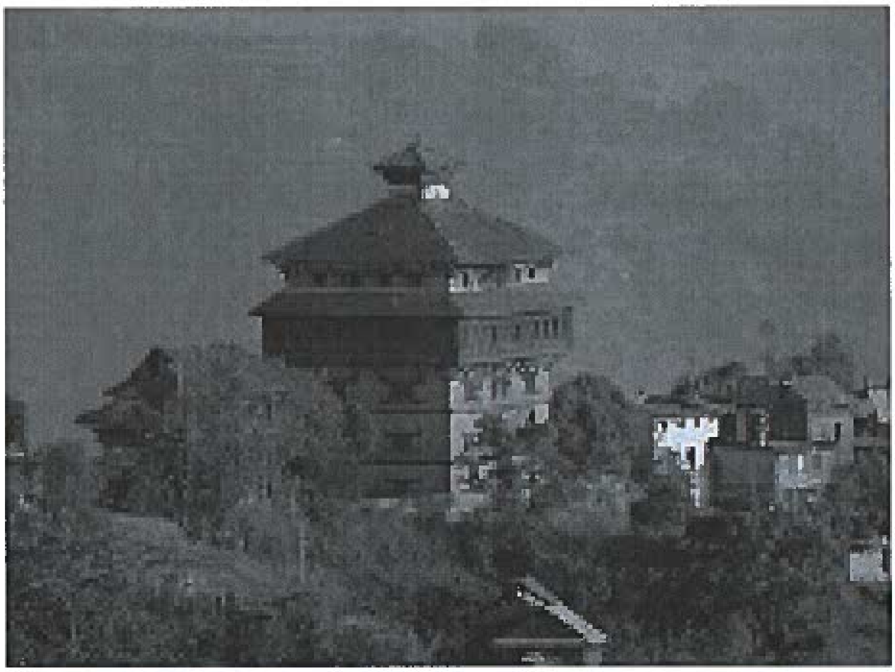

Figure 5.1-33: Nuwakot

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Vegetation Types

Nepal's unique geography, with dramatic changes in elevation along the relatively short (150 to 250 kilometer) north–south orientation, and associated variability in the physiographic and climatic conditions has resulted in rich diversity of flora in Nepal. Other important climatic factors, such as rainfall, winter snowfall, temperature, and aspect, have influenced biodiversity. Besides these local factors, the country's standing between two major biogeographic regions of the world (Indo-Malayan to the south and Palearctic to the north) has made Nepal a mixing place of species originating in both the regions (Stainton 1972).

ERM has utilized the forest classification developed by Stainton (1972) for Nepal to define the vegetation types along the ETP. These classifications, based on the phyto-geographic boundaries in climate, vegetation, and floristic composition, split Nepal's forests into 35 vegetation types. These 35 types are categorized into 10 major groups: (1) tropical, (2) subtropical broadleaved, (3) subtropical conifer, (4) lower temperate broadleaved, (5) lower temperate mixed broadleaved, (6) upper temperate broadleaved, (7) upper temperate mixed broadleaved, (8) temperate coniferous, (9) subalpine, and (10) alpine scrub. The ETP will affect the first three of these major vegetation types (1 through 3 above), as the proposed elevation of the ETP reaches less than 2,000 meters above sea level (asl).

Descriptions of the vegetation types along the ETP are outlined below in Table 5.2-1.

Table 5.2-1: Vegetation Types Identified within the ETP

S/N	Vegetation Type	Elevation	Floral Values	Distribution (MoFSC 2012)	ETP Segment
1.	Tropical forests	<1,000 m asl	*Shorea robusta (Sal), Terminalia* spp., *Adina cordifolia, Lagerstroemia parviflora, Bombax ceiba and Albizzia* spp., are the main tree species in these forests. *Acacia catechu, Dalbergia sissoo*, and *Bombax ceiba* are common in riverine forests.	Mostly occur in the Terai and Chure Hills regions	India Border to New Butwal Substation New Butwal to New Damauli Substation New Damauli to Ratmate Substation Ratmate to New Hetauda Substation Ratmate to Lapsiphedi Substation
2.	Subtropical broadleaved forests	1,000 to 2,000 m asl	Dominated by *Schima wallichii* and *Castanopsis indica. Alnus nepalensis* is widespread along streams and moist places.	Mainly occur in the eastern parts of the country	New Butwal to New Damauli Substation New Damauli to Ratmate Substation Ratmate to New Hetauda Substation Ratmate to Lapsiphedi Substation

S/N	Vegetation Type	Elevation	Floral Values	Distribution (MoFSC 2012)	ETP Segment
3.	Subtropical conifer forests	1,000 to 2,000 m asl	Primarily consist of *Pinus roxburghii* forests.	*Pinus roxburghii* forests occur along southern dry slopes	New Butwal to New Damauli Substation New Damauli to Ratmate Substation Ratmate to Lapsiphedi Substation

Source: GoN; MoFSC 2012; Stanton 1972

The area of each forest type identified along the ETP Right of Way (RoW) is outlined in Table 5.2-2. Note that these areas do not correspond to areas that will be cleared. The areas shown are total areas of forest along the ETP RoW. For comparative assessment during the impact assessment phase, an area of analysis (AoA) has also been calculated, consisting of 500 meters either side of the centerline of the RoW.

The AoA was chosen to represent the interaction of the ETP with the surrounding landscape, taking into account relative impacts to forest edges. Edge effects vary in their impact to surrounding forests with some impacts due to changes in moisture differentials estimated to impact the 120 meters whilst impacts due to invasive species can impact up to 250 meters in tropical forests (Voller 1998). In relation into changes in species mix due to forest edges, Sapkota et al. (2018) identified that impacts from villages adjacent to forests in the Terai are impacted by human disturbances between 0 – 1500 meters from human settlements, with the disturbance gradient reducing after the first 500 meters but continuing in extent. Note that this is an extreme example of human induced edge effects as human settlements are likely to have a much greater impact to adjacent forests than other types edge effects (as described).

Table 5.2-2: Area and Length of Boundary for Each Vegetation Type Identified along the ETP RoW

ETP Segment	Area of Measurement	Tropical Forests	Subtropical Broadleaved Forests	Subtropical Conifer Forests	Other Forest[1]	Total
India Border to New Butwal Substation	Area of forest within RoW (ha)	4.3	0.0	0.0	6.2	10.5
	Boundary length along RoW (km)	0.8	0.0	0.0	1.1	1.9
	Area of forest in AoA (ha)[2]	246.3	0.0	0.0	213.1	459.4
New Butwal to New Damauli Substation	Area of forest within RoW (ha)	128.8	57.2	3.6	43.3	232.9
	Boundary length along RoW (km)	26.7	12.9	0.7	9.9	50.2
	Area of forest in AoA (ha)[2]	4,315.3	529.5	354.5	1,070.2	6,269.5
New Damauli to Ratmate Substation	Area of forest within RoW (ha)	90.7	50.9	0.0	72.8	214.4
	Boundary length along RoW (km)	18.9	11.0	0.0	15.8	45.7
	Area of forest in AoA (ha)[2]	3,278.6	1,811.6	100.8	1,019.8	6,210.8
Ratmate to New Hetauda Substation	Area of forest within RoW (ha)	73.5	59.2	0.6	50.6	183.9
	Boundary length along RoW (km)	15.9	12.8	0.1	11.3	40.1
	Area of forest in AoA (ha)[2]	1,909.1	1,769.7	33.7	683.8	4,396.3
Ratmate to Lapsiphedi Substation	Area of forest within RoW (ha)	33.8	34.9	19.7	47.4	135.8
	Boundary length along RoW (km)	6.7	7.6	4.4	10.9	29.6
	Area of forest in AoA (ha)[2]	1,689.4	832.3	124.7	639.6	3,286.0
Total	**Area of forest within RoW (ha)**	**331.1**	**202.2**	**23.9**	**220.3**	**777.5**
	Boundary length along RoW (km)	**69.0**	**44.3**	**5.2**	**49.0**	**167.5**
	Area of forest in AoA (ha)[2]	**11,438.7**	**4,943.1**	**613.7**	**3,626.5**	**20,622.0**

[1] Other Forest includes other forest communities not falling into the other three primary forest types, as well as shrub/scrub habitat, which is considered potential future forest habitat and is treated as forest for this analysis.

2 Measured as 500 meters either side of the centerline of the RoW

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5.2.2 Forest Management

The following section provides the results of the desktop assessment considering the ETP route in the context of national and internationally recognized areas of high biodiversity value and other recognized conservation-specific land classifications. Additionally, the section provides information on the broad land class definitions within Nepal, as well as nationally designated conservation landscapes and protected areas. The interaction of the proposed ETP route with these classifications is highlighted in each section. Note that many of these conservation areas overlap and relevant figures are referenced to provide context to the interaction of the ETP to these areas.

It should be noted that uncontrolled forest fire is a serious threat in the Project area, particularly in the Chure region and Middle Mountains. Most of the fires are deliberately set by local farmers to clear land for agriculture or to stimulate early growth of grass for livestock to graze, although some are the result of lightning strikes or are started accidentally (e.g., cigarettes). Recurrent forest fires severely damage and prohibit regeneration and growth of seedlings, destroy non-timber forest products and other flora, injure ground fauna and provide conditions that encourage invasive species. In some parts of the Middle Mountains, frequent burning has greatly reduced the regeneration and development of understorey vegetation, thereby leading to an open forest with relatively low biodiversity (MoFSC, 2014).

5.2.2.1 National Forest Management Framework

The *Forest Act (2019)* governs Nepal's forest management framework. This act legislates the demarcation of forest management regimes, including national forests and set out provisions for community forests, protected forests, leasehold forests, religious forests, and private forests (amongst others). The *Forest Act* further sets out the offences and punishments relating to the forestry sector.

The forest management categories outlined within the *Forest Act* through which the ETP alignment passes have been superimposed to indicate the areas of forest that coincide with the alignment. Table 5.2-3 below outlines the categories where the ETP alignment coincides with acres of forest. Relevant ETP segments that correspond to these forest types are shown on Figure 5.2-1. Example areas of where the ETP coincides with the categories is shown in three callout boxes within the figure. A list of Community Forests and Leasehold Forests that falls within the ETP footprint is provided in Annex O.

Table 5.2-3: Forest Management Categories under the *Forest Act 2019* Relevant to the ETP Alignment

S/N	Forest category	Description (from *Forest Act 1993*)	Identified along ETP Alignment
1.	National Forest	All Forest excluding Private Forest within the Nepal, whether marked or unmarked with Forest Boundary and the term shall also include waste or uncultivated land or unregistered lands surrounded by the Forest or situated near the adjoining Forest as well as path, pond, lake, river or stream and riverine land within the Forest.	See categories (2–6 below)
2.	Government Managed Forest	National Forest managed by Government of Nepal.	Yes
3.	Protected Forest	National Forest declared by Government of Nepal as a Protected Forest pursuant to this Act, considering it to be of special environmental, scientific, or cultural importance.	Yes
4.	Community Forest	National Forest handed over as Community Forests to groups of designated users, known as Community Forestry User Groups, to rehabilitate and improve the management and use of forested areas in accord with the common interests of the group.	Yes
5.	Leasehold Forest	National Forest handed over as Leasehold Forests (for 40 years) to the poorest households for their exclusive use to alleviate poverty and rehabilitate degraded forest areas	Yes
6.	Religious Forest	National Forest handed over to a religious body, group, or community for its development, conservation, and utilization.	No
7.	Private Forest	Forest planted, nurtured or conserved in any private land owned by an individual pursuant to prevailing laws. Private forest is not considered to be national forest	No

Source: Nepal Forest Act, 2019; NESS 2019

Based on the spatial assessment of the ETP RoW alignment and the delineation of these forest management categories in the landscape, the area of the forest categories coinciding with the RoW has been identified through spatial analysis using a land cover model. Table 5.2-4 outlines the total area and length of the RoW within each ETP segment coinciding with each forest category. For comparative assessment during the impact assessment phase, an area of analysis (AoA) has also been calculated, consisting of 500 meters either side of the centerline of the RoW. On average, 45.6 percent of forest will be cleared within the RoW for all ETP segments. Table 5.2-5 outlines the total forest by forest type and district.

Table 5.2-4: Area and Length of ETP RoW within Forest Management Categories

ETP Segment	Area of Measurement	Forest Category		Other Forest	Total Forest
		Community Forest	Leasehold Forest		
	Area of forest in RoW (ha) [1]	1.1	0.0	9.4	10.5

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ETP Segment	Area of Measurement	Forest Category		Other Forest	Total Forest
		Community Forest	Leasehold Forest		
India Border to New Butwal Substation	Area to be cleared (ha)[2]	1.1	0.0	9.4	10.5
	Area of forest in AoA (ha)[3]	4.9	0.0	454.5	459.4
	Length (km)[4]	0.5	0.0	1.7	2.2
New Butwal to New Damauli Substation	Area of forest in RoW (ha)[1]	91.9	2.2	138.8	232.9
	Area to be cleared (ha)[2]	50.8	2.2	61.9	114.9
	Area of forest in AoA (ha)[3]	1,734.9	18.5	4,516.1	6,269.5
	Length (km)[4]	25.3	0.5	29.6	55.4
New Damauli to Ratmate Substation	Area of forest in RoW (ha)[1]	90.9	2.2	121.3	214.4
	Area to be cleared (ha)[2]	34.8	0.2	49.1	84.1
	Area of forest in AoA (ha)[3]	1,500.3	11.1	4,699.4	6,210.8
	Length (km)[4]	23.3	0.6	25.5	49.4
Ratmate to New Hetauda Substation	Area of forest in RoW (ha)[2]	73.3	0.0	110.6	183.9
	Area to be cleared (ha)[2]	45.8	0.0	49.0	94.8
	Area of forest in AoA (ha)[3]	1,265.8	0.0	3,130.5	4,396.3
	Length (km)[4]	18.8	0.0	24.2	43.0
Ratmate to Lapsiphedi Substation	Area of forest in RoW (ha)[1]	73.2	0.0	62.6	135.8
	Area to be cleared (ha)[2]	26.2	0.0	23.9	50.1
	Area of forest in AoA (ha)[3]	1,155.8	0.0	2,130.2	3,286.0
	Length (km)[4]	21.0	0.0	13.8	34.8
Total	**Area of forest in RoW (ha)[1]**	330.4	4.4	442.7	777.5
	Area to be cleared (ha)[2]	158.7	2.4	193.3	354.4
	Area of forest in AoA (ha)[3]	5,661.6	29.5	14,931.0	20,622.0
	Length (km)[4]	88.9	1.1	94.7	184.8

[1] Area calculated within the 46-m RoW

2 Area calculated to be cleared within forested areas contained within the Community and Leasehold Forest boundary

3 Length of forest intersecting the segment

4 Measured as 500 meters either side of the centerline of the RoW

Table 5.2-5: Total Forest Land by Forest Type and District

Province	Districts	CF (ha)	LHF (ha)	Government and Other Forest (ha)	Total Forest (ha)
Bagmati	Nuwakot	73.9	0.0	59.5	133.4
	Sindhupalchok	0.0	0.0	17.9	17.9
	Kathmandu	3.6	0.0	7.0	10.6
	Dhading	68.9	1.6	67.7	138.2
	Chitwan	0.0	0.6	20.6	21.2
	Makawanpur	59.1	0.0	80.7	139.8
Lumbini	Palpa	46.0	2.2	35.2	83.4
	Nawalparasi W	19.7	0.0	39.3	59.0
Gandaki	Tanahu	44.0	0.0	99.7	143.7
	Nawalparasi E	15.2	0.0	15.1	30.3
	Total	330.4	4.4	442.7	777.5

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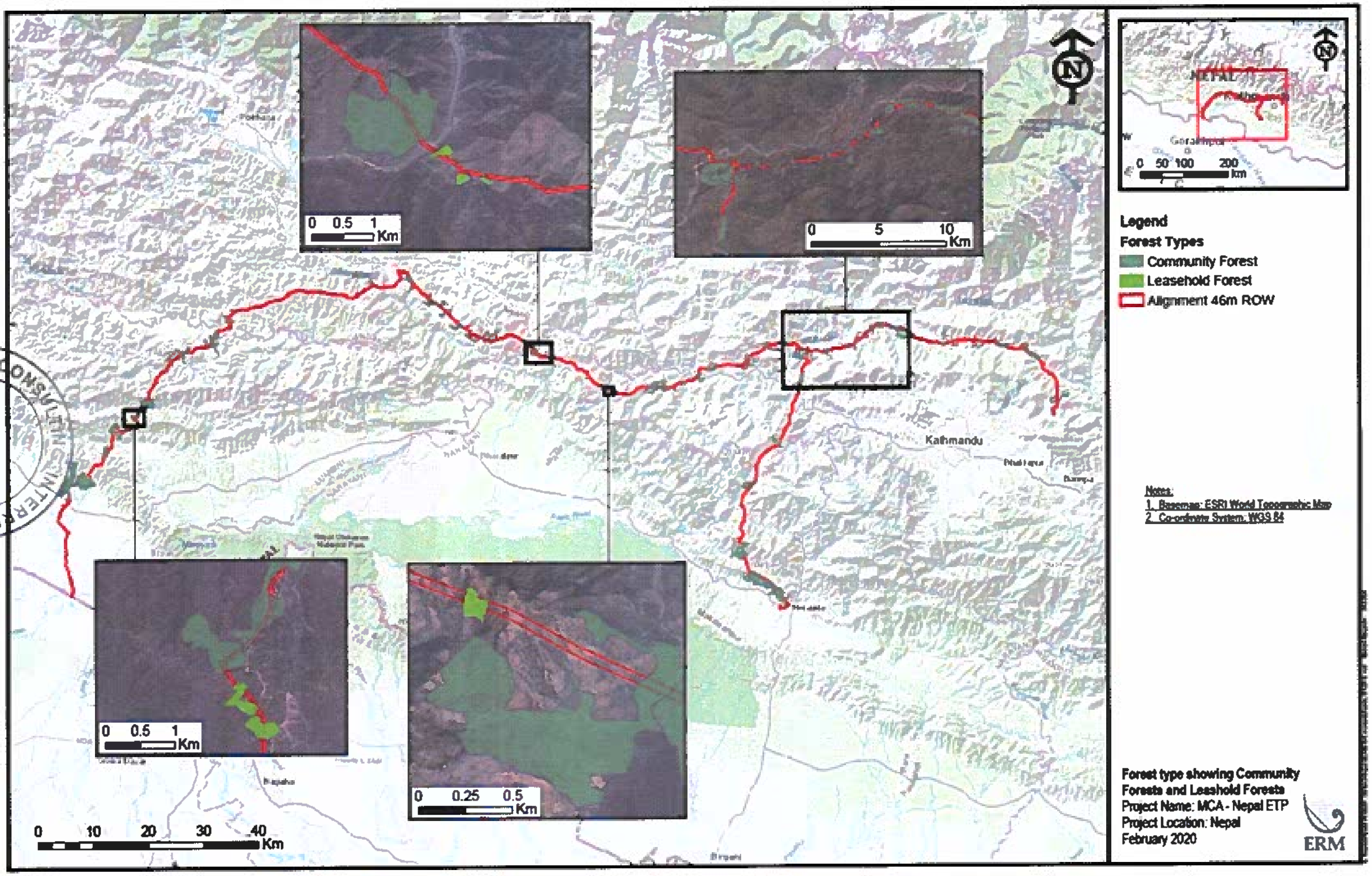

Figure 5.2-1: Forest type showing Community Forests and Leashold Forests

5.2.3 Forest Inventory Survey Results

According to the requirements of the Nepal government, a forest inventory survey was conducted to sample at least 1 percent of the total forest cover along the ETP route. This data has been supplemented by data derived from the geospatial assessment of land cover as well as LiDAR data from the ETP alignment. Further analysis was also undertaken to determine trees that would remain where the canopy is below the safe buffer of conductors. This has enabled an estimate to be made of the total number of trees/poles to be cleared along the ETP alignment.

In summary, the results have been analyzed and are shown in Table 5.2-6 in relation to the areas derived for vegetation classifications and Table 5.2-7 outlines tree clearing by district and different forest management regimes along the ETP. Annex H4 presents species number of trees to be cleared in project districts. The total number of trees/poles to be cleared is estimated to be 173,183 when calculated based on the 1 percent survey results extrapolated over the entire RoW using LiDAR land coverage (Table 5.2-6). Note that this estimate excludes the number of trees to be cleared in all other land cover types (including single trees and clumps of trees in agricultural areas), which were counted using LiDAR and accounts for an additional 28,835 trees (see Table 5.2-6). The total estimated number of trees using these results is therefore 202,018 (173,183 + 28,835).

Over all segments of the ETP, the total forest loss within the RoW is 45.6 percent, meaning that 54.4 percent of forest will remain within the RoW. This equates to 1.7 percent loss of forest within the area of analysis. This estimate takes into account the strung wires over valleys that will avoid clearing where tree heights are below the required distance between the conductors and the canopy.

The vegetation loss by project components is presented in Table 5.2-8, the amount of biomass and carbon stock calculations are presented in Tables 5.2-9(A), 5.2-9(B) and 5.2-10 for the ETP route. The biomass and carbon stock calculations were calculated only within forested areas and using the results of the 1 percent survey only. Other forested areas were assessed using LiDAR data and hence it was not possible to estimate biomass and carbon using this approach as volume data is not available.

The distribution of these forest vegetation types in relation to the ETP is shown in Figures 5.2-2 and 5.2-3. The distribution of the plots within the RoW within each district, forest type is shown on Figure 5.2-4 and in Annexes D (Transmission Line Alignment Maps) and H-4 (Complete Forest Inventory Results).

Importance Value Index (IVI) provides status of the dominant trees or tree community within the TL RoW. The field survey data of the 1% forest survey was used to calculate the IVI including Density (D), Relative Density (RD), Frequency (F), and Relative Frequency (RF) using the formula given by Raunkiaer (1934) and Zobel et al. (1987). The IVI analyses shows that *Shorea robusta, Schima wallichii, Castanopsis hystrix, Pinus roxburghii, Alnus nepalensis and Dalbergia sissoo* are the dominant tree species within the Project's RoW and the tower pad area. Please see Annex S for details

Table 5.2-6: Trees Clearing Estimates along the ETP Route

Vegetation Classification	Land Cover Analysis Assumptions	Forest Type	Total Area to be cleared within RoW (ha)	Average density from 1% Field Survey (Trees per ha)	Tree Clearing from 1% Survey Estimate (Total trees)
Vegetation class	• Minimum patch size: 0.5 ha, at least 20 m in width/length • Tree crown cover > 10% • Tree height > 5 m	Tropical forest	155.0	500	76,705
		Subtropical Broadleaved Forest	70.4	507	35,689
		Subtropical Conifer Forest	6.5	320	2,082
		Not Specified	0.2	490	61
Other wooded land	• Minimum patch size: 0.5 ha, at least 20 m in width/length • Tree crown cover > 5% and < 10%	Tropical Forest	15.6	500	7,576
		Subtropical Broadleaved Forest	10.9	507	5,538
		Not Specified	0.2	490	61
Trees that are not "Vegetation class" or "Other wooded land"	Trees that are in patches < 0.5 ha		95.6	490	45,471
		Sub Total	**354.4**	-	**173,183**
All Other Trees (e.g., single trees in agricultural areas)	• All other trees within RoW Estimated based on LiDAR data as 1% survey data was not available		-	Counted using LiDAR-	**28,835**
		Grand Total	-	-	**202,018**

Table 5.2-7: Forest and Tree Clearing by District and Forest Types

	Districts	Community Forest			Leasehold Forest			Govt and Other Forest			Total		
		Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)	Total Forest Area (ha)	Forest Clearing (ha)	Tree Clearing (No.)
Bagmati	Kathmandu	3.6	0.3	164	0.0	0.0	0.0	7.0	1.5	820	10.6	1.8	984
	Sindhupalchok	0.0	0.0	0.0	0.0	0.0	0.0	17.9	4.8	2,465	17.9	4.8	2,465
	Nuwakot	73.9	30	20,342	0.0	0.0	0.0	59.5	30.8	20,884	133.4	60.8	41,226
	Dhading	68.9	24	12,034	1.6	0.3	3,610	67.7	24.6	12,335	138.2	48.9	27,980
	Makawanpur	59.1	37.8	15,849	0.0	0.0	0.0	80.7	36.9	15,472	139.8	74.7	31,321
	Chitwan	0.0	0.0	0.0	0.6	0.0	8.0	20.6	7.0	1,453	21.2	7.0	1,453
Lumbini	Palpa	46.0	18.8	4,427	2.2	2.1	9,296	35.2	13.0	3,061	83.4	33.9	16,783
	Nawalparasi W	19.7	8.7	2,797	0.0	0.0	0.0	39.3	36.7	11,800	59.0	45.4	14,598
Gandaki	Nawalparasi E	15.2	19.4	5,303	0.0	0.0	0.0	15.1	2.3	629	30.3	21.7	5,931
	Tanahu	44.0	19.7	10,825	0.0	0.0	0.0	99.7	35.7	19,617	143.7	55.4	30,442
	Total	**330.4**	**158.7**	**71,741**	**4.4**	**2.4**	**12,906**	**442.7**	**193.3**	**88,536**	**777.5**	**354.4**	**173,183**

Table 5.2-8: Total Vegetation Loss by Project Components of the Project

SN	Project Components	Area (ha)				Vegetation Loss/Tree affected by the Project										
						Seedlings (no)	Sapling (no)	No. of Poles				No. of Trees				
		CF	GMF	LHF	Total			CF	GMF	LHF	Total	CF	GMF	LHF	Total
1.	**Tower**															
a	India Border to New Butwal	0.0	0.7	0.0	0.7	1610	4124	0	2	0	2	0	397	0	397
b	New Butwal to New Damauli	6.8	8.1	0.0	14.9	34178	87540	261	314	0	576	857	1029	1	1887
c	New Damauli to Ratmate	6.7	8.0	0.1	14.8	33925	86892	259	308	5	572	4083	5097	63	9243
d	Ratmate to New Hetauda	6.1	6.1	0.0	12.2	28037	71811	332	333	0	665	2817	2821	0	5638
e	Ratmatae to Lapsiphedi	3.7	3.5	0.0	7.2	16537	42356	189	179	0	367	2394	2271	0	4666
	Sub Total	**23.2**	**26.4**	**0.1**	**49.7**	**114287**	**292724**	**1041**	**1136**	**5**	**2182**	**10151**	**11615**	**64**	**21830**
	Substations	**0.0**	**5.5**	**0.0**	**5.5**	**0.0**	**0.0**	**0.0**	**3669**	**0.0**	**3669**	**0.0**	0.0	**0.0**	0.0
3.	**RoW**															
a	India Border to New Butwal	1.1	8.7	0.0	9.8	22540	57732	22	174	0	196	623	4930	0	5553
b	New Butwal to New Damauli	44.1	53.8	2.2	100.0	230092	589336	1706	2084	85	3875	5594	6832	278	12703
c	New Damauli to Ratematae	28.1	41.2	0.1	69.4	159505	408541	1429	2092	5	3526	18995	27818	67	46880
d	Ratmatae to New Hetauda	39.7	42.9	0.0	82.6	190003	486656	2168	2342	0	4509	18366	19857	0	38223
e	Ratmatae to Lapsiphedi	22.5	20.4	0.0	42.9	98693	252783	1151	1043	0	2193	14606	13237	0	27844
	Sub Total	**135.5**	**167.0**	**2.3**	**305**	**700833**	**1795047**	**6476**	**7735**	**90**	**14299**	**58184**	**72674**	**345**	**131203**
	Total	**158.7**	**193.3**	**2.4**	**354.4**	**815120**	**2087770**	**7517**	**12540**	**95**	**20150**	**68335**	**84289**	**409**	**153033**

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Table 5.2-9 (A): Biomass of Tree Species in Tower Station of the Project

SN	Species		Density		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
India Border to New Butwal									
1	Jingad	*Lannea coromandelica*	6.67	0.00	**1907.10**	**0.00**	**45.46**	**0.18**	**1907.10**
2	Karma	*Adina cordifolia*	6.67	0.00	**8209.56**	**0.00**	**195.70**	**0.78**	**8209.56**
3	Simal	*Bombax ceiba*	0.00	33.33	**0.00**	**2220.93**	**52.94**	**0.21**	**2220.93**
4	Sissoo	*Dalbergia sissoo*	6.67	533.33	**2944.00**	**80788.37**	**1996.00**	**7.98**	**83732.37**
New Butwal to New Damauli									
1	Bhalayo	*Semecarpus anacardium*	0.32	3.17	**250.38**	**429.33**	**16.20**	**0.06**	**679.71**
2	Botdhayaro	*Lagerstroemia parviflora*	1.27	4.76	**996.38**	**656.11**	**39.39**	**0.16**	**1652.49**
3	Chilaune	*Schima wallichii*	9.84	12.70	**6542.96**	**996.27**	**192.74**	**0.77**	**7539.23**
4	Gobre sallo	*Pinus wallichiana*	8.57	0.00	**4632.93**	**0.00**	**170.26**	**0.68**	**4632.93**
5	Jamun	*Syzygium cumini*	1.59	0.00	**1826.02**	**0.00**	**43.53**	**0.17**	**1826.02**
6	Jhigane	*Eurya acuminata*	0.32	3.17	**142.13**	**636.05**	**18.55**	**0.07**	**778.17**
7	Karma	*Adina cordifolia*	0.95	0.00	**576.64**	**0.00**	**16.95**	**0.07**	**576.64**
8	Katus	*Castanopsis hystrix*	0.00	4.76	**0.00**	**411.98**	**11.18**	**0.04**	**411.98**
9	Kusum	*Schleichera oleosa*	0.00	1.59	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
10	Phadke siris	*Albizia julibrissin*	0.32	1.59	**181.63**	**192.66**	**8.92**	**0.04**	**374.29**
11	Piyari	*Buchanania latifolia*	0.00	3.17	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
12	Saj	*Terminalia alata*	0.63	4.76	**1705.34**	**931.86**	**61.28**	**0.25**	**2637.21**
13	Sal	*Shorea robust*	11.11	71.43	**16410.85**	**9591.52**	**557.60**	**2.23**	**26002.37**
14	Seto siris	*Albizia procera*	0.32	0.00	**518.00**	**0.00**	**12.35**	**0.05**	**518.00**
15	Simal	*Bombax ceiba*	0.00	1.59	**0.00**	**135.31**	**3.23**	**0.01**	**135.31**
16	Sindure	*Mallotus philippensis*	0.00	7.94	**0.00**	**462.51**	**11.03**	**0.04**	**462.51**
17	Sissoo	*Dalbergia sissoo*	3.49	6.35	**4957.33**	**752.97**	**136.12**	**0.54**	**5710.30**

SN	Species		Density		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
New Damauli to Ratmate									
1	Aanp	*Magnifera indica*	0.33	0.00	**196.33**	**0.00**	**4.68**	**0.02**	**196.33**
2	Amala	*Phyllanthus emblica*	0.00	3.28	**0.00**	**121.09**	**2.89**	**0.01**	**121.09**
3	Bajh	*Quercus lanata*	0.33	1.64	**304.66**	**74.06**	**7.59**	**0.03**	**378.72**
4	Bakaino	*Melia azedarach*	0.00	1.64	**0.00**	**229.35**	**5.47**	**0.02**	**229.35**
5	Bel	*Aegle marmelos*	0.00	3.28	**0.00**	**70.89**	**1.69**	**0.01**	**70.89**
6	Bhalayo	*Semecarpus anacardium*	0.98	11.48	**598.31**	**1090.04**	**40.25**	**0.16**	**1688.35**
7	Botdhangero	*Lagerstroemia parviflora*	0.00	9.84	**0.00**	**894.73**	**21.33**	**0.09**	**894.73**
8	Chilaune	*Schima wallichii*	18.69	211.48	**13152.84**	**26540.62**	**1014.77**	**4.06**	**39693.47**
9	Chuiri	*Diploknema butyracea*	0.00	4.92	**0.00**	**260.23**	**6.20**	**0.02**	**260.23**
10	Gobre sallo	*Pinus wallichiana*	0.00	44.26	**0.00**	**12798.14**	**305.08**	**1.22**	**12798.14**
11	Guiyela	*Callicarpa arborea*	0.33	3.28	**171.19**	**362.37**	**12.72**	**0.05**	**533.56**
12	Guras	*Rhododendron arboreum*	0.33	1.64	**393.90**	**0.00**	**10.86**	**0.04**	**393.90**
13	Jamun	*Syzygium cumini*	0.00	1.64	**0.00**	**328.68**	**7.83**	**0.03**	**328.68**
14	Kaiyo	*Gravellia robusta*	0.33	6.56	**212.25**	**0.00**	**5.06**	**0.02**	**212.25**
15	Katus	*Castanopsis hystrix*	8.85	62.30	**4767.99**	**5747.11**	**285.36**	**1.14**	**10515.10**
16	Khair	*Acacia catechu*	0.00	8.20	**0.00**	**862.71**	**17.29**	**0.07**	**862.71**
17	Khaniyu	*Ficus semicordata*	0.00	6.56	**0.00**	**683.23**	**16.29**	**0.07**	**683.23**
18	Kharsu	*Quercus semecarpifolia*	0.00	3.28	**0.00**	**192.16**	**4.58**	**0.02**	**192.16**
19	Khirro	*Falconeri insigni*	0.00	14.75	**0.00**	**878.06**	**20.93**	**0.08**	**878.06**
20	Khote sallo	*Pinus roxburghii*	4.92	9.84	**4289.39**	**1191.01**	**148.73**	**0.59**	**5480.40**
21	Mauwa	*Engelhardia spicata*	0.00	21.31	**0.00**	**4303.27**	**102.58**	**0.41**	**4303.27**
22	Mel	*Pyrus pashia*	0.98	0.00	**947.94**	**0.00**	**22.60**	**0.09**	**947.94**
23	Odane	*Sterculia villosa*	0.33	9.84	**238.53**	**1367.30**	**38.28**	**0.15**	**1605.84**
24	Patle Katus	*Castanopsis hystrix*	0.00	6.56	**0.00**	**287.82**	**6.86**	**0.03**	**287.82**

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SN	Species		Density		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
25	Phadke siris	*Albizia julibrissin*	0.00	4.92	**0.00**	**1685.76**	**40.18**	**0.16**	**1685.76**
26	Saj	*Terminalia alata*	0.00	1.64	**0.00**	**72.48**	**1.66**	**0.01**	**72.48**
27	Sal	*Shorea robust*	16.39	237.70	**15614.59**	**34274.98**	**1000.06**	**4.00**	**49889.58**
28	Simal	*Bombax ceiba*	0.33	3.28	**396.37**	**596.94**	**23.68**	**0.09**	**993.32**
29	Unknown	*0*	0.00	11.48	**0.00**	**1140.37**	**27.18**	**0.11**	**1140.37**
Ratmate to New Hetauda									
1	Angeri	*Lyonia ovalifolia*	0.00	6.25	**0.00**	**356.57**	**8.50**	**0.03**	**356.57**
2	Bhalayo	*Semecarpus anacardium*	0.00	8.33	**0.00**	**1362.92**	**32.49**	**0.13**	**1362.92**
3	Botdhangero	*Lagerstroemia parviflora*	0.00	14.58	**0.00**	**233.91**	**5.58**	**0.02**	**233.91**
4	Camuna	*Cleistocalyx operculata*	0.00	4.17	**0.00**	**421.45**	**10.05**	**0.04**	**421.45**
5	Chilaune	*Schima wallichii*	5.42	60.42	**2861.23**	**3451.23**	**161.38**	**0.65**	**6312.46**
6	Chiuri	*Diploknema butyracea*	0.00	6.25	**0.00**	**94.44**	**2.25**	**0.01**	**94.44**
7	Falame	*Homalium napaulense*	0.00	8.33	**0.00**	**278.27**	**6.63**	**0.03**	**278.27**
8	Gobre sallo	*Pinus wallichiana*	0.00	6.25	**0.00**	**995.00**	**23.72**	**0.09**	**995.00**
9	Gogan	*Saurauia napaulensis*	0.00	2.08	**0.00**	**55.69**	**1.33**	**0.01**	**55.69**
10	Gurans	*Rhododendron arboreum*	0.00	6.25	**0.00**	**401.96**	**9.58**	**0.04**	**401.96**
11	Ipil Ipil	*Leucaena leucocephala*	0.42	0.00	**512.29**	**0.00**	**12.21**	**0.05**	**512.29**
12	Jamun	*Syzygium cumini*	0.00	10.42	**0.00**	**222.77**	**5.31**	**0.02**	**222.77**
13	Jhigane	*Eurya acuminata*	0.00	2.08	**0.00**	**129.84**	**3.10**	**0.01**	**129.84**
14	Kadam	*Neolamarckia cadamba*	0.42	0.00	**474.09**	**0.00**	**11.30**	**0.05**	**474.09**
15	Kaijal	*Bischofia javanica*	0.42	0.00	**891.90**	**0.00**	**21.26**	**0.09**	**891.90**
16	Kaiyo	*Gravellia robusta*	0.00	27.08	**0.00**	**2330.47**	**55.55**	**0.22**	**2330.47**
17	Katus	*Castanopsis hystrix*	2.08	27.08	**1314.57**	**1752.45**	**83.23**	**0.33**	**3067.01**
18	Khair	*Acacia catechu*	0.42	8.33	**396.00**	**1850.20**	**45.03**	**0.18**	**2246.20**
19	Khaniyu	*Ficus semicordata*	0.00	4.17	**0.00**	**199.14**	**4.75**	**0.02**	**199.14**

SANTEC CONSULTING INTERNATIONAL LLC 2000

नेपाल सरकार
वन तथा वातावरण मन्त्रालय
सिंहदरबार काठमाडौं

SN	Species		Density		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
20	Kharsu	*Quercus semecarpifolia*	0.00	2.08	**0.00**	**447.81**	**10.67**	**0.04**	**447.81**
21	Khote sallo	*Pinus roxburghii*	13.33	56.25	**17060.51**	**7446.09**	**665.07**	**2.66**	**24506.60**
22	Kutamiro	*Litsea monopetala*	0.42	0.00	**319.89**	**0.00**	**7.63**	**0.03**	**319.89**
23	Mahuwa	*Engelhardia spicata*	0.00	6.25	**0.00**	**342.40**	**8.16**	**0.03**	**342.40**
24	Piyari	*Buchanania latifolia*	0.42	0.00	**277.50**	**0.00**	**6.62**	**0.03**	**277.50**
25	Saj	*Terminalia alata*	0.83	4.17	**1124.17**	**649.69**	**40.64**	**0.16**	**1773.85**
26	Sal	*Shorea robust*	22.92	135.42	**36148.18**	**13888.02**	**1003.00**	**4.01**	**50036.20**
27	Sandan	*Desmodium oojeinense*	0.42	0.00	**259.83**	**0.00**	**6.19**	**0.02**	**259.83**
28	Saur	*Betula alnoides*	0.42	0.00	**494.51**	**0.00**	**11.79**	**0.05**	**494.51**
29	Tiju	*Solanum anguivi*	0.00	10.42	**0.00**	**1055.46**	**25.16**	**0.10**	**1055.46**
30	Tooni	*Toona ciliatae*	0.00	14.58	**0.00**	**695.89**	**16.59**	**0.07**	**695.89**
31	Uttis	*Alnus nepalensis*	5.83	31.25	**6728.71**	**8714.28**	**368.13**	**1.47**	**15442.99**
32	Unknown	*0*	0.83	0.00	**1342.65**	**0.00**	**32.01**	**0.13**	**1342.65**
Ratmate to Lapsiphedi									
1	Aanp	*Magnifera indica*	0.89	2.22	**7763.69**	**93.24**	**187.29**	**0.75**	**7856.93**
2	Arkhaule	*Lithocarpus elegans*	0.44	0.00	**253.25**	**0.00**	**6.04**	**0.02**	**253.25**
3	Bakaino	*Melia azedarach*	0.00	2.22	**0.00**	**106.93**	**2.55**	**0.01**	**106.93**
4	Bakale	*Myrsine capitellata*	0.00	15.56	**0.00**	**1803.91**	**43.00**	**0.17**	**1803.91**
5	Bhalayo	*Semecarpus anacardium*	0.44	0.00	**154.73**	**0.00**	**3.69**	**0.01**	**154.73**
6	Champ	*Magnolia champaca*	0.00	2.22	**0.00**	**345.48**	**8.24**	**0.03**	**345.48**
7	Chilaune	*Schima wallichii*	11.11	126.67	**11227.16**	**19480.36**	**785.04**	**3.14**	**30707.52**
8	Dudhilo	*Ficus neriifolia*	0.00	2.22	**0.00**	**590.32**	**14.07**	**0.06**	**590.32**
9	Gobre sallo	*Pinus wallichiana*	0.00	17.78	**0.00**	**5195.19**	**140.99**	**0.56**	**5195.19**
10	Gurans	*Rhododendron arboreum*	0.00	6.67	**0.00**	**385.42**	**9.19**	**0.04**	**385.42**
11	Kafal	*Myrica esculenla*	0.00	4.44	**0.00**	**706.02**	**16.83**	**0.07**	**706.02**

SN	Species		Density		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
12	Kalo Siris	*Albizia lebbeck*	4.00	4.44	**4345.57**	**873.26**	**124.41**	**0.50**	**5218.83**
13	Katahar	*Artocarpus heterophyllus*	0.89	0.00	**759.74**	**0.00**	**18.11**	**0.07**	**759.74**
14	Katus	*Castanopsis hystrix*	0.00	51.11	**0.00**	**648700.00**	**17604.72**	**70.42**	**648700.00**
15	Khaniyu	*Ficus semicordata*	0.00	2.22	**0.00**	**183.57**	**4.38**	**0.02**	**183.57**
16	Khote sallo	*Pinus roxburghii*	12.00	0.00	**15602.03**	**0.00**	**423.42**	**1.69**	**15602.03**
17	Kumbhi	*Careya arborea*	0.00	2.22	**0.00**	**79.59**	**1.90**	**0.01**	**79.59**
18	Lakuri	*Fraxinus floribunda*	0.89	11.11	**676.93**	**3160.62**	**91.48**	**0.37**	**3837.55**
19	Mahuwa	*Engelhardia spicata*	0.00	13.33	**0.00**	**1298.91**	**30.96**	**0.12**	**1298.91**
20	Maidal kanda	*Tamilnadia uliginosa*	0.00	2.22	**0.00**	**461.92**	**11.01**	**0.04**	**461.92**
21	Mel	*Pyrus pashia*	0.00	4.44	**0.00**	**315.59**	**7.52**	**0.03**	**315.59**
22	Saj	*Terminalia alata*	0.44	0.00	**854.32**	**0.00**	**19.57**	**0.08**	**854.32**
23	Sal	*Shorea robust*	12.00	262.22	**11569.80**	**47227.04**	**1178.61**	**4.71**	**58796.84**
24	Seto siris	*Albizia procera*	3.11	4.44	**2316.65**	**1090.96**	**81.23**	**0.32**	**3407.61**
25	Simal	*Bombax ceiba*	0.00	4.44	**0.00**	**676.60**	**16.13**	**0.06**	**676.60**
26	Sisso	*Dalbergia sissoo*	0.44	4.44	**392.53**	**334.16**	**17.32**	**0.07**	**726.69**
27	Tooni	*Toona ciliatae*	0.00	15.56	**0.00**	**3031.38**	**72.26**	**0.29**	**3031.38**
28	Uttis	*Alnus nepalensis*	4.44	86.67	**5006.70**	**18220.35**	**553.68**	**2.21**	**23227.05**

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Table 5.2-9(B): Biomass of Tree Species in Right-of-Way of the Project

SN	Species		Density		Total		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
India Border to New Butwal											
1	Jingad	*Lannea coromandelica*	6.67	0.00	65	0	18689.6	0.0	445.5	1.8	18689.6
2	Karma	*Adina cordifolia*	6.67	0.00	65	0	80453.7	0.0	1917.8	7.7	80453.7
3	Simal	*Bombax ceiba*	0.00	33.33	0	327	0.0	21765.1	518.8	2.1	21765.1
4	Sissoo	*Dalbergia sissoo*	6.67	533.33	65	5227	28851.2	791726.0	19560.8	78.2	820577.2
New Butwal to New Damauli											
	Bhalayo	*Semecarpus anacardium*	0.32	3.17	32	318	25047.9	42950.4	1620.9	6.5	67998.2
2	Botdhayaro	*Lagerstroemia parviflora*	1.27	4.76	127	476	99677.4	65637.4	3940.7	15.8	165314.8
3	Chilaune	*Schima wallichii*	9.84	12.70	985	1270	654557.7	99667.0	19281.9	77.1	754224.6
4	Gobre sallo	*Pinus wallichiana*	8.57	0.00	857	0	463477.9	0.0	17032.8	68.1	463477.9
5	Jamun	*Syzygium cumini*	1.59	0.00	159	0	182675.5	0.0	4354.6	17.4	182675.5
6	Jhigane	*Eurya acuminata*	0.32	3.17	32	318	14218.4	63630.2	1855.7	7.4	77848.6
7	Karma	*Adina cordifolia*	0.95	0.00	95	0	57687.0	0.0	1696.0	6.8	57687.0
8	Katus	*Castanopsis hystrix*	0.00	4.76	0	476	0.0	46920.7	1118.5	4.5	46920.7
9	Kusum	*Schleichera oleosa*	0.00	1.59	0	159	0.0	21210.1	505.6	2.0	21210.1
10	Phadke siris	*Albizia julibrissin*	0.32	1.59	32	159	18170.2	19274.1	892.6	3.6	37444.3
11	Piyari	*Buchanania latifolia*	0.00	3.17	0	318	0.0	24348.4	580.4	2.3	24348.4
12	Saj	*Terminalia alata*	0.63	4.76	64	476	170602.6	97003.1	6130.6	24.5	267605.6
13	Sal	*Shorea robust*	11.11	71.43	1112	7146	1641741.1	1141069.5	55782.7	223.1	2782810.6
14	Seto siris	*Albizia procera*	0.32	0.00	32	0	51820.7	0.0	1235.3	4.9	51820.7
15	Simal	*Bombax ceiba*	0.00	1.59	0	159	0.0	13536.8	322.7	1.3	13536.8
16	Sindure	*Mallotus philippensis*	0.00	7.94	0	794	0.0	46269.2	1103.0	4.4	46269.2
17	Sissoo	*Dalbergia sissoo*	3.49	6.35	349	635	495931.3	75326.6	13617.6	54.5	571257.9
New Damauli to Ratamatae											

SN	Species		Density		Total		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
1	Aanp	*Magnifera indica*	0.33	0.00	23	0	13615.5	0.0	324.6	1.3	13615.5
2	Amala	*Phyllanthus emblica*	0.00	3.28	0	227	0.0	8397.4	200.2	0.8	8397.4
3	Bajh	*Quercus lanata*	0.33	1.64	23	114	21128.2	5136.1	526.5	2.1	26264.3
4	Bakaino	*Melia azedarach*	0.00	1.64	0	114	0.0	15905.7	379.2	1.5	15905.7
5	Bel	*Aegle marmelos*	0.00	3.28	0	227	0.0	4915.9	117.2	0.5	4915.9
6	Bhalayo	*Semecarpus anacardium*	0.98	11.48	68	796	41492.6	75594.3	2791.1	11.2	117086.9
7	Botdhangero	*Lagerstroemia parviflora*	0.00	9.84	0	682	0.0	62049.6	1479.1	5.9	62049.6
8	Chilaune	*Schima wallichii*	18.69	211.48	1296	14666	912149.5	1840592.3	70374.4	281.5	2752741.8
9	Chuiri	*Diploknema butyracea*	0.00	4.92	0	341	0.0	18046.9	430.2	1.7	18046.9
10	Gobre sallo	*Pinus wallichiana*	0.00	44.26	0	3070	0.0	887551.0	21157.3	84.6	887551.0
11	Guiyela	*Callicarpa arborea*	0.33	3.28	23	227	11872.4	25130.2	882.1	3.5	37002.6
12	Guras	*Rhododendron arboreum*	0.33	1.64	23	114	27317.3	0.0	752.9	3.0	27317.3
13	Jamun	*Syzygium cumini*	0.00	1.64	0	114	0.0	22793.8	543.4	2.2	22793.8
14	Kaiyo	*Gravellia robusta*	0.33	6.56	23	455	14719.3	0.0	350.9	1.4	14719.3
15	Katus	*Castanopsis hystrix*	8.85	62.30	614	4320	330659.9	398562.3	19790.0	79.2	729222.2
16	Khair	*Acacia catechu*	0.00	8.20	0	568	0.0	50310.8	1199.3	4.8	50310.8
17	Khaniyu	*Ficus semicordata*	0.00	6.56	0	455	0.0	47381.7	1129.5	4.5	47381.7
18	Kharsu	*Quercus semecarpifolia*	0.00	3.28	0	227	0.0	13326.1	317.7	1.3	13326.1
19	Khirro	*Falconeri insigni*	0.00	14.75	0	1023	0.0	60893.8	1451.6	5.8	60893.8
20	Khote sallo	*Pinus roxburghii*	4.92	9.84	341	682	297469.3	82596.5	10314.4	41.3	380065.8
21	Mauwa	*Engelhardia spicata*	0.00	21.31	0	1478	0.0	298432.1	7114.0	28.5	298432.1
22	Mel	*Pyrus pashia*	0.98	0.00	68	0	65739.6	0.0	1567.1	6.3	65739.6
23	Odane	*Sterculia villosa*	0.33	9.84	23	682	16542.4	94822.4	2654.7	10.6	111364.8
24	Patle Katus	*Castanopsis hystrix*	0.00	6.56	0	455	0.0	19960.4	475.8	1.9	19960.4
25	Phadke siris	*Albizia julibrissin*	0.00	4.92	0	341	0.0	116907.2	2786.8	11.1	116907.2

5.2.19

SN	Species		Density		Total		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
26	Saj	*Terminalia alata*	0.00	1.64	0	114	0.0	5026.7	115.2	0.5	5026.7
27	Sal	*Shorea robust*	16.39	237.70	1137	16485	1082872.0	2376970.1	69354.1	277.4	3459842.1
28	Simal	*Bombax ceiba*	0.33	3.28	23	227	27488.5	41398.0	1642.1	6.6	68886.5
29	Unknown	*0*	0.00	11.48	0	796	0.0	79084.9	1885.2	7.5	79084.9
Ratamatae to New Hetuda											
1	Angeri	*Lyonia ovalifolia*	0.00	6.25	0	516	0.0	29456.6	702.2	2.8	29456.6
2	Bhalayo	*Semecarpus anacardium*	0.00	8.33	0	688	0.0	112590.4	2683.9	10.7	112590.4
3	Botdhangero	*Lagerstroemia parviflora*	0.00	14.58	0	1205	0.0	19323.3	460.6	1.8	19323.3
4	Camuna	*Cleistocalyx operculata*	0.00	4.17	0	344	0.0	34816.2	829.9	3.3	34816.2
5	Chilaune	*Schima wallichii*	5.42	60.42	447	4991	236366.5	285106.2	13331.6	53.3	521472.6
6	Chiuri	*Diploknema butyracea*	0.00	6.25	0	516	0.0	7801.4	186.0	0.7	7801.4
7	Falame	*Homalium napaulense*	0.00	8.33	0	688	0.0	22988.0	548.0	2.2	22988.0
8	Gobre sallo	*Pinus wallichiana*	0.00	6.25	0	516	0.0	82197.1	1959.4	7.8	82197.1
9	Gogan	*Saurauia napaulensis*	0.00	2.08	0	172	0.0	4600.8	109.7	0.4	4600.8
10	Gurans	*Rhododendron arboreum*	0.00	6.25	0	516	0.0	33206.2	791.6	3.2	33206.2
11	Ipil Ipil	*Leucaena leucocephala*	0.42	0.00	34	0	42320.3	0.0	1008.8	4.0	42320.3
12	Jamun	*Syzygium cumini*	0.00	10.42	0	861	0.0	18403.1	438.7	1.8	18403.1
13	Jhigane	*Eurya acuminata*	0.00	2.08	0	172	0.0	10725.9	255.7	1.0	10725.9
14	Kadam	*Neolamarckia cadamba*	0.42	0.00	34	0	39164.9	0.0	933.6	3.7	39164.9
15	Kaijal	*Bischofia javanica*	0.42	0.00	34	0	73680.1	0.0	1756.4	7.0	73680.1
16	Kaiyo	*Gravellia robusta*	0.00	27.08	0	2237	0.0	192520.1	4589.3	18.4	192520.1
17	Katus	*Castanopsis hystrix*	2.08	27.08	172	2237	108596.4	144769.6	6876.0	27.5	253365.9
18	Khair	*Acacia catechu*	0.42	8.33	34	688	32713.6	152845.0	3719.6	14.9	185558.6
19	Khaniyu	*Ficus semicordata*	0.00	4.17	0	344	0.0	16450.6	392.1	1.6	16450.6
20	Kharsu	*Quercus semecarpifolia*	0.00	2.08	0	172	0.0	36993.3	881.8	3.5	36993.3

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वन तथा वातावरण मन्त्रालय
सिंहदरबार, काठमाडौं

SN	Species		Density		Total		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
21	Khote sallo	*Pinus roxburghii*	13.33	56.25	1101	4647	1409369.1	615121.4	54941.6	219.8	2024490.5
22	Kutamiro	*Litsea monopetala*	0.42	0.00	34	0	26426.1	0.0	629.9	2.5	26426.1
23	Mahuwa	*Engelhardia spicata*	0.00	6.25	0	516	0.0	28286.0	674.3	2.7	28286.0
24	Piyari	*Buchanania latifolia*	0.42	0.00	34	0	22924.3	0.0	546.5	2.2	22924.3
25	Saj	*Terminalia alata*	0.83	4.17	69	344	92867.3	53670.7	3357.1	13.4	146538.0
26	Sal	*Shorea robust*	22.92	135.42	1893	11187	2986201.1	1147289.3	82857.7	331.4	4133490.4
27	Sandan	*Desmodium oojeinense*	0.42	0.00	34	0	21464.8	0.0	511.7	2.0	21464.8
28	Saur	*Betula alnoides*	0.42	0.00	34	0	40851.1	0.0	973.8	3.9	40851.1
29	Tiju	*Solanum anguivi*	0.00	10.42	0	861	0.0	87191.7	2078.5	8.3	87191.7
30	Tooni	*Toona ciliatae*	0.00	14.58	0	1205	0.0	57487.7	1370.4	5.5	57487.7
31	Uttis	*Alnus nepalensis*	5.83	31.25	482	2582	555858.4	719886.7	30411.0	121.6	1275745.1
32	Unknown	*0*	0.83	0.00	69	16	110916.1	0.0	2644.0	10.6	110916.1
Ratamatae to Lapsiphedi											
1	Aanp	*Magnifera indica*	0.89	2.22	38	95	333139.8	4000.9	8036.7	32.1	337140.7
2	Arkhaule	*Lithocarpus elegans*	0.44	0.00	19	0	10866.8	0.0	259.0	1.0	10866.8
3	Bakaino	*Melia azedarach*	0.00	2.22	0	95	0.0	4588.4	109.4	0.4	4588.4
4	Bakale	*Myrsine capitellata*	0.00	15.56	0	667	0.0	77405.7	1845.2	7.4	77405.7
[illegible]	Bhalayo	*Semecarpus anacardium*	0.44	0.00	19	0	6639.3	0.0	158.3	0.6	6639.3
6	Champ	*Magnolia champaca*	0.00	2.22	0	95	0.0	14824.4	353.4	1.4	14824.4
7	Chilaune	*Schima wallichii*	11.11	126.67	477	5435	481757.2	835902.3	33686.3	134.7	1317659.5
[illegible]	Dudhilo	*Ficus neriifolia*	0.00	2.22	0	95	0.0	25330.6	603.8	2.4	25330.6
[illegible]	Gobre sallo	*Pinus wallichiana*	0.00	17.78	0	763	0.0	222925.7	6049.9	24.2	222925.7
10	Gurans	*Rhododendron arboreum*	0.00	6.67	0	286	0.0	16538.2	394.2	1.6	16538.2
11	Kafal	*Myrica esculenla*	0.00	4.44	0	191	0.0	30295.4	722.2	2.9	30295.4
12	Kalo Siris	*Albizia lebbeck*	4.00	4.44	172	191	186468.5	37471.7	5338.2	21.4	223940.2

STANTEC CONSULTING INTERNATIONAL LLC 2000

नेपाल सरकार वन तथा वातावरण मन्त्रालय सिंहदरबार, काठमाडौं

SN	Species		Density		Total		Total Forest Products				
	Local name	Botanical name	Tree	Pole	Tree	Pole	Tree Biomass (kg)	Pole Biomass (kg)	Timber (Cu.ft)	Fuel wood (Chatta)	Total Biomass (kg)
13	Katahar	*Artocarpus heterophyllus*	0.89	0.00	38	0	32600.4	0.0	777.1	3.1	32600.4
14	Katus	*Castanopsis hystrix*	0.00	51.11	0	2193	0.0	27835717.2	755418.5	3021.7	27835717.2
15	Khaniyu	*Ficus semicordata*	0.00	2.22	0	95	0.0	7876.8	187.8	0.8	7876.8
16	Khote sallo	*Pinus roxburghii*	12.00	0.00	515	0	669483.0	0.0	18168.7	72.7	669483.0
17	Kumbhi	*Careya arborea*	0.00	2.22	0	95	0.0	3415.3	81.4	0.3	3415.3
18	Lakuri	*Fraxinus floribunda*	0.89	11.11	38	477	29046.9	135622.3	3925.4	15.7	164669.2
19	Mahuwa	*Engelhardia spicata*	0.00	13.33	0	572	0.0	55736.1	1328.6	5.3	55736.1
20	Maidal kanda	*Tamilnadia uliginosa*	0.00	2.22	0	95	0.0	19821.2	472.5	1.9	19821.2
21	Mel	*Pyrus pashia*	0.00	4.44	0	191	0.0	13542.1	322.8	1.3	13542.1
22	Saj	*Terminalia alata*	0.44	0.00	19	0	36659.0	0.0	839.8	3.4	36659.0
23	Sal	*Shorea robust*	12.00	262.22	515	11252	496460.1	2026512.1	50574.1	202.3	2522972.2
24	Seto siris	*Albizia procera*	3.11	4.44	133	191	99407.5	46813.0	3485.6	13.9	146220.5
25	Simal	*Bombax ceiba*	0.00	4.44	0	191	0.0	29033.1	692.1	2.8	29033.1
26	Sisso	*Dalbergia sissoo*	0.44	4.44	19	191	16843.6	14338.6	743.3	3.0	31182.2
27	Tooni	*Toona ciliatae*	0.00	15.56	0	667	0.0	130076.5	3100.7	12.4	130076.5
28	Uttis	*Alnus nepalensis*	4.44	86.67	191	3719	214837.5	781835.3	23758.5	95.0	996672.8

Table 5.2-10: Biomass and Carbon Stock Calculations by Project Components

SN	Project Components	Above ground tree biomass (kg)	Below-ground tree biomass (kg)	Total tree biomass (kg)	Carbon (Ton)	Carbon Dioxide (Ton)
1.	Tower					
a	India Border to New Butwal	59477.88	1814.08	61291.95	28.8072	106
b	New Butwal to New Damauli	801506.10	24445.94	825952.03	388.1975	1,425
c	New Damauli to Ratematae	2025731.39	61784.81	2087516.20	981.1326	3,601
d	Ratmatae to New Hetauda	1433324.26	43716.39	1477040.65	694.2091	2,548
e	Ratmatae to Lapsiphedi	5861891.31	178787.68	6040679.00	2,839.1191	10,420
	Sub Total	**10181930.94**	**310548.89**	**10492479.84**	**4931.47**	**18098.48**
2.	Substations	0.0	0.0	0.0	0.0	0.0
3.	RoW					
a	India Border to New Butwal	941485.56	28715.31	970200.87	455.9944	1,673
b	New Butwal to New Damauli	5395872.82	164574.12	5560446.94	2,613.4101	9,591
c	New Damauli to Ratematae	9524370.99	290493.32	9814864.31	4,612.9862	16,930
d	Ratmatae to New Hetauda	9713446.88	296260.13	10009707.01	4,704.5623	17,266
e	Ratmatae to Lapsiphedi	34983832.57	1067006.89	36050839.46	16,943.8945	62,184
	Sub Total	**60559008.82**	**1847049.77**	**62406058.59**	**29330.85**	**107644.21**
	Total	**70740939.76**	**2157598.66**	**72898538.42**	**34262.31**	**125742.69**

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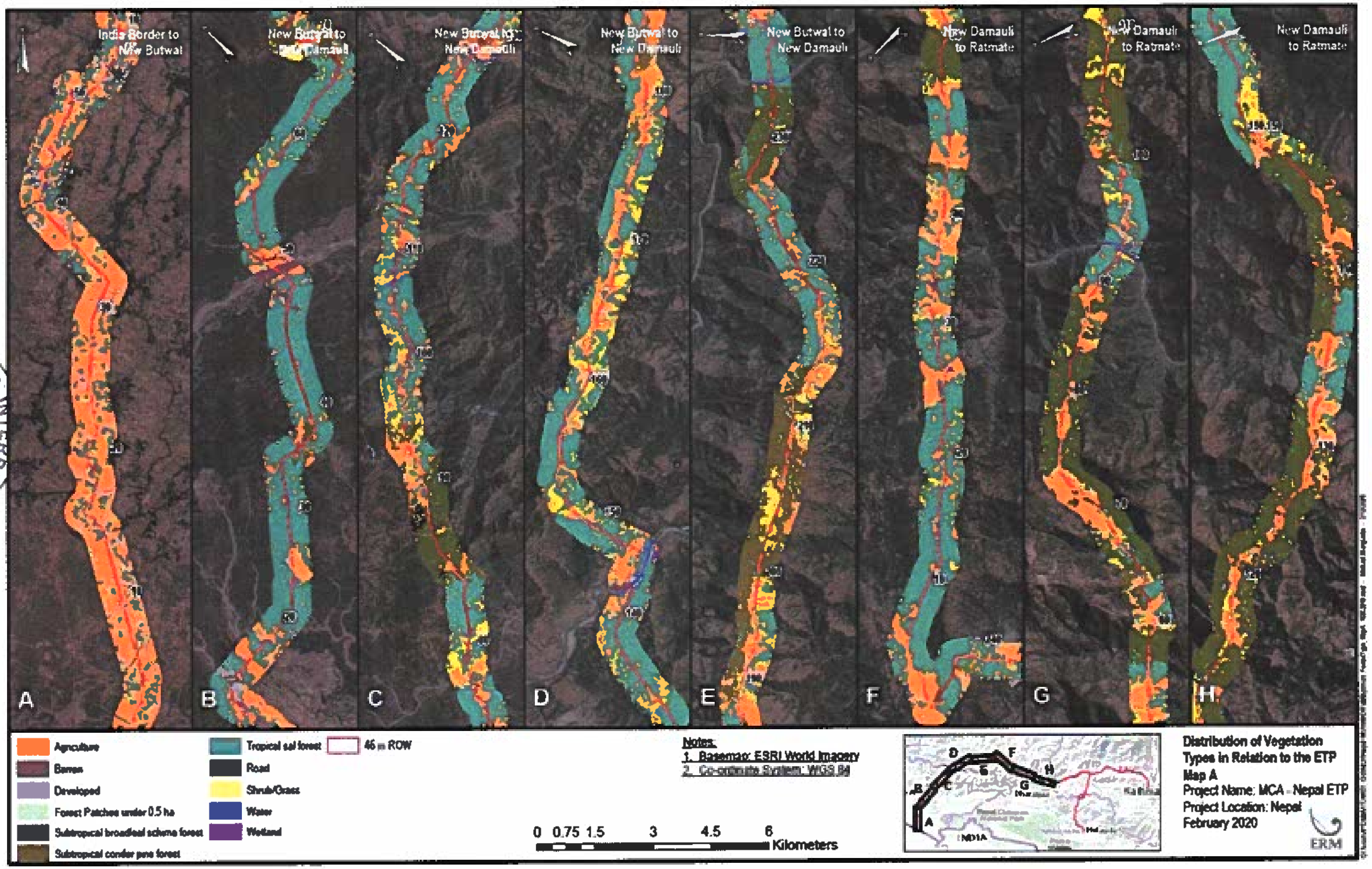

Figure 5.2-2: Distribution of Vegetation Types in Relation to the ETP

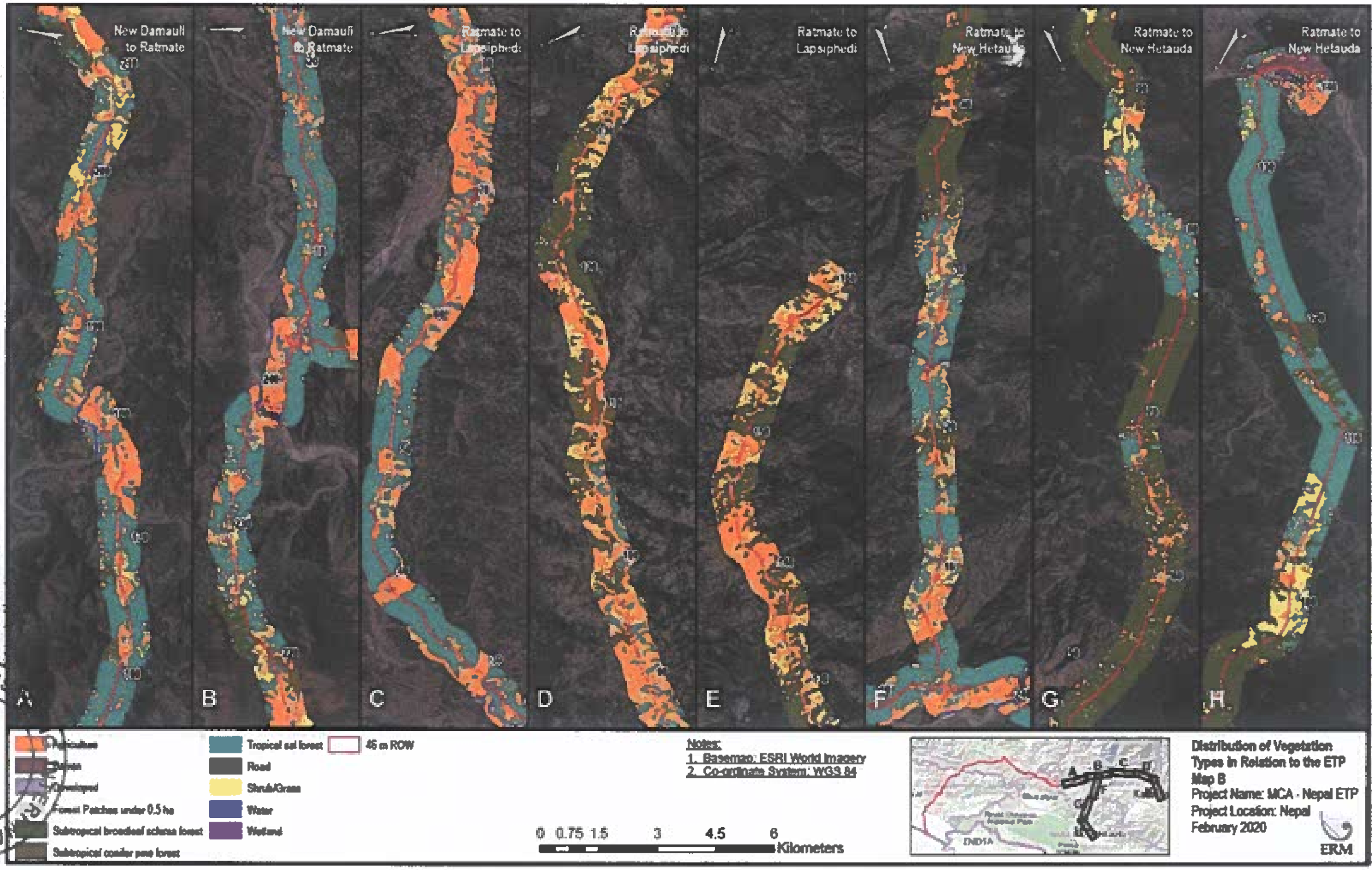

Figure 5.2-3: Distribution of Vegetation Types in Relation to the ETP

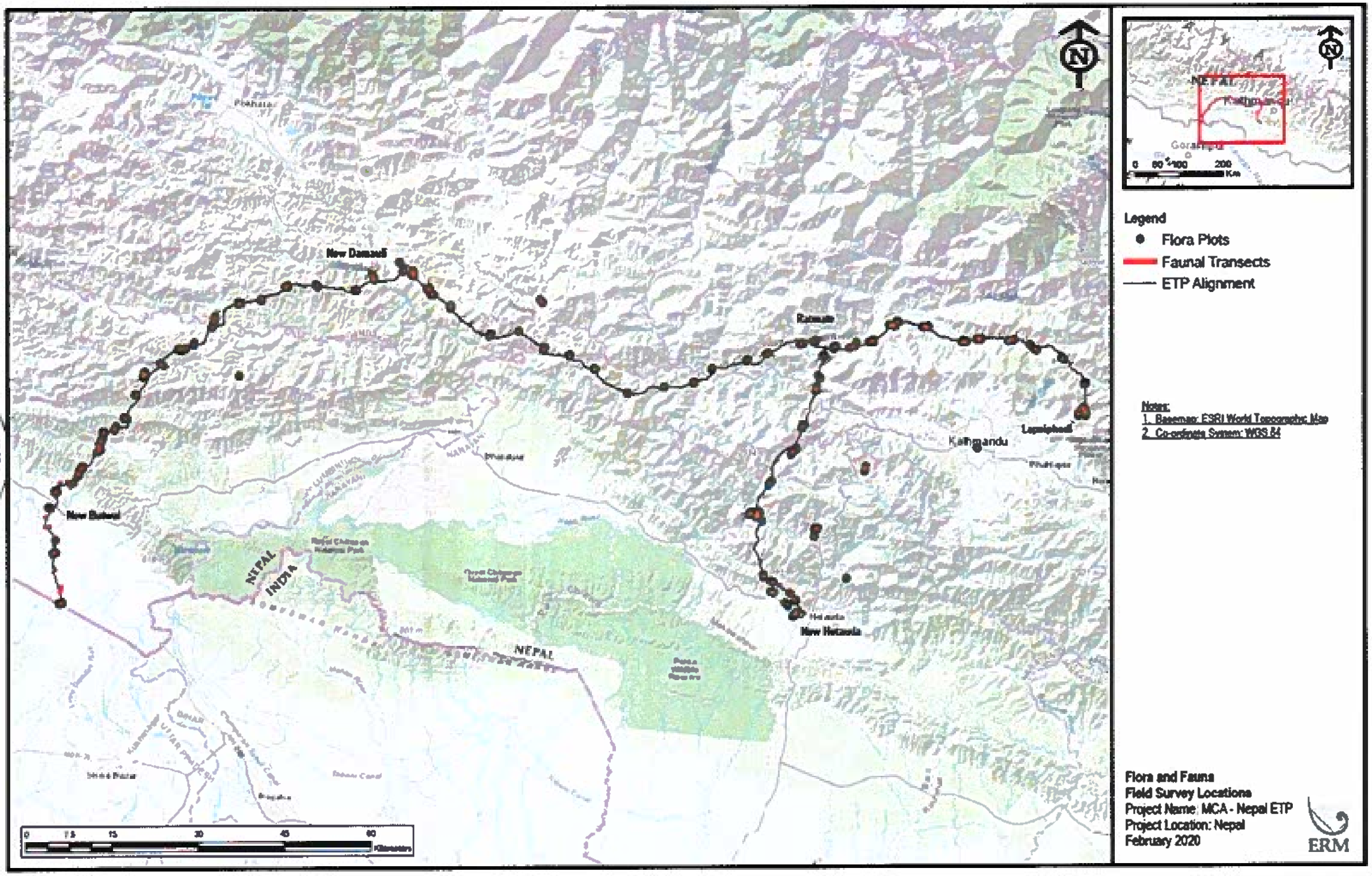

Figure 5.2-4: Flora and Fauna Field Survey Locations

5.2.4 National Conservation Areas and Landscapes of Biodiversity Importance

The ETP route does not cross any GoN–designated national parks, wildlife reserves, or their respective buffers. The ETP route, however, does pass through broad biodiversity conservation units (Chure Conservation Area (CCA) and landscapes of biodiversity importance (i.e., Chitwan Annapurna Landscape and Terai Arc Landscape). Table 5.2-11 provides a summary of the national conservation areas and landscapes of biodiversity importance and the relevance of the ETP to them. As indicated in Table 5.2-11, the Project crosses the CCA and the two important landscapes, so portions of these areas are within the Project's direct and indirect impact areas

Table 5.2-11: Summary of National Conservation Areas found along the ETP Alignment

National Conservation Area	Length of ETP within (km)	Area of Forest within ETP Segment (ha)	Corresponding ETP Segment(s)
Chure Conservation Area (CCA)	32.6	124.2	NB to New Damauli substation (Towers 26 to 48 and 52 to 74) RTE to New Hetauda substation (Towers 108 to 132 and T1 to T5) Total of 76 Towers in Chure Area
Chitwan Annapurna Landscape (CHAL)	269.3	703.5	NB to ND substation ND to RTE Substation RTE to New Hetauda substation RTE to LAP substation
Terai Arc Landscape	63.8	166.7	India Border to NB substation NB to ND substation

5.2.4.1 The Chure Conservation Area (CCA)

The Government of Nepal established the "President Chure Tarai-Madhesh Conservation Development Board" (PCTMCDB) in 2014. This Board implements the policies of management of the Chure Hill, Bhabhar, Terai Madhesh and Dun regions as a single landscape as relevant for all laws, policies, and strategies relevant for conservation of environment and forest and biodiversity in Nepal and also provides advice on the ongoing management of the Chure Conservation Area to the Nepal Government.

The Chure range rises steeply from the Terai plains along the whole of its northern border. The foothills south of the Chure range, the Terai-Madesh are included in the conservation area. The Chure range extends as a contiguous landscape from eastern to western Nepal. The elevation ranges from 120 meters to nearly 2,000 meters.

This zone includes 26 percent of the total natural forest of Nepal. In terms of biodiversity, 1,308 species out of the total 1,988 species of flora and fauna found in Nepal exist in the Chure Conservation Area. This region is also important from a conservation point of view as

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321 species out of the total 493 endangered species of flora and fauna found in Nepal inhabit this region alone (PCTMCDC 2015).

The Chure Conservation Area has faced various threats. These include the increasing incidences of unpredictable rainfall and flash floods, population growth and human encroachment in forest and river areas, unplanned land distribution and the existence of a large number of landless people and rapid construction and excessive extraction of sand, gravel, and sediment (Ghimre 2016).

Working Proedure and Standards to be followed for the Development Construction in Chure Conservation Area, 2077 provides guidelines and standards for the construction and maintenance of physical infrastructures; establishment and operation of industries; and removal/collection of river-related products within Chure Conservation Area.

A *President Chure-Terai Madhesh Conservation and Management Master Plan*, 2017, Objective 1 is the most relevant for the ETP development as it focuses on:

- Forest management for all forests outside the protected area system to be managed by adopting appropriate forest improvement on the basis of the slope of the terrain;
- Control of invasive species: The four main invasive plant species profusely found throughout the Chure-Tarai Madhesh Landscape are *Mikenia micrantha*, *Lantena camera*, *Chromolanea odorata*, *Eupatorium sp.* and *Parthenium hysterophorus*; and
- Biodiversity conservation aimed toward the conservation of the ecosystems lying outside the protected areas and the endangered species of plants.

ERM conducted a spatial assessment of the ETP route within the CCA. The length and forest areas within the CCA are outlined in Table 5.2-12. The location of the ETP route in relation to the CCA is shown on Figure 5.2-5.

Table 5.2-12: ETP Route within the Chure Conservation Area

ETP Segment	Length of Route within CCA (km)	Area of Forest within RoW (ha)	Estimated Number of Trees Cleared
NB to ND Substation	18.6 km (Towers 26 to 48 and 52 to 74)	72.8	18,368
RTE to New Hetauda Substation	14.0 km (Towers 108 to 132 and T1 to T5	51.4	14,308
Total	32.6 (76 Towers)	124.2	32,675

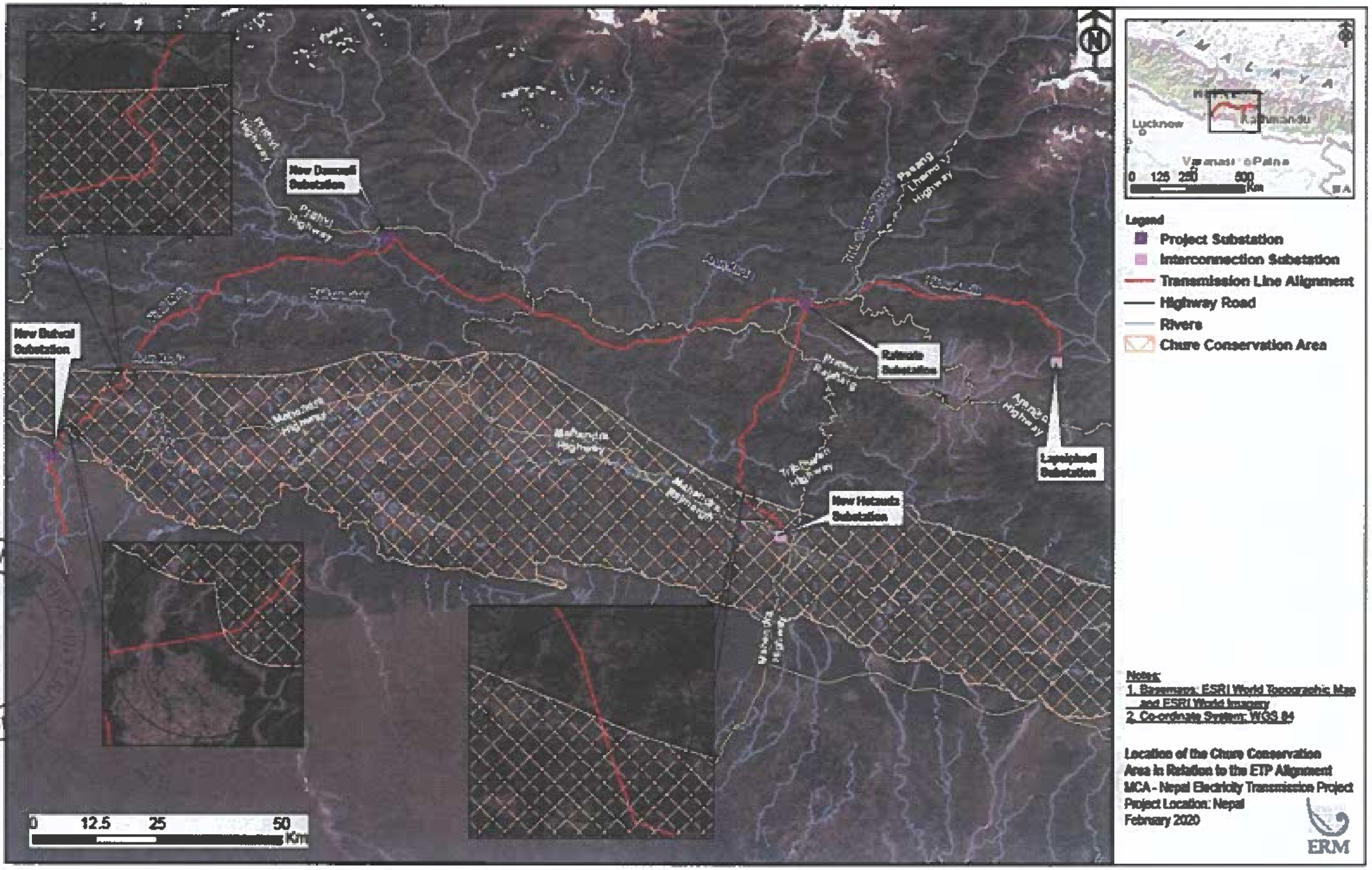

Figure 5.2-5: Location of the Chure Conservation Area in Relation to the ETP Alignment

5.2.4.2 Chitwan-Annapurna Landscape

The Chitwan-Annapurna Landscape (CHAL) in central Nepal is known for its biodiversity. Eight major rivers (Kali Gandaki, Seti, Madi, Marsyangdi, Daraundi, Budi Gandaki, Trishuli, and Rapti) and their tributaries of the broader Gandaki River system drain the landscape. It includes the whole of the Kali Gandaki River Basin in Nepal (WWF 2013). The proposed landscape is 32,068 square kilometers —11.4 percent in the Chure, 37.8 percent in the Midhills, and 50.8 percent in the Mountains. CHAL is a portion of a larger landscape, the Greater Himalayan Landscape, conceived in 1999 (WWF and ICIMOD 2001). The CHAL has a management plan that expired in 2017 (MoFSC 2015).

The Mid-hills in the CHAL have a significant overlap with the ETP alignment and occupy 37.8 percent of the CHAL. The Mid-hills have a sub-tropical to temperate monsoonal climate and are characterized by intensive farming on hillside terraces. This elevational zone is under intense use for terraced agriculture and human settlement. Community forest management, in recent times, has helped to restore some of the denuded forests in some areas (WWF 2013).

The Mid-hills contains several mammals that are threatened in the International Union for the Conservation of Nature (IUCN) Red-List or protected in Nepal.

The CHAL falls in the watersheds of the Kali Gandaki, Marsyangdi, Modi, Seti, Madi, Trishuli, Rapti, and Narayani Rivers. The potential linkages identified were within the existing major river systems within the CHAL, including their tributaries.

There are seven naturally existing RoWs in the CHAL (Basnet 2000). The ETP alignment only passes through the Kali Gandaki River, Seti River and the Trishuli River Valleys. There are also seven proposed north-south and east-west RoWs, however the ETP alignment does not pass through any of these RoWs (Basnet 2000).

The length and forest areas within the CHAL are outlined in Table 5.2-13. About 87 percent of the total length of ETP lies in CHAL area. The location of the ETP route in relation to the CHAL is shown on Figure 5.2-6.

Table 5.2-13: ETP Route within the Chitwan-Annapurna Landscape

ETP Segment	Length of Route within CHAL (km)	Area of Forest within RoW (ha)	Estimated number of trees/poles cleared
New Butwal to New Damauli	77.8	200.3	32,190
New Butwal to Ratmate	89.7	210.9	39,471
Ratmate to New Hetauda	57.5	184.2	41,410
Ratmate to Lapsiphedi	44.3	108.2	29,960
Total	**269.3**	**703.6**	**143,031**

Figure 5.2-6: Location of the Chitwan-Annapurna Landscape in Relation to the ETP Alignment

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5.2.4.3 Terai Arc Landscape

While the early conservation efforts focused on species within district protected areas, there was a growing recognition that certain wide-ranging species such as tiger could not be conserved through protected areas alone. This resulted in a landscape-scale approach with the creation of the transboundary Terai Arc Landscape (TAL), and the portion in Nepal was declared a priority conservation landscape by the Government of Nepal (GoN) in 2001. The entire TAL extends for over 900 kilometers from the Bagmati River, Nepal in the east to the Yamuna River in Uttarakand, India in the west, with an area of 51,002 square kilometers.

The TAL harbors globally important biodiversity of the Terai Duar Savanna and Grasslands ecoregion (Olson et al. 2000). It adopts a landscape-level approach to conserve several of Asia's large mammals, birds, reptiles, and freshwater fishes; sustain environmental flows that maintain important ecosystems; and provides ecosystem services that support the socioeconomic well-being of people and development in the Terai and Churia region of Nepal.

The highly productive alluvial grasslands and riverine forests of the TAL support Asia's largest herbivores and carnivores. The fauna includes 85 species of mammals, 565 species of birds, 47 species of herpetofauna, and more than 125 species of fish. Fauna species found in the TAL and whose distribution likely overlap with the ETP alignment include Tiger (*Panthera tigris*), Great Hornbill (*Buceros bicornis*), Sarus Crane (*Grus antigone*), Lesser Adjutant Stork (*Leptoptilos javanicus*), and several species of vultures.

A ranking of threats in the TAL through stakeholder consultations indicated that the highest overall threats to species and biodiversity targets were from large infrastructure, encroachment, and wildlife poaching and illegal trade. Threats from invasive species, unsustainable fuelwood, and Non-Timber Forest Products (NTFP) collection were also high for large mammals. Illegal logging was a high threat for the rare tree species (MoFSC 2015).

A Strategic and Action Plan was formulated to achieve the goal of the TAL (MoFSC 2015) being to "conserve the ecosystems of the Terai and Churia hills in order to ensure integrity of ecological, economic, and sociocultural systems and communities."

The broad strategic themes and objectives were species and ecosystem conservation, forest and land use and socioeconomic well-being. The strategic theme of species and ecosystem conservation is most relevant for the ETP development and has the following objective:

- Objective 1: To conserve and ensure recovery of endangered species and critical ecosystems

This objective will be achieved by adopting strategies relevant for the ETP development such as managing rare and endangered species and protecting and restoring critical habitats.

While the ETP alignment will not pass through any protected areas (e.g., National Parks), there is the possibility of fauna from protected areas dispersing into the ETP alignment.

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The length and forest areas within the TAL are outlined in Table 5.2-14. The table indicates that the largest impact to forests is within the NB to ND Substation Segment with 83.5 hectares and 75.0 hectares affected respectively. The location of the ETP route in relation to the TAL is shown on Figure 5.2-7. The figure demonstrates the extent to which the TAL is bisected by the ETP in the India Border to Bew Butwal and NB to ND Substation Segments.

Table 5.2-14: ETP Route within the Terai Arc Landscape

ETP Segment	Length of Route within TAL (km)	Area of Forest within RoW (ha)	Estimated number of trees/poles cleared
India Border to New Butwal	18.1	9.0	5,324
New Butwal to New Damauli	27.0	89.6	24,072
Ratmate to New Hetauda	18.7	68.1	16,867
Total	**63.8**	**166.7**	**46,263**

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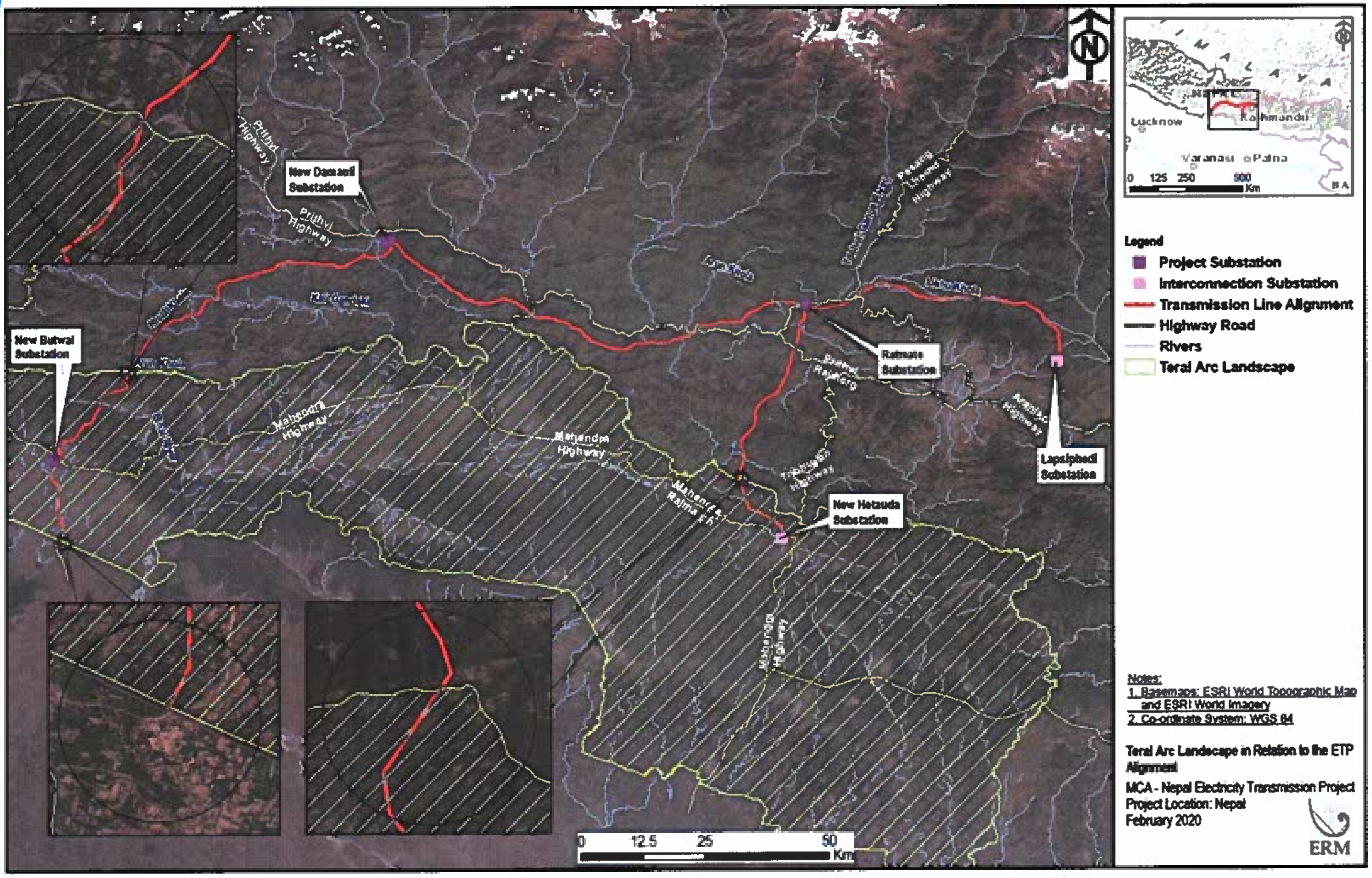

Figure 5.2-7: Terai Arc Landscape in Relation to the ETP Alignment

5.2.5 Protected Areas

The ETP passes near two protected areas (i.e national parks) and their buffers. These protected areas are further discussed below.

5.2.5.1 Parsa National Park

The ETP alignment does not pass through the Parsa National Park (PNP), nor does any of its Direct or Indirect Impact Area. The PNP core lies about 7.5 kilometers to the south of the ETP alignment, and the buffer area is about 0.8 km south of the ETP alignment. There is an area of contiguous natural habitat between PNP and the ETP alignment, which is shown on Figure 5.2-8

The PNP was gazetted by the *National Parks and Wildlife Conservation (NPWLC) Act* (1973) in July 2017 and has a core area of 627.39 square kilometers and a buffer zone area of 285.3 square kilometers (PNP 2018). The Park is assigned an IUCN Management Category II and is an Important Bird Area (IBA Code NP018).

Threats to the Park as relevant for the ETP development include (PNP 2018):

- Unsustainable use of sand and gravel mining pose threat to biodiversity conservation;
- Habitat loss and fragmentation due to encroachment in the buffer zone;
- Poaching and illegal trade of wildlife and its derivative; and
- Illegal timber smuggling.

The Parsa National Park and Buffer Zone Management Plan (PNP 2018) has the following management objectives as relevant to the construction and operation of the ETP.

- To restore, improve and manage habitat for wild elephant, tiger, rhinos and other species;
- To ensure maintenance of a viable population of wild elephant and tiger including all flora and fauna by restoring RoWs to ensure connectivity, reduce illegal killing and illegal trade;

5.2.5.2 Shivapuri-Nagarjun National Park

The Shivapuri-Nagarjun National Park was gazetted by the *NPWLC Act* (1973) in 2009 and has a core area of 159 square kilometers (Shivapuri: 144 square kilometers and Nagarjun: 15 square kilometers) and a buffer zone area of 166 square kilometers. The Park is assigned an IUCN Management Category II and is an IBA (IBA Code NP018) (DNPWLC 2017). The Park is also an IBA. The ETP alignment does not pass through the Shivapuri-Nagarjun National Park, and the park is outside of the Project's Direct Impact Area. The Project is located 2.5 kilometers to the north and east of the park core and about 0.1 km from the buffer zone. The location of the ETP in relation to the Park is shown on Figure 5.2-8.

The key drivers of land use change include over harvesting of fuel wood for alcohol production, timber extraction, and non-conducive government policies. Due to limited livelihood options, people residing inside Shivapuri-Nagarjun National Park boundary are involved in illegal extraction of fuel wood mainly for alcohol production (Shrestha et al. 2013).

Other threats to Park as relevant for the ETP development include (DNPWC 2017)

- Poaching continues to be a threat as long as market value for illegal wildlife parts exists;
- Grassland degradation from natural succession;
- Traditional resource dependency of local people;
- Frequent Forest fire due to pine forests and undulating landscape;
- Encroachment in park and its buffer zone;
- Development activities especially road network in the park and its buffer zone from the other Government organizations; and
- Changing land use pattern in the park and its buffer zone

The draft Shivapuri-Nagarjun National Park and Buffer Zone Management Plan has the following management objectives as relevant to the ETP development.

- To protect, conserve and document biodiversity with special focus on nationally protected and globally threatened and locally valuable rare, endangered and endemic species, communities, ecosystems, and diverse habitats of wildlife species; and
- To manage the representative terrestrial and aquatic wildlife habitat and assess habitat status to maintain ecological functions and processes of mid-mountain ecosystem.

The ETP construction and operation does not have any direct impacts to the Shivapuri-Nagarjun National Park. There is the potential that some large mammal species from the Park could potentially move from the park into the Project area of influence (e.g., Clouded leopard, Common Leopard, and Himalayan Black Bear).

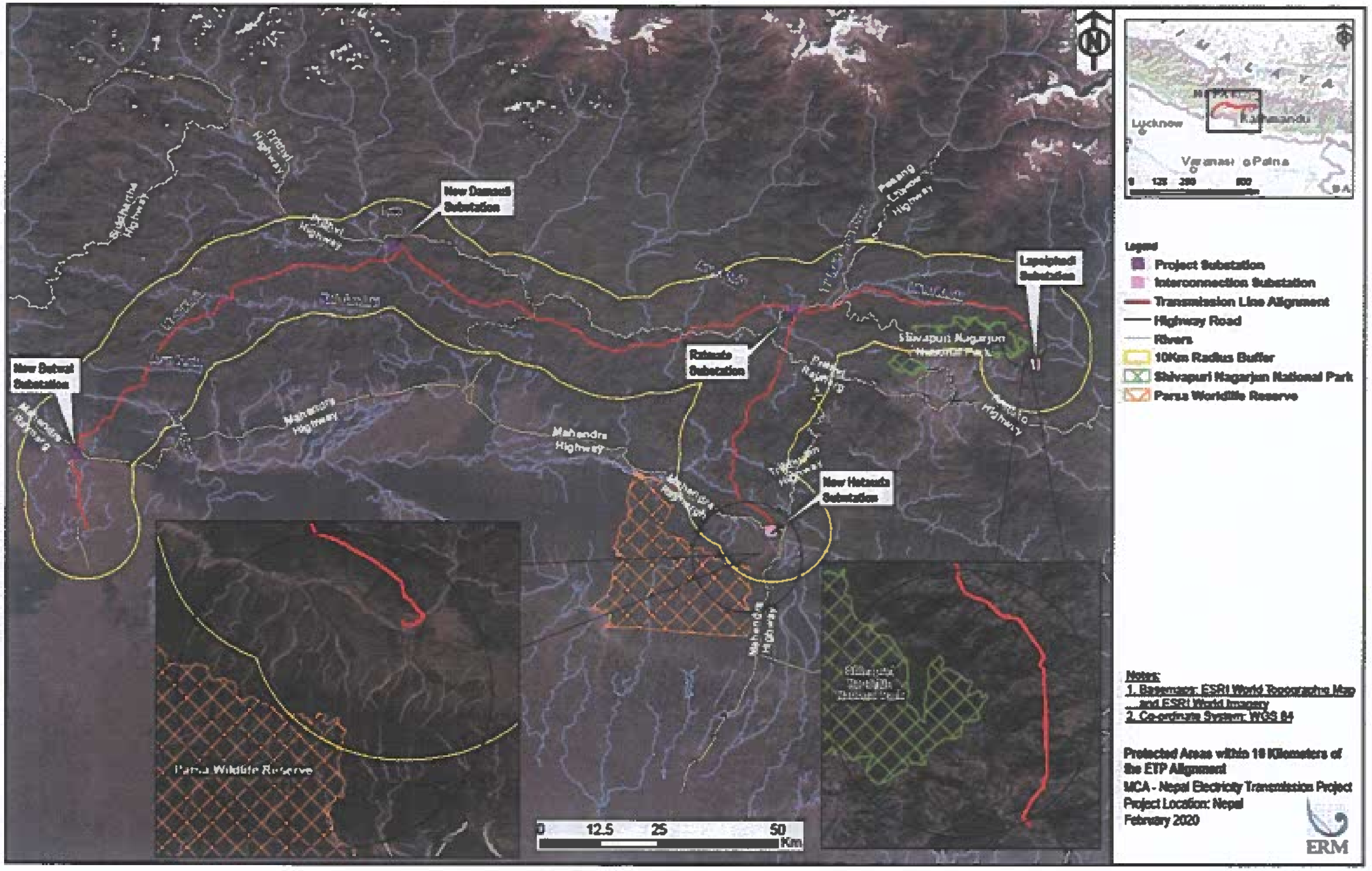

Figure 5.2-8: Protected Areas within 10 Kilometers of the ETP Alignment

5.2.6 Internationally Recognized Areas of High Biodiversity Value

The Consultant Team has undertaken screening of the potential for these areas in context of the ETP route. Descriptions of these areas are outlined below and potential interaction with the ETP is also discussed.

5.2.6.1 Key Biodiversity Areas

Key Biodiversity Areas (KBA) are defined by the Key Biodiversity Areas Partnership[1] as sites that contribute significantly to the global persistence of biodiversity, applicable to terrestrial, freshwater, and marine ecosystems (BirdLife International 2018c). Sites qualify as global KBAs if they meet one or more of 11 criteria as defined by the Partnership, grouped into the following five categories: threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes, and irreplaceability.

KBAs within 10 kilometers of the ETP were chosen in order to identify those that may interact with the activities within the ETP during construction and operation. Given the terrain and terrestrial species present, this is considered to be a reasonable distance for assessment. Some more mobile and migratory species will have larger ranges (migratory birds), however these species are considered individually within the assessment.

KBAs that are located within 10 kilometers of the Project Area are shown in Table 5.2-15. A 10 kilometers distance was chosen given the species likely to interact with the ETP, including ground dwelling fauna and birds such as the Chinese and Indian pangolin (*Manis pentadactyla* and *Manis crassicaudata*), Clouded Leopard (*Neofelis nebulosi*) and the endmiec Spiny Babbler (*Turdoides nepalensis*). The distribution of KBAs within a 10 kilometers radius of the Project Area is illustrated on Figure 5.2-9. Four Important Bird and Biodiversity Areas were identified within 10 kilometers of the ETP RoW.

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[1] Key Biodiversity Partnership comprises a consortium of 12 conservation NGOs including BirdLife International, IUCN, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society of the Protection of Birds, WWF and Wildlife Conservation Society.

Table 5.2-15: Biodiversity Areas within 10 Kilometers of the ETP RoW

S/N	KBA/IBA	Summary	Length of ETP within KBA	ETP Distance From KBA	Area of Forest within ETP Segment of IBA	Corresponding ETP Segment(s)	Number of towers identified within IBA
1.	Nawalparasi Forest IBA (IBA Code NP017)	The Nawalparasi Forest IBA is largely used for agriculture and almost all of the southern part is intensively farmed. Natural and semi-natural forests remain towards the north, along the northern section of the East West highway. These forests are managed by local communities, as community forests. Agriculture forms a significant part of the landscape. Nawalparasi has been identified as an IBA because of its important colony of White-rumped Vultures (*Gyps bengalensis*). The IBA also contains nesting colonies of the Lesser Adjutant (*Leptoptilos javanicus*) (Birdlife Datazone, 2019a).	6 km	0 km	683 m^2	India Border to NB Substation NB to ND Substation	10
8.	Rampur Valley IBA (IBA Code NP020)	The Kali Gandaki River borders Rampur valley on the northern side. Most of the communities practice terraced agriculture on the lower slopes; the higher slopes remain vegetated in some form. The IBA has been identified because of its important White-rumped Vulture (*Gyps bengalensis*) nesting colony. A total of 70 active nests were recorded from this area. Vulture nests are spread along the Kali Gandaki River in a 15 km stretch in patches of riverine forests. The most important of the nesting sites is located at Khaireni forest where over 30 nests have been located. The Silk-Cotton is the main nesting tree in the area (Birdlife Datazone, 2019b)	0 km	2 km	0 km^2	NB to ND Substation	0

S/N	KBA/IBA	Summary	Length of ETP within KBA	ETP Distance From KBA	Area of Forest within ETP Segment of IBA	Corresponding ETP Segment(s)	Number of towers identified within IBA
9.	Shivapuri-Nagarjun National Park (IBA Code NP024)	This IBA, initially established as a wildlife reserve, was designated a national park in 2003. It is the main source of the rivers Bagmati and Vishnumati that flow from the southern slopes of the mountain. The lower slopes are extensively covered by scrub. Chir Pine (*Pinus roxburghii*) is the dominant tree species The northern slopes are dominated by these broadleaved trees at lower elevations and some scrub whereas higher up in the upper temperate zone the mountain is densely vegetated. A total of 178 bird species has been identified from this IBA and it supports good population of two restricted range species viz. Spiny Babbler (*Turdoides nepalensis*) and Hoary-throated Barwing (*Actinodura nepalensis*). In addition, this is the only site in Nepal for globally threatened Relict Himalayan Dragonfly (*Epiophlebia laidlawi*) (Birdlife Datazone 2019c). Chinese Pangolin has also been recorded in this national park.	0 km	10 km	0 km^2	RTE to LAP Substation	0

S/N	KBA/IBA	Summary	Length of ETP within KBA	ETP Distance From KBA	Area of Forest within ETP Segment of IBA	Corresponding ETP Segment(s)	Number of towers identified within IBA
10.	Parsa National Park (IBA Code NP018)	The reserve encompasses part of the Chure hills and bhabar land. It has a subtropical monsoon climate but, due to the gravel and conglomerate soil composition, the ground is very porous and, as a result, there are many dry streams, ravines, and gullies. The reserve is dominated by Sal (*Shorea robusta*) forests throughout. Over 250 species of fauna and flora have been reported from this area including Critically Endangered White-rumped Vulture (*Gyps bengalensis*). The large areas of dry tropical forest in Parsa are likely to support significant populations of characteristic species of the Indo-Malayan Tropical Dry Zone biome. In addition, the reserve provides excellent habitat to other globally threatened mammalian species including Tiger (*Panthera tigris*), Asian Elephant (*Elephas maximus*), and Asian Wild Dog (*Cuon alpinus*) (Birdlife Datazone 2019d).	0 km	<10 km	0 km²	RTE to New Hetauda Substation	0

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S/N	KBA/IBA	Summary	Length of ETP within KBA	ETP Distance From KBA	Area of Forest within ETP Segment of IBA	Corresponding ETP Segment(s)	Number of towers identified within IBA
11.	Barandabhar Forests and Wetlands	The Barandabhar forest ranges from 1.8-7 km in width and stretches from Chitwan National Park in the south to the Mahabharat Range in the north. The forest south of the Mahendra Highway lies in the park's buffer zone. The forest area includes Sal (*Shorea robusta*), riverine forest *Trewia nudiflora*, *Bombax cebia*, *Mallotus philippensis*, *Dalbergia sissoo*/*Acacia catechu*, mixed forest, shrubs and wetlands (streams, lakes, canals and water holes) (Adhikari et al. 2000, Dahal 2003). Bees Hazari Tal is a wetland lying within the forest. A total of 282 bird species has been recorded in Barandbhar forest and Bees Hazari Tal, including the globally threatened Lesser Adjutant and near-threatened Great Hornbill, Grey-headed Fish Eagle (*Ichthyophaga ichthyaetus*) and Darter (*Anhinga melanogaster*). Surveys have shown that, although it is small, Barandabhar is an extremely important forest, providing a migration route for the passage of birds and other wildlife (Birdlife Datazone 2019).	0 km	>5 km	0 km^2	ND to RTE Substation	0

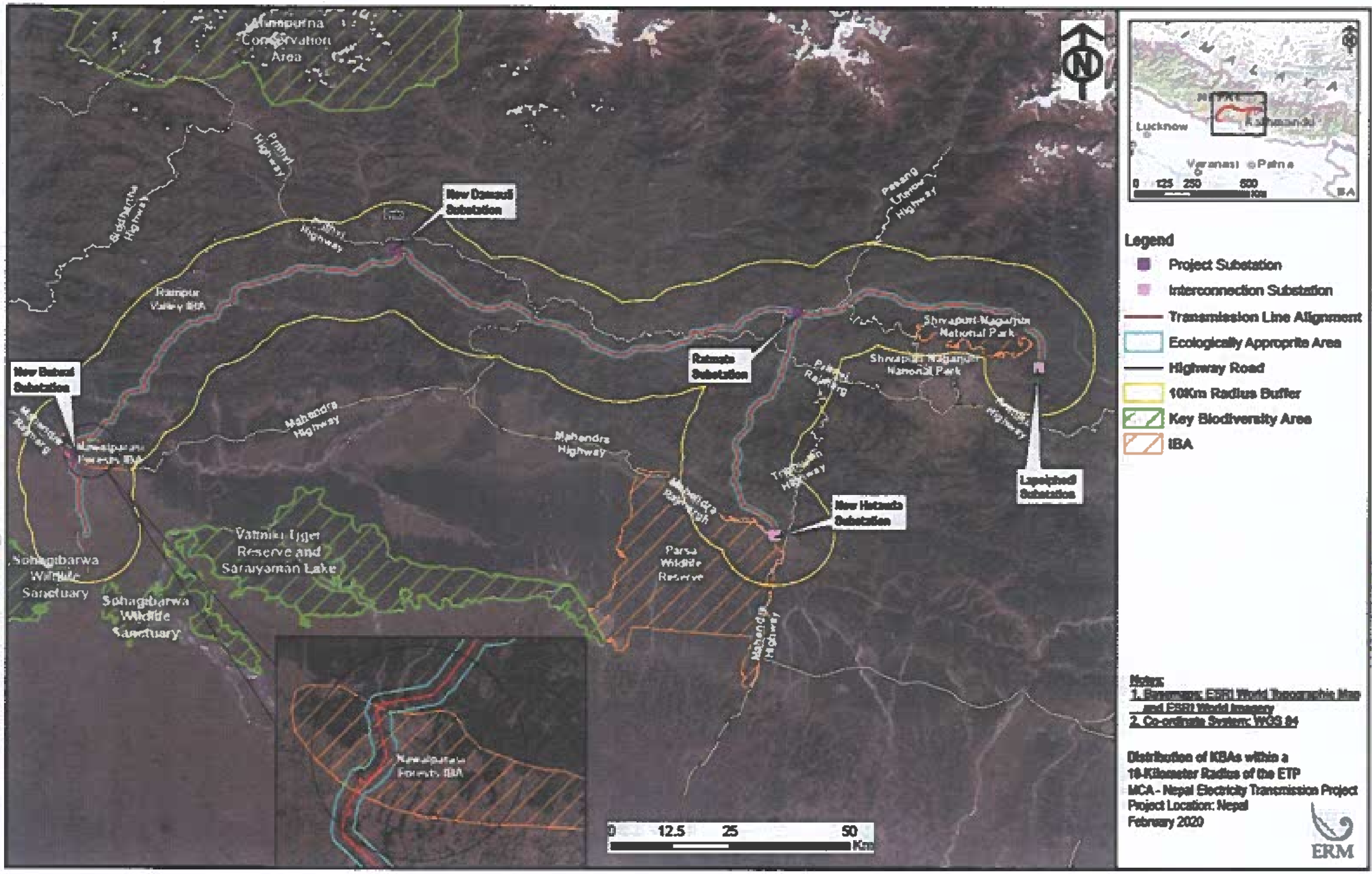

Figure 5.2-9: Distribution of KBAs within a 10-Kilometer Buffer of the ETP

5.2.6.2 Alliance for Zero Extinction Sites

The Alliance for Zero Extinction (AZE) Sites works to increase the population of endangered and critically endangered species (AZE 2018). This method involves eliminating human threats such as commercial exploitation, disease, and introduction of invasive species. The National AZE is a form of partnership between government agencies and non-governmental organizations, in compliance with national commitments under the United Nations Convention on Biological Diversity.

The ETP route does not pass within 10 kilometers of any AZE sites.

5.2.6.3 World Heritage Areas

World Heritage Areas are sites that are selected by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as having cultural, historic, scientific, or other form of significance. These areas are legally protected by international treaties and demarcated by UNESCO as protected zones. This allows for practical conservation of areas that would otherwise be subjected to threats such as uncontrolled and unrestricted access, and associated activities such as poaching and illegal logging.

The ETP route does not pass within 10 kilometers of any UNESCO World Heritage Sites or UNESCO Man and the Biosphere Reserves (Man and Biosphere Programme 1971).

5.2.6.4 Tiger Conservation Landscapes

Tigers are large carnivores that occur at low densities and require large home ranges to harbor viable populations (Linkie et al. 2008). Tiger Conservation Landscapes (TCL) were developed by a consortium of NGOs (World Wildlife Fund, Zoological Society of London, Wildlife Conservation Society, and Smithsonian Institute) to determine the current and future predicted distribution of tigers (Sanderson et al 2006). TCLs are defined as identified connected areas of suitable tiger habitat that can support at least five adult tigers and where tiger presence has been confirmed in the past decade.

Within Nepal, tigers are found within five protected areas and surrounding forests in the Terai Arc Landscape in the south of the country, straddling the border with India (Wikramanayake et al. 2004). Of global importance for tiger recovery, the Chitwan–Parsa–Valmiki forest complex of the Terai Arc Landscape was designated a Level I Tiger Conservation Unit (in addition to other protected area complexes in India within the TAL), a region of global priority, in 1998 (Wikramanayake et al. 2004). It also constitutes one of the 42 global source sites for tigers (Walston et al. 2010).

The location of the ETP in relation to the Terai Arc Tiger Conservation Landscape is shown on Figure 5.2-10. As the figure shows, the NB to ND Substation segment of ETP crosses the Terai Arc Landscape in Nawalparasi (East of Bardaghat Susta) district and Nawalparasi (West of Bardaghat Susta). The foothills of the Terai-Chure CCA in this landscape through which the ETP alignment passes through, are included within the Tiger Conservation Landscape.

These foothills are included to promote connectivity across the Terai Arc Landscape for tiger dispersal. As described in Section 5.2.10, no tigers have been recorded in this part of the ETP alignment from literature search and surveys.

5.2.6.5 Endemic Bird Areas

Endemic Bird Areas (EBAs) are regions that represent natural areas of bird endemism where the distribution of two or more restricted-range bird species overlap, where restricted-range refers to a breeding range of no more than 50,000 square kilometers (Birdlife International 2018f). EBAs were identified in 1998 through assessments of the BirdLife secretariat to identify important habitats for restricted range/endemic birds (Stattersfield et al 1998). There are four EBAs within Nepal. Descriptions of the EBAs, trigger species, and corresponding ETP alignment are shown in Table 5.2-16. The ETP alignment in relation to the EBAs is shown on Figure 5.2-11. The figure demonstrates the location of the endemic bird areas in relation to the ETP alignment.

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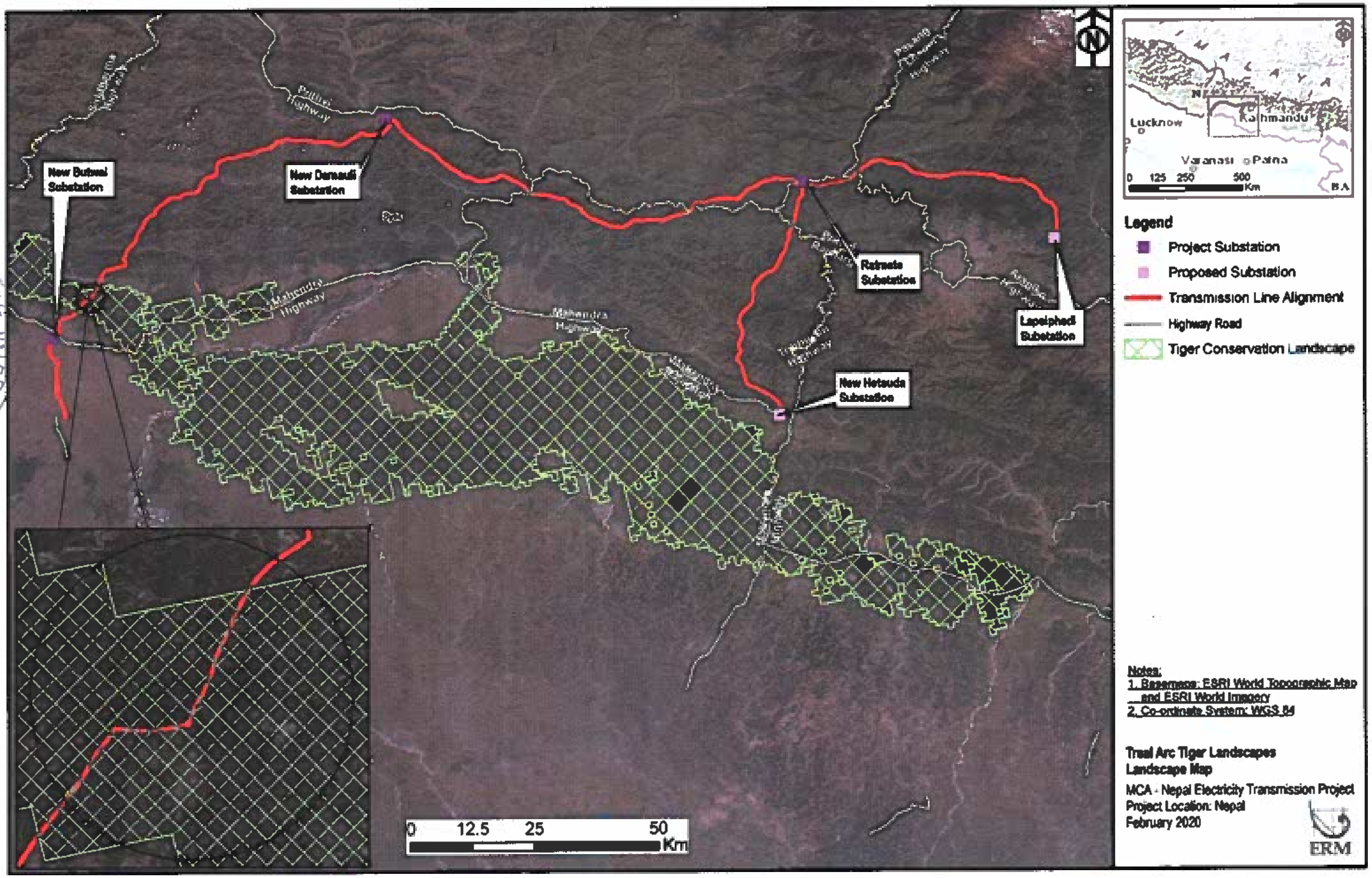

Figure 5.2-10: Terai Arc Tiger Landscapes

Table 5.2-16: Endemic Bird Area Associated with the ETP Alignment

S/N	Name	Area	Trigger Species	Corresponding Protected Area(s)	Corresponding ETP Alignment and Potential Impacts
1.	Central Himalayas	56,000 km²	Nepal Cupwing (*Pnoepyga immaculata*) IUCN LC, Red-List for Nepal's Birds (NRLB), LC, Spiny Babbler (*Acanthoptila nepalensis*) IUCN LC, NRLB, LC, Hoary-throated Barwing (*Sibia nepalensis*) IUCN LC, NRLB, LC	Shivapuri-Nagarjun National Park	NB to RTE Substation RTE to LAP Substation The ETP alignment could cause loss of habitat during clearance of the RoW for these species all of which breed in Nepal.
2.	Western Himalayas	130,000 km²	White-throated Tit (*Aegithalos niveogularis*) IUCN LC, NRLB, LC	Shivapuri-Nagarjun National Park	RTE to LAP Substation The ETP alignment could cause loss of habitat during clearance of the RoW for this species which breeds in Nepal.

IUCN Red List: LC=Least Concern, VU=Vulnerable, NT=Near Threatened, EN=Endangered, CR=Critically Endangered

DS=Dry Season, WS=Wet Season, IB=IBAT

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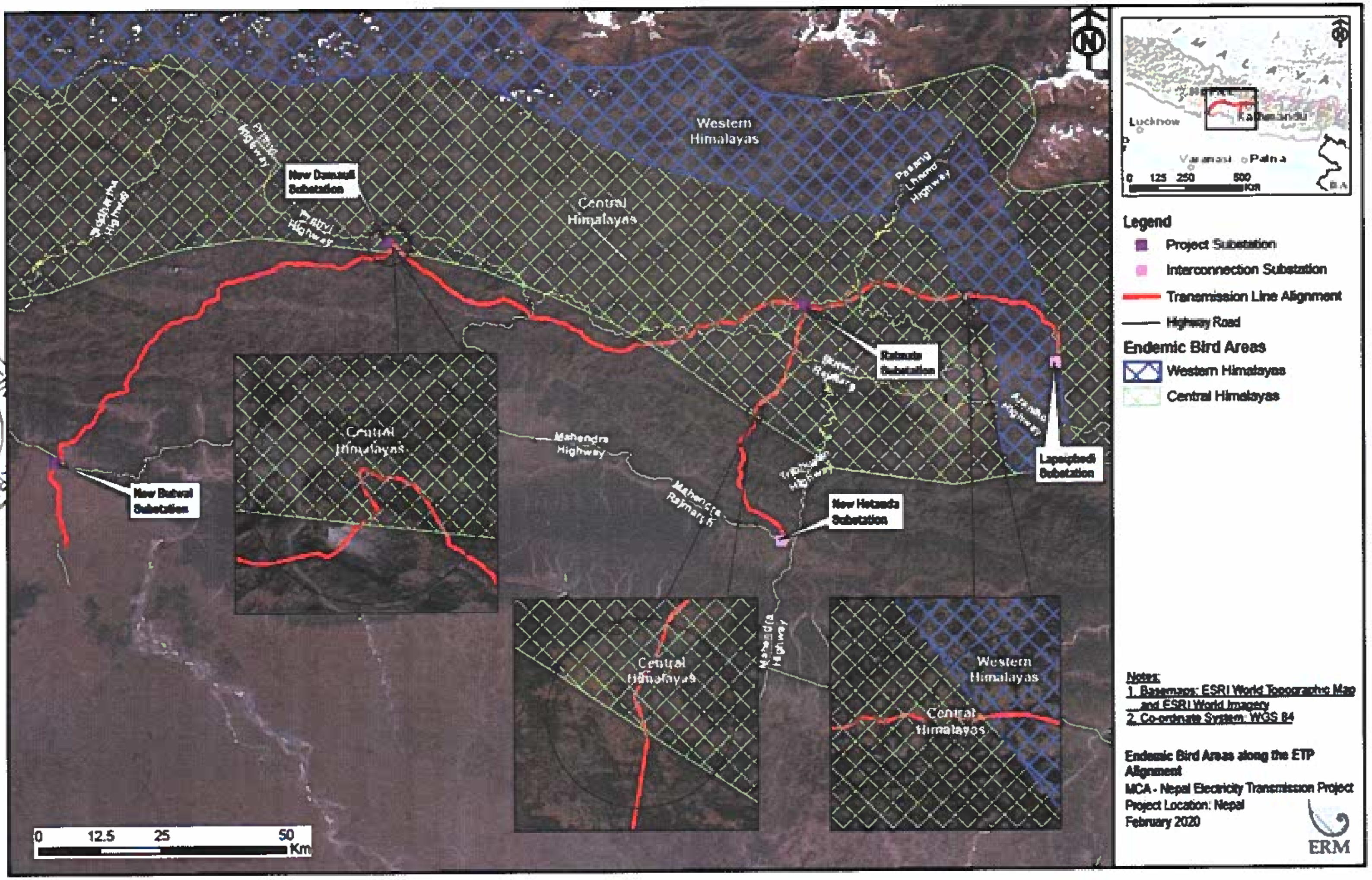

Figure 5.2-11: Endemic Bird Areas along the ETP Alignment

5.2.6.6 Central Asian Flyway

The Central Asian flyway connects the Palaearctic region with the Indian Subcontinent (Palm et al. 2013). Many threatened birds including wetland birds such as the Baer's Pochard (*Aythya baeri*) and the Falcated Duck (*Anas falcate*) breed in the Palaearctic Region and fly south towards the Indian subcontinent to avoid harsh cold winter and vice versa. During this migration, they use various areas as stopover habitats to energize themselves to complete their journey of migration and most of these areas are not protected except for the Chitwan National Park, which is an important stopover site and well protected. The ETP alignment does not impact this stopover site as it is located more than 20 kilometers east of the ETP alignment. The Barandabhar forest and wetland IBA ranges from 1.8-7 kilometers in width and stretches from Chitwan National Park in the south to the Mahabharat Range in the north. Barandabhar is an important forest RoW, providing a migration route for the passage of birds and other wildlife (Birdlife International 2019e). Bees Hazari Tal in the Barbandar Forests and Wetlands is also an important wetland for birds and other wildlife. However, the IBA lies >5 kilometers south of the ETP alignment and will not be impacted.

The route through the Kaligandaki River Valley, Pokhara Valley, and Chitwan is a major migratory route in Nepal. These valleys form part of the Central Asian Flyway, which is located within Chitwan-Annapurna Landscape (Singh undated) and extends into China and Southern India.

The location of the Flyway in relation to the ETP is shown on Figure 5.2-12.

5.2.6.7 Biodiversity Hotspots and WWF Eco-regions

A biodiversity hotspot is a biogeographic area that is both a significant reservoir of biodiversity and is under threat. The Eastern Himalayan Biodiversity Hotspot extends along the Himalayan range from Nepal to Myanmar (Mittermeier et al. 2004). This hotspot sustains a diverse array of wildlife, including many rare species of fauna and flora, which in Nepal includes the Indian rhinoceros, Asian elephants, and water buffaloes in its southern region. This hotspot also encompasses the three major river basins of Nepal, namely the Karnali, Narayani, and Koshi basins, which feature dense forests that contain 5 percent of the world's butterfly species and 8 percent of the world's bird species.

The ETP coincides only with the Eastern Himalayas Broad Leaved and Conifer Forests and the Terai Duar Grasslands global eco-regions. This area contains important biodiversity values for conservation within the Eastern Himalayan region in general. The biodiversity values that the area contains are covered within other broad biodiversity conservation landscape units and are defined at a greater scale within protected areas within the landscape.

At present, hotspot areas within Nepal do not have any legal recognition, although the National Biodiversity Strategy and Action Plan of Nepal recommends that awareness programs be carried out to expose local communities to the value of biodiversity hotspots.

5.2.6.8 Vulture Safe Zones in Nepal

Vultures are highly intolerant to the nonsteroidal anti-inflammatory drugs diclofenac, which they are exposed to through the carcasses of recently treated livestock. Diclofenac is known to kill Gyps vultures (i.e., White-Rumped Vulture, Indian Vulture (IV), (Slender-billed Vulture (SBV), Himalayan Vulture HV); Oaks et al., 2004; Swan. et al., 2006a; Das et al., 2010) and possibly other species. These have resulted in major declines across the Indian sub-continent

In 2006, the Nepal government banned veterinary diclofenac and introduced meloxicam as a safe alternative. In Nepal safe feeding sites and Vulture Safe Zone have been set up. The overall goal of the project was to measure identified threats to vultures and identifying possible new threats to help in ensuring the overall safety of proposed Vulture Safe Zones. The Nawalparasi District in Central Nepal, through which the ETP alignment passes through, is considered a Vulture Safe Zone (Chaudary et al. 2011)

Along with Nawalparasi district, ten other adjoining districts were declared as Diclofenac Free Zone between November 2010 and June 2011 covering an area of 22,206 square kilometers to create the world's first Vulture Safe Zone.

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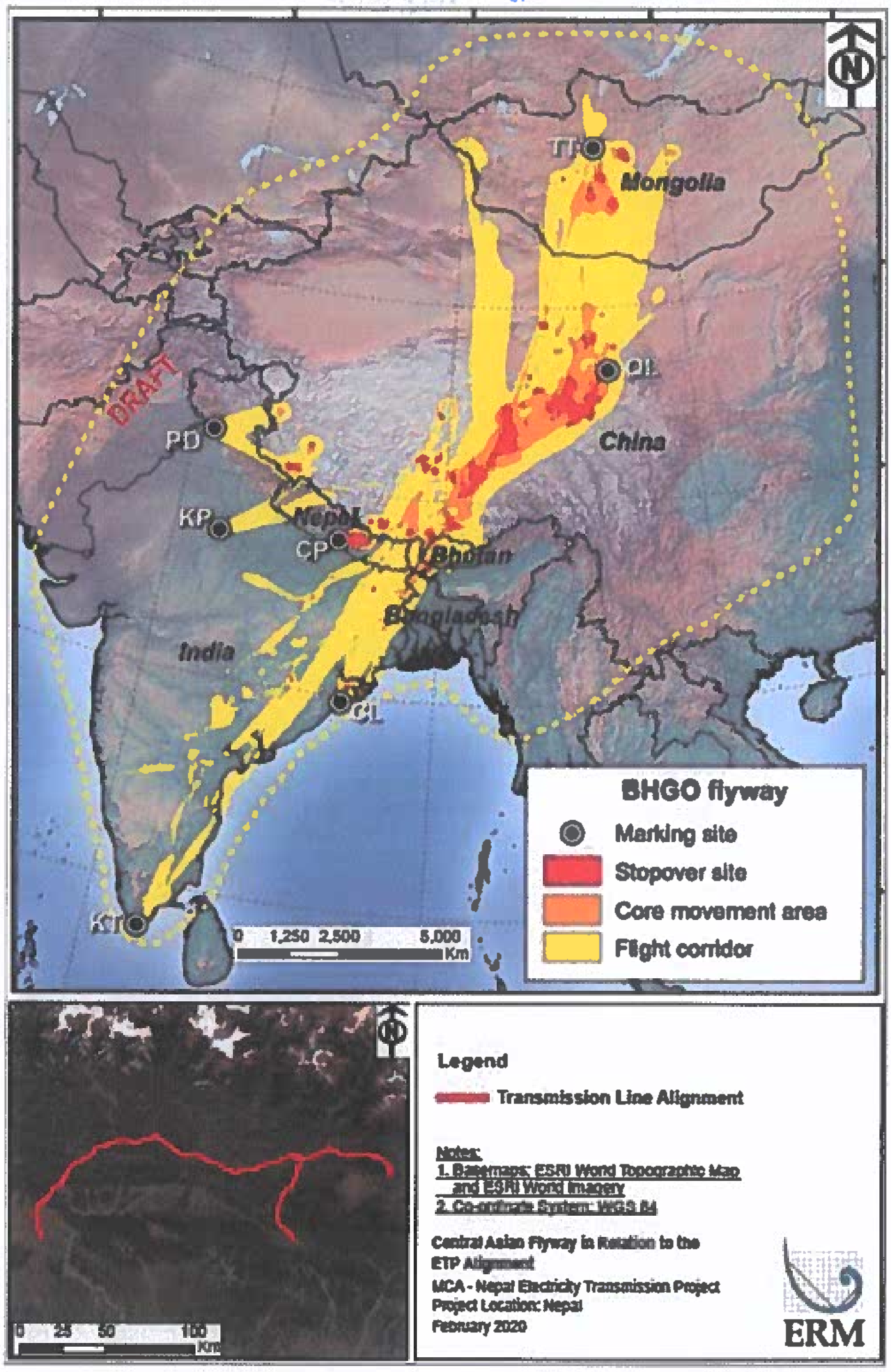

Source: (Birdlife International, 2019e)

Figure 5.2-12: Central Asian Flyway in Relation to the ETP Alignment

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5.2.7 Flora

5.2.7.1 Floral Diversity

Nepal records a high diversity of flora species. There are 1,822 species of fungi, 853 species of bryophytes, and 534 species of ferns and fern allies in Nepal. Similarly, there are 6,391 angiosperms and 25 species of gymnosperms listed in Nepal. Lichenologists estimate about 2,000 lichen species in Nepal of which 48 species are reported to be endemic to Nepal (ICIMOD 2007)

The diversity is driven due to Nepal's geographical location and is a transitional zone between the plants of the western Himalaya (including western Asiatic and Mediterranean elements) and the eastern Himalaya (with many Sino-Japanese elements). Adding variety to the mix are Tibetan Plateau (Central Asiatic) plants from the north and humid tropical species of the lowland plains (Terai) from the Gangetic plains of India and further afield into Indochina.

As per the surveys carried out in the dry and west seasons in 2019 (NESS, 2019), the floral biodiversity along the ETP alignment included the following floral diversity:

- Several species of Bryophyta;
- Eight species of Pteridophyta;
- Several species of lichens;
- 14 species of climbers;
- 266 species of herbs;
- 205 species of shrubs; and
- 91 species of tree.

Among these are:

- One taxa (lichens) and one tree species banned for export outside the country without processing (*Taxus wallichiana*)
- Two tree species banned for felling, transportation and export;
  1. *Juglans regia*
  2. *Shorea robusta*
- One taxa (orchids), one climber species (*Dioscorea deltoidea*) and 1 tree species (*Taxus wallichiana*) listed under Convention on International Trade in Endangered Species (CITES) Appendix II;
- One endangered (EN) species (*Taxus wallichiana*) and three vulnerable (VU) species (*Taxus mairei, Oryza malampuzhaensis* and *Anacyclus pyrethrum*); and

- Nine species likely to have ranges restricted to the districts through which the ETP alignment passes but among these, only one species was recorded.

5.2.7.2 Floral Species of Conservation Significance

For the purposes of this assessment, flora species of conservation significance are defined as:

- IUCN Red Listed CR, EN, VU protected and restricted range species;
- Species listed on the Red List of Nepal; and

    1. Nepal Government has, under the following descriptions prepared a list of protected species through its periodic Gazette (Rajpattra) viz. Section 51 (36), 53 (31):
    2. Banned for collection, transportation, and trade
    3. Banned for export outside the country without processing;
    4. Banned for felling, transportation, and export; or
    5. Banned for export without identification and certification

The species screened and observed during surveys along the ETP route are discussed below.

A complete list of all flora is provided in Annex H-1.

IBAT Screened Species

ERM undertook screening of data from the Integrated Biodiversity Assessment Tool (IBAT) to identify conservation significant flora species that are predicted to occur along the ETP route as listed on the IUCN Red List. Only two species were identified from the IBAT search, which indicates that the results are likely in error, as other conservation significant species are known to occur in Nepal. The two species included *Oryza malampuzhaensis* (IUCN VU) and Atlas daisy, *Anacyclus pyrethrum* (IUCN VU).

Nationally Protected Flora Species

Flora protected under the Nepal Rajpatra are described below to provide a context on their distribution and the ETP alignment are outlined in Table 5.2-17 below.

Table 5.2-17: Nationally Protected Flora Species

Family/ Species	Local Name	IUCN List	Nepal Red List	GoN Protected Species	CITES Appendix	Description	Corresponding ETP Alignment
Taxus wallichiana	Loth salla	E	NE	Yes (banned for export except after processing with permission from Department of Forests)	II	There are about 30 taxa of gymnosperms in Nepal. *Taxus*, commonly called as Yew, is the genus with two naturally occurring taxa namely *Taxus wallichiana* Zucc. and *Taxus contorta* Griffith. Another species *Taxus mairei* (Leme ´e & H. Le ´veille ´) S.Y. Hu ex T.S. Liu is found as cultivated species as well as in natural habitat. Both species are trees, 30 m tall, and 150 cm DBH, usually with a single trunk and a pyramidal, rounded, or spreading crown. The former species has darker green leaves while *Taxus mairei* has pale green leaves. This species is distributed in Central Nepal in Makwanpur, Sindhuli, and Sindhupalchowk. However, *Taxus wallichiana* is distributed from Central to Eastern Nepal (Gajurel and Gautam 2016). Elevation ranges from 900 m to 3,700 m asl and soils are mostly derived from silicate-bearing rocks, i.e. acidic to neutral (Farjon 2010).	RTE to Lapsihedi Substation
Taxus mairei	Loth salla	VU	NE	No	-		Lapshedi to RTE Substation (plantation near LAP Substation) Also recorded in 4 to 5 Community Forests in Makwanpur District but these locations are not along the ETP alignment
Shorea robusta	Sal	LC	NE	Yes (Banned for felling, transportation and export)	-	Sal (*Shorea robusta*) forest is found in an extensive array of conditions in lowland Nepal and has been heavily used by both government and local people. The *Shorea* forest type is distributed in the Terai and Middle hills. Forests provide fuelwood, timber, fodder, and Non-Timber Forest	NB to ND Substation ND to RTE Substation RTE to LAP Substation

Family/ Species	Local Name	IUCN List	Nepal Red List	GoN Protected Species	CITES Appendix	Description	Corresponding ETP Alignment
						Products to the rural people for their daily subsistence requirements. There is a widespread belief that the management of forests in Nepal is not sustainable and the recent forest statistics shows a decrease in forest area (Acharya et al. 2017).	
Dalbergia latifolia	*Sati sal*	VU	NE	No	-	*Dalbergia latifolia* (Indian rosewood) is found in Nepal typically in Terai up to 1000 m. It is commonly find in *Dalbergia sisoo* forests. Because of multiple uses, it is highly exploited in Nepal and few mature trees remain. It however has a rapid regeneration capacity (Thapa 2004)	ND to RTE Substation
Juglans regia	*Okhar*	LC	NE	Yes (Bark banned for transportation and export)	-	*Juglas regia* (walnut) is native to the mountainous areas of Central Asia, including Nepal. It is grown in the country's High Mountains region with an elevation of 1000 - 4000 m. Walnut trees can be found across the temperate regions of the country as well. (Devkota 1999). In Nepal, one of the primary uses of the Okhar tree is the harvesting of its fruit. Although rarely used as a commercial crop, the walnut has been used as a traditional indigenous medicine and as a subsistence food item. In Nepal the nuts and bark have been used to treat skin disorders among other ailments (Aryal et al. 2009)	LAP to RTE

Family/ Species	Local Name	IUCN List	Nepal Red List	GoN Protected Species	CITES Appendix	Description	Corresponding ETP Alignment
Dioscorea deltoidea	Bhyakur/ban tarul	NE	NE	No	II	*Dioscorea deltoidea* is a perennial climbing plant, producing vigorous annual stems from a large underground tuber. The stems scramble over the ground and twine into nearby vegetation. The plant is sometimes used locally as a medicine, hair wash and food, but it is mainly of importance as a source of the medically active compound diosgenin. It is commonly harvested from the wild for this compound and also sometimes cultivated in countries such as Vietnam and Russia.2	NB to ND Substation ND to RTE Substation
Pterocarpus marsupium	Bijaya sal	LC	NE	Yes (Banned for felling, transportation and export)	-	*Pterocarpus marsupium* a medium to large sized deciduous tree with ecological, economic, and medicinal value. A medium to large tree it is distributed in the foothills of Siwalik and in the flatlands of Terai, all in Community Forests/Government Managed Forest. The species is mostly associated with Sal (*Shorea robusta*) and scattered either in pure Sal forest, or Sal mixed with other tree species like Karma (*Adina cordifolia*) and Sindure (*Mallotus philippensis*).	Not recorded but likely
Lichens	Dhusi	Several species	NE	Yes	-	Out of 1,200 species of Lichen, some occur along the TL alignment in tropical and sub-tropical regions. In the tropical forest, the Lichens dominating	RTE to New Hetauda Substation

[2] http://tropical.theferns.info/viewtropical.php?id=Dioscorea+deltoidea

Family/ Species	Local Name	IUCN List	Nepal Red List	GoN Protected Species	CITES Appendix	Description	Corresponding ETP Alignment
						include crustose lichens like *Lecanora Bullia*, *Bacidia*, and *Pyxine*. The foliose lichen includes *Drinaria*, *Physcia*, *Parmelia*, etc. Sometimes, *Usnea* and *Ramalina* have been reported from moist tropical section. In the sub-tropical forests, the common lichens include *Pyxine*, *Bacidia*, *Pyrenula*, etc. *Alnus* and *Castonopsis* forest favor *Glyphis* and *Pyrenula*. The foliose lichen of this type of forest include *Parmelia*, *Leptogium*, and *Physcia* (Olley and Sharma 2013).	

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Endemic/Restricted Range Species

Table 5.2-18 provides a list of floral species endemic to or having restricted ranges within central Nepal that are present close to the ETP alignment. However, all these species are present at elevations above 2,000 m and are therefore unlikely along the ETP route (with the exception of *Taxus mairei*) (Rajbhandari et al. 2017).

Table 5.2-18: Restricted Range Flora Species

Scientific Name	Local Name	IUCN Red-List	Nepal Red List	GoN Protected Species	Endemism	Corresponding ETP Alignment
Taxus mairei	Loth Salla	VU	-	-	Smaller population in Dhading, Makawanpur districts Gymnosperm in the RTE to New Hetauda Substation	RTE to LAP
Pilea kanaii	-	NE	-	-	Endemic to Rasuwa; Sim Chotala to Ramche	Location unknown along alignment
Hypericum cordifolium	-	NE	-	-	Shivapuri Nagarjuna National Park	Location unknown along alignment
Crotalaria kanaii	-	NE	-	-	Endemic to Rasuwa	Location unknown along alignment
Astragalus pseudorigidulus	-	NE	-	-	Endemic to Nepal	Location unknown along alignment
Begonia flagellaris	-	NE	-	-	Endemic to Rasuwa	Location unknown along alignment
Sinocarum normanianum	-	NE	-	-	Endemic to Kathmandu District	Location unknown along alignment
Pimpinella acronemastrum	-	NE	-	-	Endemic to Rasuwa District	Location unknown along alignment
Lalldhwojia pastinacifolia	-	NE	-	-	Endemic to Rasuwa, Trishuli Basin	Location unknown along alignment

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5.2.8 Fauna

5.2.8.1 Faunal Diversity

The following diversity of fauna species were observed during the biodiversity baseline surveys, reported by local residents, or likely to occur along the ETP alignment based on the literature description of their range:

- 35 species of mammals representing 15 families
- 25 species of reptiles representing 11 families
- 3 species of restricted range amphibians
- 123 species of birds representing 36 families

Among these the following number of species were threatened (CR, EN, VU) in either the IUCN Red-List or the Nepal Red-list, protected or in CITES Appendix I and II.

1. One CR, six EN, four VU, and six protected species of mammals. Seven species of mammals are in CITES Appendix I and 2 in Appendix II (Table 5.2-16)
2. One CR, three VU, and one protected species of reptile. Two species of reptiles are in CITES Appendix I and 3 are in Appendix 2 (Table 5.2-16)
3. Eleven CR, 6 EN, 13 VU, and 4 protected species of birds. Two species of birds are in CITES Appendix I and 17 in Appendix II (Table 5.2-20)

Apart from the three species of amphibians, one species of bird is endemic to Nepal.

Complete lists of all terrestrial fauna and birds are provided in Annex H2.

5.2.8.2 Fauna Species of Conservation Significance

Terrestrial vertebrate species of conservation significance include CR, EN, VU species listed in either the IUCN Red-List Version 2018-2 or the Red-List for Nepal's Mammals (Jnanwali et al. 2012), species protected under the *NPWLC Act* (1973) and on CITES Appendices I and II. For CITES Appendix status, the latest version of the CITES database, Species +, powered by the United Nations Environment Programme-World Conservation Monitoring Centre, was used.

A desktop assessment and field surveys for terrestrial vertebrate species was undertaken to understand the likelihood of these species being present along the ETP alignment.

IBAT Screened Species

IBAT was screened to identify terrestrial vertebrate species considered to be conservation significant that are located along the ETP alignment. This information was used to inform surveys and also to identify species that are likely to occur but were not detected during surveys. These species are shown in Table 5.2-17.

Protected Terrestrial Vertebrates

The *NPWLC Act* (1973) lists terrestrial vertebrates that are protected species in Nepal. The majority of these species were detected during surveys and are outlined in Table 5.2-16.

Species Detected During Survey
Conservation significant species detected during surveys or predicted to occur as per IBAT screening and other secondary sources with conclusions on presence, are shown in Table 5.2-19 and Table 5.2-20. Table 5.2-20 also discusses species that were indicated to occur as per community consultations but are highly unlikely to be present within the ETP alignment.

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Table 5.2-19: Conservation Significant Vertebrate Species Recorded along the ETP Alignment

S/N	Common Name	Scientific Name	Nepali Name	Source of Data	Transmission Line Segment Found					Sampling Method	Record Type	IUCN Red List (version 2018-2)	Red List of Nepal Mammals (RLNM2012)	GoN Protected Species (NPWC Act 1972)	CITES Appendix	Endemic to Nepal	Endemic to Project Area of Influence
					India Border to NB Substation	NB to ND Substation	ND to RTT Substation	RTT to New Hetauda Substation	RTT to LAP Substation								
Mammals																	
1.	Asiatic Black Bear	*Ursus thibetanus*	Kalo Bhalu	DS		X				T	CC	VU	EN	-	I	-	-
2.	Sloth Bear	*Melursus ursinus*	Bhalu	WS		X		X		T	CC, CT	VU	EN	-	I	-	
3.	Common leopard	*Panthera pardus*	Chituwa	DS		X	X		X	T	CC/SC/SR/FP, CT	VU	VU	-	I	-	-
4.	[illegible]	*Panthera tigris tigris*	Bagh	WS				X		T	CC	EN	EN	P	I	-	
5.	Leopard cat	*Prionailurus bengalensis*	Chari Bagh	DS		X	X		X	T	SC/ FP, CT	LC	VU	P	II	-	-
6.	Bengal Fox	*Vulpes bengalensis*	Syal	DS				X	X	T	FP/D/SC	LC	VU	-	III	-	-
7.	Large Indian Civet	*Viverra zibetha*	Thulo Nir Biralo	DS					X	T	SC/FP	LC	NT	-	III	-	-
8.	Dhole	*Cuon alpinus*	Ban Kukur	DS				X		T	SC	EN	EN	-	II	-	-
9.	Northern Red Muntjac	*Muntiacus vaginalis*	Ratuwa Mirga	DS	X	X	X		T	T	CC	VU	-	-	-	-	-
10.	Chinese Pangolin	*Manis pentadactyla*	Kalo Salak	DS				X	X	T	NB	CR	CR	P	I	-	-
11.	Indian Pangolin	*Manis crassicaudata*	Salak	WS				X		T	CC	EN	EN	P	I	-	-
12.	Assam Macaque	*Macaca assamensis*	Assame Rato Bandar	DS		X				T	CC	NT	VU	P	II	-	-
13.	Asiatic Elephant	*Elephas maximus*	Hatti	WS				X		T	CC	EN	EN	P	I	-	-
Reptiles																	
14.	Yellow Monitor Lizard	*Varanus flavescens*	Sun Gohoro	DS		X				T	CC	LC	-	P	I	-	-
15.	Bengal Monitor Lizard	*Varanus bengalensis*	Gohoro	DS	X	X	X		X	T	D	LC	-	-	I	-	
15.	Burmese Python	*Python bivittatus*	Ajingar	WS			X	X		T	CC	VU	-	P	II	-	
16.	King Cobra	*Ophiophagus hannah*	Raaj Goman	WS				X		T	CC	VU	-	-	II	-	
17	Elongated Tortoise	*Indotestudo elongata*	Kechuwa	DS		X		X		T	CC	CR	-	-	II	-	
18.	Tricarinate Hill Turtle	*Melanochelys tricarinata*	Kechuwa	DS		X				T	CC	VU	-	-	I	-	

Note:

DS=Dry Season, WS=Wet Season, IB=IBAT

T=Transect, P=Protected.

Record Type D=Direct, SC=Scat/Dung (Indirect), SR=Scrape, FP=Pug/Hoof Mark, NB=Nest/Burrow, CC=Community Consultations, CT=Camera Trap

IUCN Red List: LC=Least Concern, VU=Vulnerable, NT=Near Threatened, EN=Endangered, CR=Critically Endangered-

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Table 5.2-20: Fauna Species Predicted to Occur but Not Recorded During Surveys

S/N	Common Name	Scientific Name	Nepali Name	Source	IUCN Red List	NRLM	GoN Protected Species (NPWLC Act 1973)	CITES Appendix	Comments
1.	Clouded Leopard	*Neofelis nebulosa*	Dwanse Chituwa	IB	VU	EN	P	I	Discussed below
2.	Fishing Cat	*Prionailurus viverrinus*	Malaha Biralo	IB	VU	EN	-	II	
3.	Spotted Linsang	*Prionodon pardicolor*	Silu Biralo	SS	LC	EN	P	I	Discussed below
4.	Smooth-Coated Otter	*Lutrogale perspicillata*	Khairo Oat	IB	VU	EN	-	I	Discussed below
5.	Striped Hyena	*Hyaena hyaena*	Hundar	WS/CC	NT	EN	P	-	Discussed below
6.	Hog Deer	*Axis porcinus*	Laguna	IB	EN	EN	-	I	Discussed below
7.	Barasingha	*Rucervus duvauceli*	Barasingha	IB	VU	EN	P	I	The Swamp Deer inhabits swampy habitats, grasslands, and floodplains. This species is restricted to two locations: Bardia National Park and Shukla Phanta Wildlife Reserve (Jnanwali et al 2012). It does not occur along the ETP alignment
8.	Sambar	*Rusa unicolor*	Jarayo	IB	VU	VU	-	-	The Sambar is generally found in dense Sal and riverine forests of the lowlands and in subtropical forests of higher elevations. The species occurs in only four locations (possibly five depending on further confirmation of observations in Kathmandu (Jnanwali eta al 2012). It may be found along the ETP alignment
9.	Gaur	*Bos gaurus*	Gauri Gai	IB	VU	VU	P	I	This species is confined to the Sal forests of the Churia foothills in Chitwan National Park and Parsa Wildlife Reserve in southern central parts of Nepal. Stray animals have been observed in Koshi Tappu Wildlife Reserve (Jnanwali et al 2012). It does not occur along the ETP alignment
10.	Four-Horned Antelope	*Tetracerus quadricornis*	Chauka	IB	VU	VU	P	III	The Four-horned Antelope inhabits tropical and subtropical habitats, dry deciduous forests, dry Sal forests and grasslands. The Four-horned Antelope is a browser and mainly feeds on shrubs and legumes (Jnanwali et al 2012. It may be found along the ETP alignment
11.	Mandelli's Mouse-Eared Myotis	*Myotis sicarius*	Musakane Chamero	IB	VU	VU	-	-	The distribution of this species includes Annapurna Conservation Area, Shivapuri Nagarjun National Park and districts of Kaski (Sudame), sections of Kathmandu Valley (Bansbari) and Bajrabarahi Religious Forest, Godavari, Lalitpur(Jnanwali et al 2012). It may be found along the ETP alignment
12.	Hispid Hare	*Caprolagus hispidus*	Laghukarna Kharayo	IB	EN	EN	P	I	Discussed below
13.	Indian Rhinoceros	*Rhinoceros unicornis*	Gainda	IB	VU	EN	P	I	Discussed below

DS=Dry Season, WS=Wet Season, IBAT=IB, SS=Secondary Sources

Conservation Significant Vertebrate Species Profiles

The following information provides species-specific assessment of vertebrates detected from direct observations or literature reviews that are likely associated with habitats contiguous with the ETP alignment.

MAMMALS

1. Dhole (IUCN EN; Nepal EN)

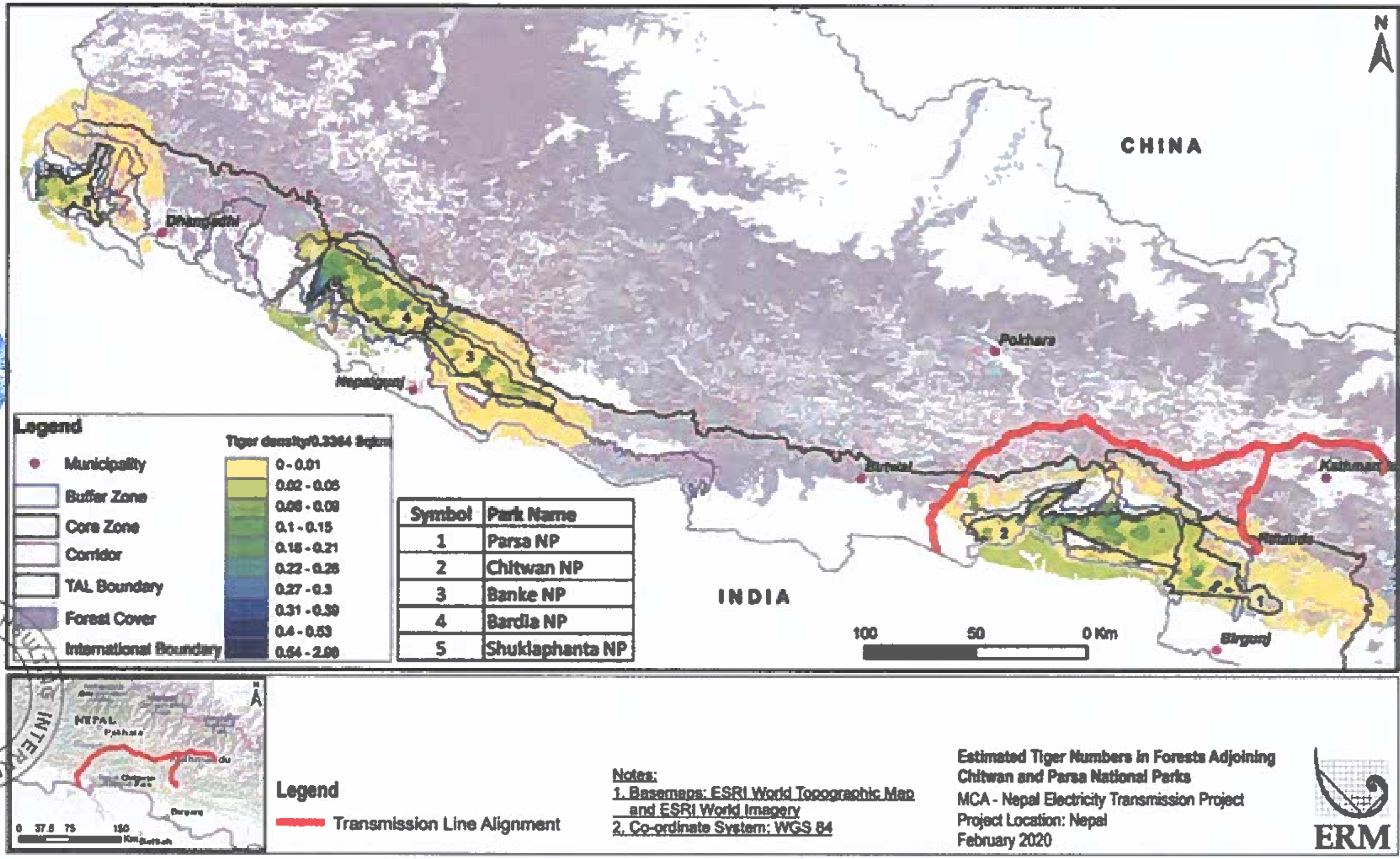
The current distribution of Dhole in Nepal includes the Chitwan National Park and Parsa Wildlife Reserves. Outside the protected areas it was observed in Udaipur in the 1990s (Jnanwali 2012). However, despite what seems like a potentially widespread distribution, sightings of this species are not common. A study in Chitwan National Park in 1991 found no signs of the species, yet it was widespread throughout the park in the 1970s. However, the species has been reported in RTE to LAP Substation through community consultations, though these are most likely past occurrences. The species is likely in Parsa National Park, but there is no habitat contiguity between the Park and the forested areas in the Chure Hills due to the township of Hetauda and agricultural lands. The species is therefore unlikely to occur along the ETP alignment.

2. Tiger (IUCN EN; Nepal EN)

The Tiger has been observed in the Chure Hills, the Chitwan National Park, and the Parsa Wildlife Reserve (Jnanwali 2012), so its occurrence along the undisturbed forest tracts along the ETP alignment may need consideration. Community consultations revealed that it was seen in the RTE to New Hetauda (NH) Substation Segment. On further consultations with communities in May 2019, after the dry season surveys, it was confirmed that these observations were 2 years old. It was also confirmed by communities that tigers are confined to the Parsa National Park and do not cross the river which is the northern boundary of the Park. There is no habitat contiguity between the Park and the forested areas in the Chure Hills due to the township of Hetauda and agricultural lands.

Figure 5.2-13 provides the estimated density of tigers in forests adjoining Chitwan and Parsa National Parks as estimated from the nationwide survey of tigers and prey species (DNPWC 2018).

From the nationwide survey, only nine tigers were camera trapped outside of PAs. Of these, an adult female in the district forest of Nawalparasi was photographed with three healthy cubs. In Central Terai a male and female tiger were recorded in the collaborative forests in Parsa, three tigers (1 female, 2 unknown) were observed in Someshwor hill forest (Chitwan National Park NP buffer zone), four tigers (2 males, 2 female) were captured from Barandabhar RoW (Chitwan National Park NP buffer zone) and two female tigers were captured in the forests of Nawalparasi close to Binayee and Madhyabindu.



Source: DNPWLC 2018

Figure 5.2-13: Estimated Density of Tigers in Forests Adjoining Chitwan and Parsa National Parks

3. Sloth Bear (IUCN VU; Nepal EN)

The Sloth Bear is supposed to be restricted to the Terai area of Nepal. Chitwan National Park is considered to have the highest population density of Sloth Bears with an estimated 200 to 250 (Jnanwali 2012). However, the species was recorded in the NB to ND Substation Segment through camera trapping and was reported to occur in the RTE to NH Substation Segment based on community consultations.

4. Asian Elephant (IUCN EN; Nepal EN)

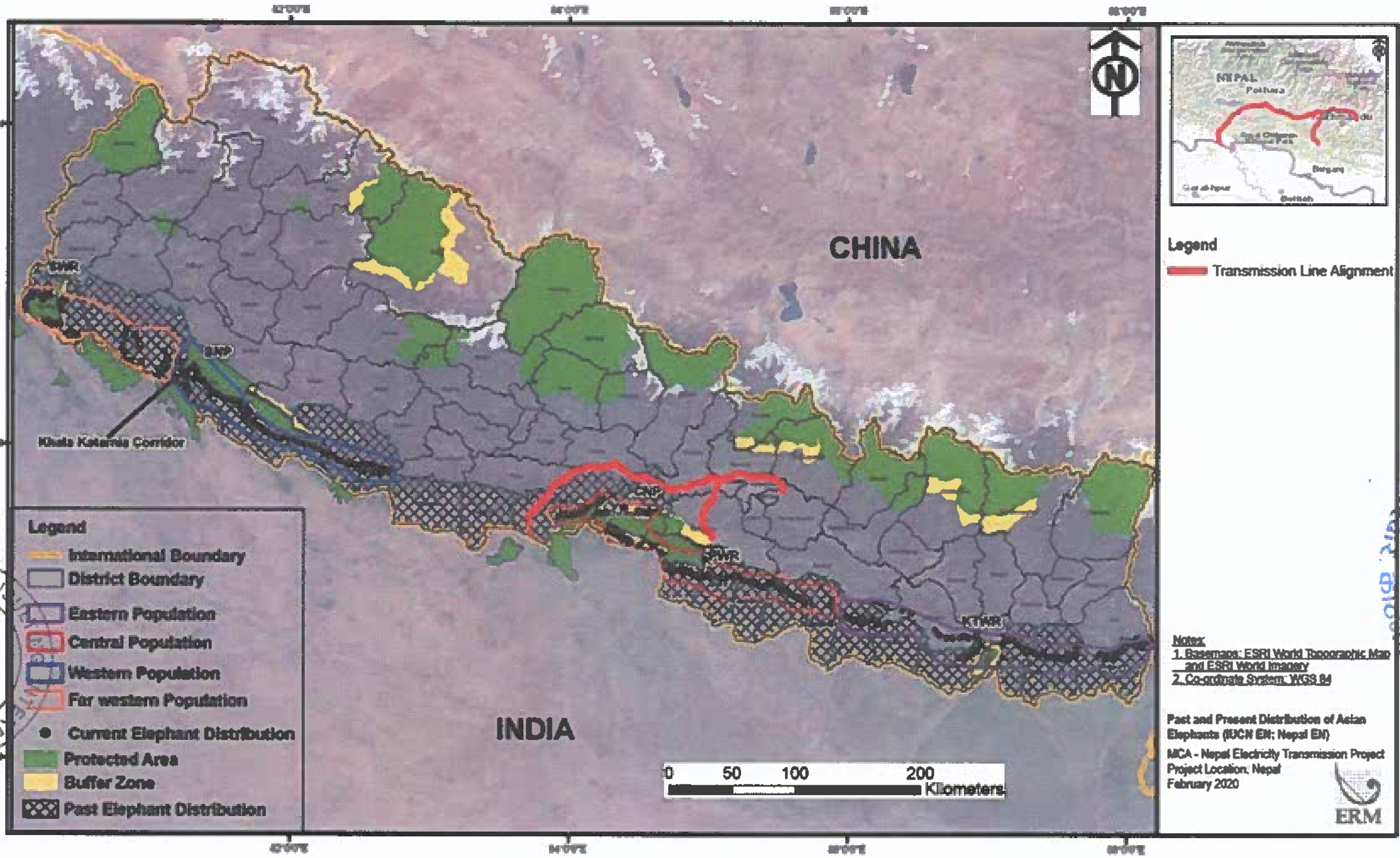
The number of resident wild Asian elephants in Nepal is estimated to be between 109 and 142 animals (DNPWC 2008). They occur in four isolated populations (Eastern, Central, Western, and Far-Western). The past and present distribution of elephants in Nepal is indicated on Figure 5.2-14. As indicated by the figure, the ETP does not cross current elephant habitat.

5. Indian Pangolin (IUCN EN; Nepal EN)

The current population size of the Indian Pangolin is not known; however, indicators point towards a declining population (Jnanwali 2012). The species is very likely to occur along the ETP alignment.

6. Chinese Pangolin (IUCN CR; Nepal CR)

The Chinese Pangolin occurs in subtropical and deciduous forests, agricultural lands, and near human settlements. Pangolins are able to adapt to modified habitats such as secondary forests, provided their termite food source remains abundant and they are not heavily preyed upon. There is little available information for the population status of this species. The current population is estimated to consist of approximately 5,000 individuals and has been observed to be in decline (Jnanwali 2012). The Chinese Pangolin has been recorded in the Shivapuri-Nagarjun National Park (Bhandari and Chalise 2014; Gurung 1996).



Source: Pradhan et al. 2011

Figure 5.2-14: Past and Present Distribution of Asian Elephants (IUCN EN; Nepal EN)

The IBAT screening indicated that the following CR and EN mammal species (IUCN Red-List and Nepal Red-List for Mammals (Jnanwali et al. 2012) were likely to occur along the ETP alignment. Based on available information, the likelihood of occurrence is further discussed.

7. Clouded Leopard (IUCN VU; Nepal EN)

Clouded leopards were believed to be extinct in Nepal, the last published record being from 1863, but in 1987–1988 four individuals were found in the country. These findings extend the known range of the species westward and suggest that clouded leopards are able to survive and breed in degraded woodlands and scrub previously supporting moist subtropical semi-deciduous forest (Dinerstein and Mehta 1989).

The Clouded Leopard has been found in the Shivapuri Nagarjun National Park (Jnanwali 2012) and is likely to occur along the ETP alignment.

8. Fishing Cat (IUCN VU Nepal EN)

The Fishing Cat has a distribution restricted to the Terai region and has been reported from Bardia National Park, Chitwan National Park, Koshi Tappu Wildlife Reserve, Parsa Wildlife Reserve mainly in the flood plains of the Karnali, Babai, Rapti, Narayani, Koshi and Reu Rivers and Ghodaghodi Tal (Jnanwali et al. 2012). It is unlikely to occur along the ETP alignment.

9. Spotted Linsang (IUCN LC Nepal EN)

This Spotted Linsang occurs in the Annapurna Conservation Area to east Nepal below elevations of 2,000 meters and has been observed in Chitwan National Park (Hetauda and Island Jungle Resort areas) (Jnanwali et al. 2012). It is likely to occur along the ETP alignment.

10. Smooth-coated Otter (IUCN VU Nepal EN)

Direct observations of the Smooth-coated Otter are said to be rare and are only found in Bardia National Park, Chitwan National Park, and Shukla Phanta Wildlife Reserve (Jnanwali 2012). The species is unlikely found along the alignment.

11. Striped Hyaena (IUCN NT Nepal EN)

The Striped Hyaena has a restricted distribution, which is limited to protected areas of the Terai. The species has been recorded outside protected areas, however these records are likely to refer to small numbers / stray individuals (Jnanwali et al. 2012). The species is unlikely to occur along the ETP alignment.

12. Hispid Hare (IUCN EN Nepal EN)

The Hispid Hare occurs in the Nepal Terai and has been recorded in the past in Bardia National Park, Chitwan National Park, and Shukla Phanta Wildlife Reserve (Jnanwali 2012).

As the ETP alignment passes through heavily modified habitat in the Terai, it is unlikely to occur along the ETP alignment.

13. Indian Rhinoceros (IUCN VU Nepal EN)

The Indian Rhinoceros occurs in three locations: Bardia National Park, Chitwan National Park, and Shukla Phanta Wildlife Reserve, with occasional movement into Parsa Wildlife Reserve from adjoining areas of Chitwan (Jnanwali 2012). As the species is confined to the Terai habitat in the Chitwan National Park, it is unlikely to move into modified Terai habitat along the ETP alignment.

14. Hog Deer (IUCN EN Nepal EN)

The Hog Deer is found within Chitwan National Park and Parsa Wildlife Reserve. The species is locally common but restricted within these protected areas. This species has a small distribution and is suspected to have an area of occupancy of approximately 300 square kilometers restricted to three protected areas in the Terai region. Although the species may occur outside of these areas, it faces significant threat from subsistence hunting (Jnanwali 2012). The species is unlikely to occur along the ETP alignment.

HERPETOFAUNA

The following CR, EN, and protected herpetofauna species were recorded in the dry and wet season surveys.

8. Elongated Tortoise (IUCN CR Nepal NE)

In Nepal, the Elongated Tortoise is thought to be restricted to Terai habitat in Chitwan National Park (IUCN Red-List version 2018-2). However, the species was reported through community consultations in the Chure Hills along the NB to ND Substation and RTE to NH Substation segments.

9. Yellow Monitor (IUCN LC Nepal NE)

The Yellow Monitor is a protected species in Nepal and is listed in CITES Appendix I.

Varanus falvescens was reported from several segments, hilly as well as in the Terai region as reported from surveys and public consultations. It prefers lowland marshes and swamps around water bodies, cultivated lands, secondary Sal forest, along the floodplains of large rivers and sometimes along in foothills but never in mountain areas. It is rare in mixed evergreen forests. Their habitat is often sandy, but they avoid salty sand along coast. During the monsoon rains, the habitat is often inundated; they spend much time in the water. During the intense drought, they seek shelter in the cracks of drying marsh soil, which are to one meter below the surface. They hide in burrows in banks around pools, lakes, and canals as well as in cervices, drain holes, or termite mounds. The entrance is occasionally closed with earth.

It prefers wet areas, found to be edge of forest and near to human settlements that increase its threat from direct killing. *V. flavescens* tolerates the habitat modification to some degree for agriculture as it was also found on agricultural land. They are not habitat specialists, but are generally found less frequently in forests with large trees and in dry areas (Karki et al. 2008). The habitats of *V. flavescens* and *V. bengalensis* are found to be partially separated, with *V. flavescens* mostly associated with wetter areas and few large trees, whereas *V. bengalensis* was closely associated with large trees (Ghimire et al., 2014).

10. Burmese Python (IUCN VU; Nepal NE)

The species occurs in a wide range of habitats, including grasslands, swamps, marshes, rocky foothills, woodlands, "open" jungle, and river valleys. They depend on a permanent source of water. They are occasionally found in abandoned mammal burrows, hollow trees, and dense water reeds. Most habitat and range of the species is below 200 meters in elevation. There are a few records of pythons occurring above 1,000 meters (Schleich and Kästle 2002; Barker and Barker 2008; Pandey 2012). During the survey, Burmese pythons were reported from the lowlands of RTE to NH Substation and NB to ND Substation segments based on public consultations. No direct evidence was recorded.

The following restricted range species of amphibians, as determined from the IUCN Red-List version 2019-1), are likely to be found in the vicinity of the ETP alignment (Table 5.2-21).

Table 5.2-21: Restricted-Range Species of Amphibians

S/N	Common Name	Scientific Name	IUCN Red-List	Nepal Red List	Comment
3.	Dubois' Paa Frog	*Nanorana rostandi*	VU	-	The species is only found west of the alignment and in the Chitwan National Park and is unlikely to be found along the alignment.
4.	Chitwan Burrowing Frog	*Sphaerotheca maskeyi*	LC	-	The species is found along the central and eastern foothills of the Himalayas. It is a fossorial species that breeds in pools and marshes. The species is likely to be found along the alignment.
5.	Chitwan Frog	*Hylarana chitwanensis*	NT	-	This species is endemic to Nepal. It is a lowland species occurring below 500 m asl in the foothills of the Himalayan range. It is associated with terai grasslands, bushes, and tropical Shorea forest in hilly areas. It is likely to be found along the alignment.
6.	Narayanghat Whipping Frog	*Polypedates zed*	DD	-	This species is endemic to the Himalayan foothills of eastern Nepal and has been recorded from 100-300 m asl. It is an arboreal tropical forest inhabitant. The species is likely to be found along the ETP alignment.

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Birds

Avifaunal species of conservation significance include CR, EN and VU species listed in either the IUCN Red-List Version 2018-2 or the Red-List for Nepal's Birds (Inskipp et al. 2016), species protected under the *NPWLC Act* (1973) and those on CITES Appendices I or II, restricted range (with an extent of occurrence of < 50,000 square kilometers) and migratory species.

A desktop assessment and field surveys for bird species was undertaken to understand the likelihood of these species being present along the ETP alignment. The results of the assessment are outlined below.

IBAT Screened Species

IBAT was screened to identify bird species considered to be conservation significant that are located along the ETP alignment. This information was used to inform surveys and also to identify species that are likely to occur but were not detected during surveys. These species are shown in Table 5.2-20.

Nepal Nationally Listed Birds

The *NPWLC Act* (1973) lists birds that are protected species in Nepal. The majority of these species were detected during surveys and are outlined in Table 5.2-20. However, three species were not detected during surveys and these are listed below in Table 5.2-22.

Table 5.2-22: Protected Species of Avifauna

Common Name	Nepal Names	Scientific Name	IUCN Red-List	Nepal Red-List Birds (2016)	CITES Appendix
White Stork	Seto Bhundiphor	*Ciconia ciconia*	LC	LC	-
Himalayan Monal	Danphe	*Lophophorus impejanus*	LC	NT	I
Satyr Tragopan	Munal	*Tragopan satyra*	NT	VU	III

As mentioned below the Satyr Tragopan is not likely to occur along the ETP alignment being largely confined to protected areas.

The Himalayan Monal is a locally common resident, mainly occurring in protected areas. Since 1990 the species has been recorded in all mountain protected areas. The species previously occurred outside protected areas more or less continuously throughout the Himalayas from west to east Nepal. Since 1990 outside the protected areas' system the species has been much less recorded. Given that the species is found at low abundances outside protected areas and normally prefers higher elevations it is unlikely along the ETP alignment Inskipp et. al 2016.

Species Detected during Survey

Endemic/restricted range, migratory and conservation significant species detected during surveys are shown in Table 5.2-23. Table 5.2-24 also provides a list of species as screened by IBAT and a conclusion is derived as to whether they are likely to occur along the ETP alignment.

Note that specific surveys for birds deemed to have a collision risk with the ETP were undertaken by Bird Conservation Nepal (BCN) and a summary of this assessment is contained Section 7.3.

Table 5.2-23: Conservation Significant Bird Species

S/N	Common Name	Scientific Name	Nepali Name	Source of Data	Number of Individuals	Transmission Line Segment Found					Sampling Method	Record Type	IUCN Red List	Red List of Nepal's Birds	GoN Protected Species	CITES Appendix	Endemic to Nepal	Migratory
						India Border to NB Substation	NB to ND Substation	ND to RTE Substation	RTE to NH Substation	RTE to LAP Substation								
1.	Himalayan Griffon	*Gyps himalayensis*	Himali Giddha	DS	307	13	266	14		14	V, T	D	NT	VU	-	II	-	Y
2.	Egyptian Vulture	*Neophron percnopterus*	Seto Giddha	DS	32		25			7	V	D	EN	VU	-	II	-	-
3.	Red-Headed Vulture	*Sarcogyps calvus*	Sun Giddha	DS	19		18			1	V	D	CR	EN	-	II	-	-
4.	White-Rumped Vulture	*Gyps bengalensis*	Dangar Giddha	DS	54	10	44				V, T	D	CR	CR	-	II	-	-
5.	Slender-Billed Vulture	*Gyps tenuirostris*	Sano Khairo Giddha	DS	2		2				V	D	CR	CR	-	II	-	-
6.	Cinereous Vulture	*Aegypius monachus*	Raj Giddha	DS	10	1	9				V, T	D	NT	EN	-	II	-	Y
7.	Steppe Eagle	*Aquila nepalensis*	Gomaayu Mahaachil	DS	37	13	6	3		15	V, T	D	EN	VU	-	II	-	Y
8.	Upland Buzzard	*Buteo hemilasius*	Pahadi Shyenbaaz	DS	1					1	V	D	LC	DD	-	II	-	Y
9.	Greater Spotted Eagle	*Aquila clanga*	Jeewahar Mahacheel	DS	4	4					T	D	VU	VU	-	II	-	Y
10.	Indian Spotted Eagle	*Aquila hastata*	Ladhu Mahacheel	DS	1	1					T	D	VU	VU	-	II	-	-
11.	Lesser Fish Eagle	*Ichthyophaga humilis*	Sano Machhakul	WS						X	T	CC	NT	-	-	II	-	-
12.	White-Tailed Sea Eagle	*Haliaeetus albicilla*	Kangam Chill	WS						X	T	CC	LC	CR	-	I	-	Y
13.	Ruddy Shelduck	*Tadorna ferruginea*	Chakevachakevi	DS	3						V	D	LC	NT	-	-	-	Y
14.	Great Hornbill	*Buceros bicornis*	Raaj Dhanesh	WS				X			T	CC	VU	EN	P	I	-	-
15.	River Lapwing	*Vanellus duvaucelii*	Khole Huttityau	WS						X	T	CC	NT	NT	-	-	-	-
16.	Yellow-Wattled Lapwing	*Vanellus malabaricus*	Doyem Huttityau	WS						X	T	CC	LC	VU	-	-	-	-
17.	Asian Woollyneck	*Ciconia episcopus*	Lobhipapi Garud	DS	6	1	1			4	V, T	D	VU	NT	-	-	-	-
18.	Asian Openbill	*Anastomus oscitans*	Dungiphor Garud	DS	1				1		T	D	LC	VU	-	-	-	-
19.	Black Stork	*Ciconia nigra*	Kalo Garud	DS	8	4	4				T	D	LC	VU	P	II	-	-
20.	Lesser Adjutant	*Leptoptilos javanicus*	Bundiphor Garud	DS	38	37	1				T	D, N	VU	VU	-	-	-	-
21.	Sarus Crane	*Antigone antigone*	Sarus	DS	14	14					T	D	VU	VU	P	II	-	-
22.	Demoiselle Crane	*Grus virgo*	Karyang Kurung	WS			X	X		X	T	CC	LC	VU	-	II	-	-
23.	Ibisbill	*Ibidorhyncha struthersii*	Tilhari Chara	DS	8					8	V	D	LC	EN	-	II	-	Y
24.	Spiny Babbler	*Acanthoptila nepalensis*	Kande Bhyakur	DS	10		4	6			V	D	LC	LC	-	-	Y	-
25.	Great Cormorant	*Phalacrocorax carbo*	Jalewa	DS	4				2	2	V, T	D	LC	NT	-	-	-	-
26.	Grey Francolin	*Francolinus pondicerianus*	Kapijal Titra	DS	6	6					T	D	LC	VU	-	-	-	-
27.	Indian Peafowl	*Pavo cristatus*	Mayur	WS				X			T	CC	LC	NT	-	III	-	-

S/N	Common Name	Scientific Name	Nepali Name	Source of Data	Number of Individuals	Transmission Line Segment Found					Sampling Method	Record Type	IUCN Red List	Red List of Nepal's Birds	GoN Protected Species	CITES Appendix	Endemic to Nepal	Migratory
						India Border to NB Substation	NB to ND Substation	ND to RTE Substation	RTE to NH Substation	RTE to LAP Substation								
28.	Great Slaty Woodpecker	*Mulleripicus pulverulentus*	Rajlahanche	DS	6		6				T	D	VU	EN	-	-	-	-
29.	Alexandrine Parakeet	*Psittacula eupatria*	Karo Suga	DS	8	7	1				V, T	D	NT	NT	-	II	-	-
30.	Brown Fish Owl	*Ketupa zeylonensis*	Malaha Hucheel	DS	1		1				T	D	LC	VU	-	II	-	-

Note: T=Transect, V=Vantage point, P=Protected,
Record Type: D=Direct, CC=Community Consultation
IUCN Red List: LC=Least Concern, VU=Vulnerable, NT=Near Threatened, EN=Endangered, CR=Critically Endangered
DS=Dry Season, WS=Wet Season, IB=IBAT

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Table 5.2-24: Bird Species Predicted to Occur Along the ETP Alignment based on IBAT and other Secondary Sources

S/N	Common Name	Scientific Name	Nepali Name	Source	IUCN Red List	NRLB	GoN Protected Species	CITES Appendix	Comments
1.	Pallas's Fish-Eagle	*Haliaeetus leucoryphus*	Boksi Cheel	IB	EN	CR	-	II	Discussed below
2.	Eastern Imperial Eagle	*Aquila heliaca*	Rammath Mahacheel	IB	VU	CR	-	I	Discussed below
3.	Baer's Pochard	*Aythya baeri*	Dev Haans	IB	CR	CR	-	-	Discussed below
4.	Common Pochard	*Aythya ferina*	Kailotauke Haans	IB	VU	NT	-	-	Common Pochard is a rare and local passage migrant, most often seen in the Koshi area and very recently at Chimdi Lake, Sunsari District. Since 1990 it has been most often recorded in the Koshi area where it is now a rare passage migrant and seen less frequently and less regularly than previously. Kosi Tappu Wildlife Reserve is the only protected area where it has been recorded, pre- and post-1990 (Inskipp et al. 2016). Given its restricted distribution, the species is unlikely to occur along the EP alignment
5.	Sociable Lapwing	*Vanellus gregarius*		IB	CR	-	-	-	The species has not been recorded in Nepal
6.	Black-Bellied Tern	*Sterna acuticauda*	Utkroshi Phyalphyale	IB	EN	CR	-	-	Discussed below
7.	Wood Snipe	*Gallinago nemoricola*	Van Chaha	IB	VU	VU	-	-	Wood Snipe is rare and sparsely distributed. It breeds in the subalpine zone of the Himalayas. Some birds are possibly resident, descending to lower In west-central Nepal Inskipp and Inskipp (2003) considered it was a rare altitudinal migrant and probably a partial resident in the Annapurna Conservation Area (ACA).altitudes in winter (Inskipp eta al. 2016). Given its restricted distribution to the ACA, the species is unlikely to occur along the EP alignment.
8.	Indian Skimmer	*Rynchops albicollis*	Jhanjhar Chihua	IB	VU	CR	-	-	Discussed below
9.	Greater Adjutant	*Leptoptilos dubius*	Raj Garud	IB	EN	CR	-	-	Discussed below
10.	Painted Stork	*Mycteria leucocephala*	Laltauke Garud	IB	NT	EN	-		Discussed below
11.	Saker Falcon	*Falco cherrug*	Top Baaz	IB	EN	EN	-	II	Discussed below
12.	Bengal Florican	*Houbaropsis bengalensis*	Kharmajur	IB	CR	CR	P	I	Discussed below
13.	Lesser Florican	*Sypheotides indicus*	Sano Khar Mayur	IB	EN	CR	P	II	Discussed below
14.	Bristled Grassbird	*Chaetornis striata*	Khanse Ghansecheri	IB	VU	VU	-	-	Bristled Grassbird is very local, and primarily a summer visitor to lowland Nepal. A 1996-99 survey found the species to be distributed in suitable habitat from west to east Nepal It has primarily been recorded in protected areas: in Sukla Phanta Wildlife (Inskipp et al 2016). The species is likely to occur along the ETP alignment.
15.	Slender-Billed Babbler	*Chatarrhaea longirostris*	-	IB	VU	CR	-	-	Discussed below
16.	Jerdon's Babbler	*Chrysomma altirostre*	Narkat Byakur	IB	VU	CR	-	-	Discussed below
17.	Grey-crowned Prinia	*Prinia cinereocapilla*	Gegari Ghansepisto	IB	VU	CR	-	-	Discussed below
18.	White-throated Bushchat	*Saxicola insignis*	Sethokante Dhipsi	IB	VU	EN	-	-	Discussed below

S/N	Common Name	Scientific Name	Nepali Name	Source	IUCN Red List	NRLB	GoN Protected Species	CITES Appendix	Comments
19.	Yellow-breasted Bunting	*Emberiza aureola*	Bagalo Bagedi	IB	CR	CR	-	-	Discussed below
20.	Cheer Pheasant	*Catreus wallichii*	Cheer	IB	VU	EN	-	I	Discussed below
21.	Swamp Francolin	*Francolinus gularis*	Sim Titra	IB	VU	EN	-	-	Discussed below

Note: T=Transect, V=Vantage point, P=Protected.

Record Type: D=Direct, CC=Community Consultation

IUCN Red List: LC=Least Concern, VU=Vulnerable, NT=Near Threatened, EN=Endangered, CR=Critically Endangered

DS=Dry Season, WS=Wet Season, IB=IBAT

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नेपाल सरकार वन तथा वातावरण मन्त्रालय सिंहदरबार, काठमाडौं

Conservation Significant Bird Species Profiles

The following information provides species-specific assessment of birds detected from direct observations or literature reviews that are likely associated with habitats contiguous with the ETP alignment.

HIMALAYAN VULTURE (IUCN NT; NEPAL VU)

The Himalayan Vulture is a widely distributed resident subject to altitudinal movements; its current level of abundance is uncertain. The species has reportedly occurred throughout the mountains, common along the well-used trade routes in the Kali Gandaki valleys, and fairly common elsewhere. Known records indicate that the species is still widespread (Inskipp et al. 2016). Despite the species being widespread, it is considered a migratory species and the ETP alignment needs to be assessed in terms of its role in supporting a significant percentage of the global population of the species.

WHITE-RUMPED VULTURE (IUCN CR; NEPAL CR)

The White-rumped Vulture is now a patchily distributed resident, rare in the center, rare and very local in the east, and locally frequent in the west. The species was formerly a common and widespread resident up to 1,000 meters, and the most common vulture up to this altitude and in the Kathmandu Valley at 1,370 meters. It is less frequent up to 1,800 meters. The White-rumped Vulture population was estimated to have declined by 91 percent since the mid-1990s (Inskipp et al. 2016). This population decline may well have been overlooked for some time because the species was formerly so abundant and widespread.

Baral et al. (2013) estimated the future extinction risk of the White-Rumped vulture by counting seven nesting colonies between 2002 and 2012 in the Rampur Forests in the Palpa District in the south-west part of Nepal. Using population viability analysis models, they estimated that there was a 51 percent probability of populations facing quasi-extinction (i.e., ≤20 vultures) in 13 years and a 99 percent probability of quasi-extinction in 18 yr. The White-Rumped Vulture populations in Rampur are in danger of disappearing within 2 decades, so conservation efforts should be expedited to prevent the loss of this species. The Rampur valley is located within 10 kilometers to the west of the ETP alignment.

However, the species is showing signs of recovery at some sites in response to conservation measures (Inskipp et al. 2016). The Vulture Safe Zone in central Nepal (Bhusal 2018) covers most of the part of ETP alignment and is believed to reduce the threats.

RED-HEADED VULTURE (IUCN CR; NEPAL EN)

The Red-headed Vulture is a resident, still widespread in the mid-west to far west, and locally frequent there and in west-central Nepal, but now very rare and virtually absent from most areas east of Kathmandu (Inskipp et al. 2016). Its nesting is mostly confined in the western midhills of Nepal (Bhusal et al. 2016)

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SLENDER-BILLED VULTURE (IUCN CR; NEPAL CR)

The Slender-billed Vulture is a local resident, now extremely rare in the east and uncommon in the center and west. Since 2004, virtually all records have been from the western and central lowlands and lower hills (Inskipp et al. 2016).

CINEROUS VULTURE (IUCN NT; NEPAL EN)

Cinereous Vulture is a winter visitor and passage migrant; now very uncommon in the center and west, and rare and very local in the east. The species is mainly an uncommon winter visitor, most frequently seen in central Nepal and eastwards (Inskipp et al. 2016).

EGYPTIAN VULTURE (IUCN EN; NEPAL VU)

The Egyptian Vulture is a resident, now widespread and locally fairly common in west and west-central Nepal, but very rare in the east (Inskipp et al. 2016).

STEPPE EAGLE (IUCN EN; NEPAL VU)

Steppe Eagle is a fairly common winter visitor and passage migrant. It is widespread, recorded post-1990 from Api Nampa Conservation Area in the far west to Kanchenjunga Conservation Area in the far east (Inskipp et al. 2016). It migrates from east to west in Nepal through the Kathmandu valley (Decandido et al. 2013) and stopover numbers have recorded in the Kathmandu Valley (BCN unpublished).

WHITE- TAILED SEA EAGLE (IUCN LC; NEPAL CR)

The White-tailed Sea Eagle is now a very rare winter visitor and passage migrant. Since 1990, there have been fewer reports from the Chitwan National Park. There were several records from the Kathmandu Valley in the 1980s, but only three recent records from the Valley: one at Gokarna, Kathmandu Valley in January 1992, and two records of singles in December 2005 (Inskipp et al. 2016).

GREAT HORNBILL (IUCN VU; NEPAL EN)

The Great Hornbill is a rare and local resident. Since the 1990s, Great Hornbills have been mainly recorded and regularly seen throughout Chitwan National Park, including in the east. Single individuals were seen at three sites in Parsa Wildlife Reserve in April and May 2003. It was also recorded in the Chitwan National Park buffer zone in the Barandbahar IBA in 2000 and in the Kumrose Community Forest in March 2012 (Sagar Giri) (Inskipp et al. 2016). It was also recorded in Maghi Community Forest in Ghodaghodi Lake IBA in 2015 (Bird Conservation Network 2018). The Great Hornbill is also protected in Nepal. The possibility of it occurring along the ETP alignment is very high.

IBISBILL (IUCN LC; NEPAL EN)

The Ibisbill is a very uncommon altitudinal migrant. It is known to breed locally in Nepal, but wintering records are widespread from the west to the far east. It is regularly sighted between late November and mid-March on the Rapti River near Hetauda, Makwanpur District, where three birds were first found in December 1970 (Inskipp et al. 2016). Minimum number of adult individual of the species was recorded in the winter season in the lower Trishuli River of Dhading District. Only one individual in Chiraudi and two individuals each in Baireni and Galchhi of Dhading district were recorded (Ghimire et al. 2011). Locations of recording ibis bill are provided on Figure 5.2-15.

The IBAT screening indicated that the following CR and EN avifaunal species (IUCN Red List and Nepal Red-List for Birds (Inskipp et al. 2016) were likely to occur along the ETP alignment but were not detected during survey. Based on available information, the likelihood of occurrence is further discussed.

PALLAS'S FISH-EAGLE (IUCN EN; NEPAL CR)

The Pallas's Fish Eagle is a very rare visitor and has been recorded in areas close to the ETP alignment (Inskipp et al. 2016). It is therefore likely to occur along the ETP alignment.

EASTERN IMPERIAL EAGLE (IUCN VU; NEPAL CR)

The Eastern Imperial Eagle is a rare passage migrant and winter visitor. There were a few winter records from Chitwan National and also in the Kathmandu Valley (Inskipp et al. 2016) and is likely to occur along the ETP alignment.

SAKER FALCON (IUCN EN; NEPAL EN)

The Saker Falcon is a rare winter visitor and passage migrant. Saker has been most frequently recorded in the Annapurna Conservation Area (ACA). At least two were seen in the upper Kali Gandaki Valley between Marpha and Muktinath between 2,590 and 2,795 meters (Inskipp et al. 2016). Given the altitude of observation, the species is unlikely to occur along the ETP alignment.

BAER'S POCHARD (IUCN CR; NEPAL CR)

The Baer's Pochard is a rare and local passage migrant, most often seen in the Koshi area and very recently at Chimdi Lake, Sunsari District. The species was also seen south of the Annapurna Conservation Area (Inskipp et al. 2016) and is likely to occur along the ETP alignment.

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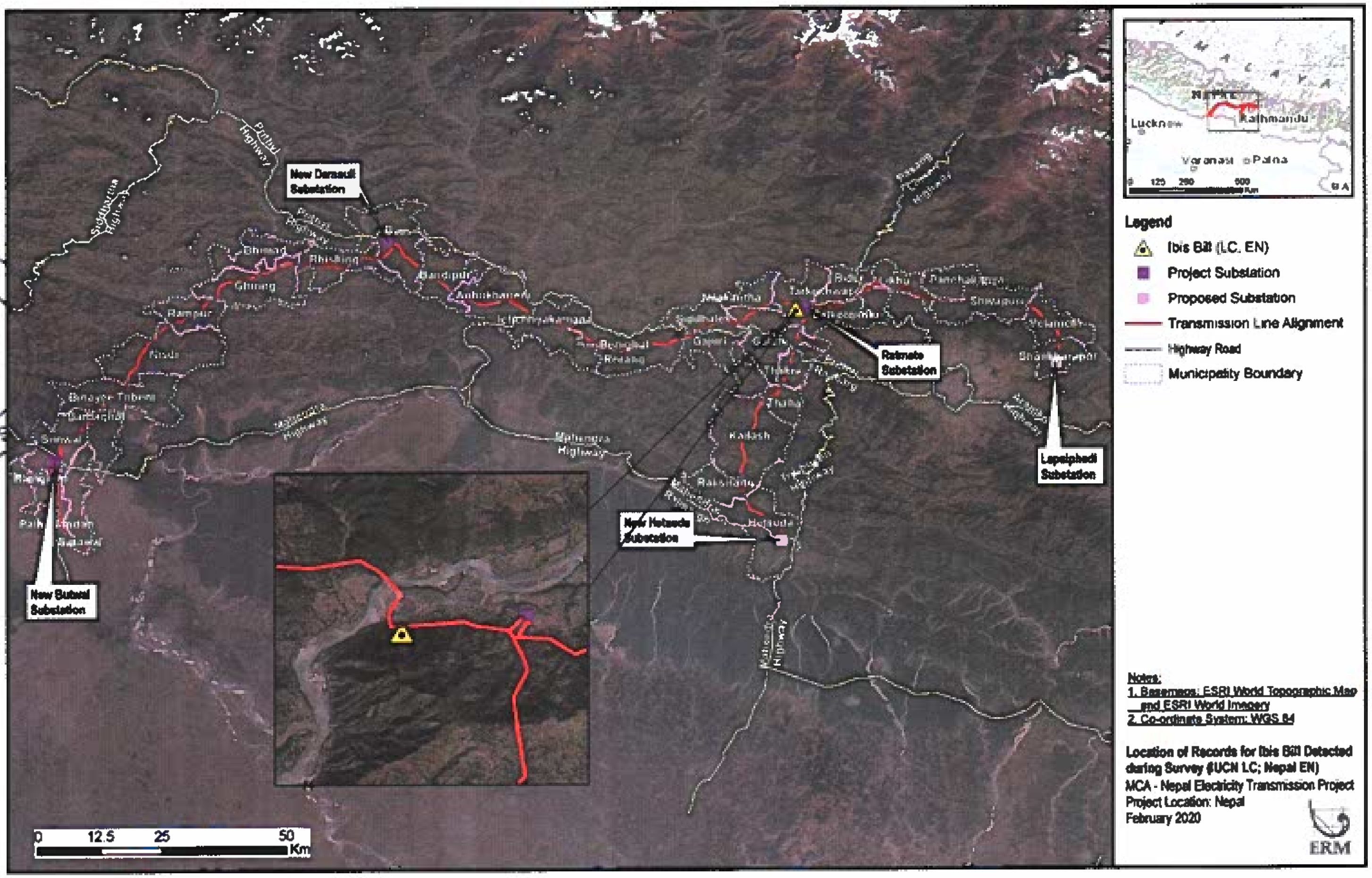

Figure 5.2-15: Location of Records for Ibis Bill Detected during Survey (IUCN LC; Nepal EN)

BLACK-BELLIED TERN (IUCN EN; NEPAL CR)

The Black-bellied Tern is a rare and very local visitor. It has been observed in areas close to the ETP alignment (Inskipp et al. 2016) and is therefore likely to occur here.

INDIAN SKIMMER (IUCN VU; NEPAL CR)

The Indian Skimmer is an irregular and very rare non-breeding visitor. According to the one known record since 2000, only four were seen at Koshi in February 2006 (Inskipp et al. 2016). Therefore, the species is unlikely to occur along the ETP alignment.

PAINTED STORK (IUCN NT; NEPAL EN)

The Painted Stork is a very rare visitor in the lowlands, according to post-1990 records from the far western, central, and far eastern Nepal. The Painted Stork was previously an uncommon visitor to Chitwan National Park, mainly seen only from May to October (Inskipp et al. 2016). In the annual waterbird count 2017, 6 were seen in Badhaiya Tal, Bardia, and two in Laukabhauka Tal, Kailali (Nepal and Thapa 2018). The species is unlikely to occur along the ETP alignment.

GREATER ADJUTANT (IUCN EN; NEPAL CR)

The current status of Greater Adjutant is uncertain; there are no known records of the species since 1995 (Inskipp et al. 2016). The species is unlikely to occur along the ETP alignment.

CHEER PHEASANT (IUCN VU; NEPAL EN)

The Cheer Pheasant is a local resident in the west in and around Dhorpatan Hunting Reserve, but scarcely elsewhere (Inskipp et al. 2016). A survey carried by BCN in June 2017 reported a maximum of 30 calling birds heard with the population ranging between 28 and 32 and total 11 observed through two sightings (BCN 2017). The species is unlikely to occur along the ETP alignment.

SWAMP FRANCOLIN (IUCN VU; NEPAL EN)

The Swamp Francolin is a very local resident. The species was once thought to be present throughout the Nepal lowlands (Baral 1998), but Shukla Phanta Wildlife Reserve and Koshi Barrage/Koshi Tappu Wildlife Reserve are now the only sites where the species has been recorded recently (Inskipp et al. 2016). The species is unlikely to occur along the ETP alignment.

BENGAL FLORICAN (IUCN CR; NEPAL CR)

A total of 41 Bengal Florican, 28 males and 13 female were recorded from 2014 survey. All are recorded from protected areas, Koshi Tappu Wildlife Reserve, Chitwan National Park, and Shukla Phanta Wildlife Reserve only (BCN 2015). The Bengal Florican is now rare and local and its distribution is highly fragmented in the lowlands (Inskipp et al. 2016). All records close to the ETP alignment have been from the Chitwan National Park. Occurrence is possible along the ETP alignment

LESSER FLORICAN (IUCN EN; NEPAL CR)

The Lesser Florican is a very rare summer visitor. The species was formerly recorded more frequently, but may have only been a non-breeding monsoon visitor to Nepal, largely dependent on monsoon rains. The species has been recorded at the Chitwan National Park. Since 1990, there have been only four known confirmed records that include two males in Chitwan National Park in April 1996. There is no information on its present distribution (Inskipp et al. 2016), and its occurrence along the ETP alignment cannot be ascertained.

SLENDER BILLED BABBLER (IUCN VU, NEPAL CR)

Slender-billed Babbler is a very local resident, only recorded in Chitwan National Park, where it is widespread and locally fairly common, and also in some community-managed forests/grasslands in the park buffer zone. Given that the species is found in the Park's buffer zone and in community managed forests it is likely along the ETP alignment.

JERDON'S BABBLER (IUCN VU, NEPAL CR)

Jerdon's Babbler is a very rare and very local resident. It has only recorded from two highly disjunct localities. The first Nepal record was in November 1989 in Chitwan National Park), although it was probably overlooked previously. There are a number of later records from the park (Inskipp et al. 2016). Given the restricted distribution in the park, it is unlikely to be found along the ETP alignment as the habitat characteristics of the Park does not exist here.

GREY-CROWNED PRINIA (IUCN VU; NEPAL CR)

The Grey-crowned Prinia is a local breeding resident. The species is now almost entirely confined to three protected areas: Chitwan National Park, and in adjoining areas of Parsa Wildlife Reserve and Bardia National Park and buffer zone (Inskipp et al. 2016) The species is likely to occur along the ETP alignment.

WHITE-THROATED BUSHCHAT (IUCN VU; NEPAL EN)

The White-throated Bushchat is a very local winter visitor. Post-1990, one or two individuals have been recorded, irregularly at other localities mainly in west and central Nepal. A single bird was seen in Chitwan National Park in February 2004. The species is unlikely to occur along the ETP alignment.

YELLOW-BREASTED BUNTING (IUCN CR; NEPAL CR)

While the Yellow-breasted bunting appears in the official check-list of the birds of Nepal (DNPWC 2018) and the Nepal Red-List (Inskipp et al. 2016), there is no recent good information on its distribution and its occurrence in Nepal. However, a very recent study carried by BCN has recorded 157 individuals around the lake cluster of Pokhara Valley (BCN 2019). Its occurrence along the ETP alignment cannot be ascertained.

SATYR TRAGOPAN (IUCN NT; NEPAL VU)

The Satyr Tragopan is an uncommon resident that mainly occurs in protected areas. The most important known area for the species in Nepal is the Annapurna Conservation Area, especially on the western slopes of the Seti River. The species has also been regularly recorded from a few locations in Langtang National Park since 1980 (Inskipp et al. 2016). Given that the species presently is rarely seen outside protected areas, it is unlikely to occur along the ETP alignment

5.2.8.3 Fauna and Flora species of ethnological significance

The following section presents a list of fauna and flora of ethnozoological and ethnobotanical significance found in forests in transmission line alignment. The data are collected from consultations with Community Forest Group Members and is also complemented with information existing in the secondary literature. Annex O provides a list of all Community and Leasehold Forests that may be impacted by the project and section 5.3 includes discussion on communities' dependency on these forests.

Ethnozoological Species

Table 5.2-25 presents the fauna species and their potential ethnozoological uses reported by the CFUGs along transmission line alignment. However, no poaching incidents were reported, and this information is not meant to encourage killing of wild animals.

Table 5.2-25: Fauna of Ethnozoological Significance in ETP Route

S/N	Common Name	Scientific Name	Uses
1.	Common Leopard	*Panthera pardus*	Bone: cure of uric acid
2.	Barking Deer	*Muntiacus muntjak*	Skin: Hindu rituals
3.	Porcupine	*Hystrix brachyura*	Meat: cure of asthma, uric acid, epilepsy; Spikes: witch doctors, Hindu rituals
4.	Bengal Fox	*Vulpes bengalensis*	Meat: asthma, uric acid, epilepsy, alcohol
5.	Chinese Pangolin	*Manis pentadactyla*	Meat: delicacy; Scales: trade
6.	Rhesus monkey	*Macaca mulatta*	Meat: cure for tuberculosis
7.	Yellow monitor Lizard	*Varanus salvator*	Skin: playing instruments
8	Snake	-	Meat

Ethnobotanical Species

In addition, there are around 60 medicinal and aromatic plant species listed as threatened in Nepal (Bhattarai et al. 2002). Among these, 12 have been recorded along the ETP alignment (*Alstonia scholaris, Arisaema costatum, Asparagus racemosus, Bergenia ciliate, Dalbergia* latifolia, Dioscorea deltoidea, Oroxylum indicum, Rubia manjith, Swertia angustifolia, Swertia chirayita, Taxus wallichiana,* and *Tinospora sinensis*).

India Border to New Butwal Substation

Table 5.2-26 provides a list of all plants of ethnobotanical significance as ascertained with interviews from Community Forest User Groups. However, there is not much extraction of these plants due to easy access to local hospitals.

Table 5.2-26: Flora of Ethnobotanical Significance in the IB–NB Segment

S/N	Scientific Name	Local Name	Parts Use	Use In
22.	*Woodfordia fruticosa*	Sano Dhayaro	Bark and flower	Dysentery and gastritis
23.	*Syzygium cumini*	Jamun	Bark	Dysentery, toothache
24.	*Stephania glandulifera*	Batulpate	Leaf	Menstrual disorder
25.	*Semecardium anacardium*	Bhalayo	Fruit	To make soft foot
26.	*Psidium guajava*	Amba	Bark and shoot	Dysentery, gastritis
27.	*Ageratum conyzoides*	Gandhe Jhar	Leaf	Wound and cut
28.	*Aegle marmelos*	Bel	Fruit And Leaf	To get relief from heat and jaundice

New Butwal to New Damauli Substation Segment

Table 5.2-27 provides a list of all plants of ethnobotanical significance as ascertained with interviews from Community Forest User Groups.

Furthermore, a total of 51 climbing plants species belonging to 40 genera and 22 families used in folk medicine, have been documented from different VDCs of Palpa district, which is less than 25 kilometers from the ETP alignment (Singh and Kumar 2017).

Table 5.2-27: Flora of Ethnobotanical Significance in the NB–ND Segment

S/N	Scientific Name	Local Name	Parts Use	Use In
1.	*Woodfordia fruticosa*	Sano dhayaro	Bark and flower	Dysentery and gastritis
2.	*Urtica dioca*	Sisno	Shoot	Diabetes, fracture As vegetable
3.	*Rubus ellipticus*	Aiselu	Root and Fruit	Wound and jaundice
4.	*Smilex aspera*	Kukurdiano	Root boiling	Joint pain
5.	*Urena lobata*	Nalu kurro	Root	Wound
6.	*Thysanolaena latifolia*	Amriso	Root	Typhoid and wound
7.	*Terminallia bellerica*	Barro	Fruit	Cough, gastritis, stimulants
8.	*Terminalia chebula*	Harro	Fruit	Cough, indigestion
9.	*Terminalia elliptica*	Saj	Bark	Snake bite, dysentery and dye

S/N	Scientific Name	Local Name	Parts Use	Use In
10.	*Syzygium cumini*	Jamun	Bark	Dysentery, toothache
11.	*Stephania glandulifera*	Batulpate	Leaf	Menstrual disorder
12.	*Semecardium anacardium*	Bhalayo	Fruit	To make soft foot
13.	*Schima wallichii*	Chilaune	Bark	Fish poisoning
14.	*Psidium guajava*	Amba	Bark and shoot	Dysentery, gastritis
15.	*Rhododendron arboreum*	Laligurans	Flower	Cough, diarrhea and dysentery
16.	*Phyllanthus emblica*	Amala	Fruit	Cough, dysentery, and edible
17.	*Myrica esculanta*	Kafal	Fruit	Edible
18.	*Lycopodium clavatum*	Bhutle lahara	Whole plant	Making gunpowder, for decoration purpose
19.	*Nephrolepis cordifolia*	Pani amala	Whole plant	Used as decoration, tuber are used as to quench thirst
20.	*Ageratum conyzoides*	Gandhe jhar	Leaf	Wound and cut
21.	*Melastoma malabathricum*	Kalo Angeri	Whole plant	Wound and cut, dysentery, diarrhea, stomach
22.	*Aegle marmelos*	Bel	Fruit and leaf	To get relief from heat and jaundice

New Damauli to Ratmate Substation Segment

Table 5.2-28 provides a list of all plants of ethnobotanical significance as ascertained from interviews with Community Forest User Groups.

Table 5.2-28: Flora of Ethnobotanical Significance in the ND–RTE Segment

S/N	Scientific Name	Local Name	Parts Use	Use In
23.	*Castanopsis indica*	Katus	Stem and leaves	Timber use shelter and also use as fodder
24.	*Cissampelos pareira*	Gujar gano	Root	Use in wounds as medicine
25.	*Gaultheria fragrantissima*	Dhasingre	Fruit	Wounds and bone fractures
26.	*Lyonia ovalifolia*	Angeri	Stem and fruit	Skin diseases
27.	*Clerodendrum viscosum*	Rajbeli	Leave	Leaf extract use in ear infection
28.	*Bombax ceiba*	Simal	Flower and stem	Timber and fiber used to make pillows
29.	*Woodfordia fruticosa*	Dhayero	Flower	Fruit juice used in eye infection
30.	*Mallotus philippensis*	Sindure	Fruit	Fruits and barks are used to make dye

S/N	Scientific Name	Local Name	Parts Use	Use In
31.	*Pyrus pashia*	Mayal	Fruit and stem	Fruit edible, timber, and stem used to make agricultural tools.
32.	*Dioscorea deltoidea*	Ghar Tarul	Tuber	Harvested as a source of food by Chepang Community
33.	*Aegle marmelos*	Bel	Fruit	Fruits edible, leaves used in worship
34.	*Semecarpus anacardium*	Bhalyo	Stem	Fruit edible and latex is used in wound
35.	*Pogostemon bengahlensis*	Rudhilo	Leave	Plant extract used for stomachic treatment
36.	*Artemisia vulgaris*	Titepate	Whole plant	Used in worship and juice used in cut and wounds
37.	*Sapium insigne*	Khirro	Stem	Stem used to make musical instruments: Madal, Sarangi

Ratmate to New Hetauda Substation Segment

Table 5.2-29 provides a list of all plants of ethnobotanical significance as ascertained with interviews from Community Forest User Groups.

In a study carried out in Makwanpur District, a total of 68 wild plant species belonging to 58 genera and 40 families were identified as wild vegetables. Of these, 53 species were herbs, 5 climbers, 4 shrubs, 4 trees, and 2 aquatic runners. The wild vegetables were harvested mainly from March to July by women for household consumption and were sold in the market.

Amaranthus lividus, Bambusa tulda, Bauhinia purpurea, Chenopodium album, Dendrocalamus hamiltonii, Diplazium esculentum, Dryopteris cochleata, Ficus lacor, Ipomoea aquatica, Macropanax dispermus, Phytolacca acinosa, Rorripa nasturtium-aquaticum and Tectaria coduanata, were frequently used as wild vegetables (Joshi and Siwakoti 2012).

Table 5.2-29: Flora of Ethnobotanical Significance in the RTE–NH Segment

S/N	Scientific Name	Local Name	Parts Use	Use In
38.	*Acacia catechu*	Khair	Stem and leaves	Joints aches and Fever
39.	*Dioscorea*	Ghar Tarul	Tuber	To neutralize mushroom poisoning
40.	*Gaultheria fragrantissima*	Dhasingre	Fruit and leaves	Wounds and bone Fractures
41.	*Lyonia ovalifolia*	Angeri	Stem and fruit	Skin diseases
42.	*Myrica esculenta*	Kaphal	Fruit	Fruits edible
43.	*Phyllanthus emblica*	Amala	Fruit	Cough and gastritis
44.	*Pinus roxburghii*	Khote salla	Resin	Cough
45.	*Quercus lanata*	Banjha	Wood	Scorpion sting
46.	*Rhododendron arboreum*	Laligurans	Flower	Throat obstruction especially fish bones
47.	*Schima wallichii*	Chilaune	Branches and leaves	Wounds
48.	*Shorea robusta*	Sal	Wood	Furniture
49.	*Sida cordifolia*	Balu	Whole plant	Eye problems and whitening of cornea
50.	*Smilax aspera*	Kukurdaino	Leaves	Toothaches
51.	*Thalictrum foliolosum*	Dampate	Whole plant	Asthma
52.	*Thysanolaena maxima*	Amriso	Root	Malarial fever
53.	*Urtica dioica*	Sisnu	Root and leaves	Bone fractures
54.	*Woodfordia fruticosa*	Dhayero	Flower	Dysentery

Ratmate to Lapsiphedi Substation Segment

Table 5.2-30 provides a list of all plants of ethnobotanical significance as ascertained with interviews from Community Forest User Groups.

Table 5.2-30: Flora of Ethnobotanical Significance in the RTE–LAP Segment

S/N	Scientific Name	Local Name	Parts Use	Use In
55.	*Woodfordia fruticosa*	Sano Dhayaro	Bark and Flower	Dysentery and gastritis
56.	*Urtica dioca*	Sisno	Shoot	Diabetes, fracture; as vegetable
57.	*Rubus ellipticus*	Aiselu	Root and Fruit	Wound and jaundice
58.	*Smilex species*	Kukurdiano	Root Boiling	Joint pain
59.	*Urena lobata*	Nalu Kurro	Root	Wound
60.	*Thysanolaena latifolia*	Amriso	Root	Typhoid and wound
61.	*Terminalia elliptica*	Saj	Bark	Snake bite, dysentery, and dye
62.	*Syzygium cumini*	Jamun	Bark	Dysentery, toothache
63.	*Stephania gracilenta*	Batulpate	Leaf	Menstrual disorder
64.	*Semecardium anacardium*	Bhalayo	Fruit	To make soft foot
65.	*Schima wallichii*	Chilaune	Bark	Fish poisoning
66.	*Rhododendron arboreum*	Laligurans	Flower	Cough, diarrhea, and dysentery
67.	*Phyllanthus emblica*	Amala	Fruit	Cough, dysentery, and edible
68.	*Myrica esculanta*	Kafal	Fruit	Edible
69.	*Lycopodium clavatum*	Bhutle Lahara	Whole Plant	Making gunpowder, for decoration purpose
70.	*Nephrolepis cordifolia*	Pani Amala	Whole Plant	Used as decoration, tuber are used as to quench thirst
71.	*Ageratum conyzoides*	Gandhe Jhar	Leaf	Wound and cut
72.	*Melastoma malabathricum*	Kalo Angeri	Whole Plant	Wound and cut, dysentery, diarrhea, stomach
73.	*Erioscirpus comosus*	Raani Babiyo	Whole Plant	Thatching, making ropes

5.2.9 Invasive Species

As required by International Finance Corporation PS6 and best practices, alien invasive species should be identified and managed for projects that may affect natural habitats. The Global Invasive Species Database (ISSG undated) lists invasive alien species identified within different jurisdictions. The list of invasive alien species for Nepal first provided a complete list of species in Nepal. Shrestha (2016) was then used for plants, for determining if they occurred along the ETP RoW through understanding the distribution of an invasive species (Eastern, Central or Western Nepal), ecoregion (Terai, Chure Hills or Hills), and elevation where found (Table 5.2-31).

Table 5.2-31: Invasive Plant Species Identified Within Nepal

S/N	Species	Phylum	Family	System
74.	*Ageratina adenophora*	Magnoliophyta	Asteraceae	Terrestrial
75.	*Ageratum conyzoides*	Magnoliophyta	Asteraceae	Terrestrial
76.	*Ageratum haustonianum*	Magnoliophyta	Asteraceae	Terrestrial
77.	*Alternanthera philoxeroides*	Magnoliophyta	Amaranthaceae	Terrestrial
78.	*Amaranthus spinosus*	Magnoliophyta	Amaranthaceae	Terrestrial
79.	*Argemone mexicana*	Magnoliophyta	Papaveraceae	Terrestrial
80.	*Bidens pilosa*	Magnoliophyta	Asteraceae	Terrestrial
81.	*Chromolaena odorata*	Magnoliophyta	Asteraceae	Terrestrial
82.	*Eichhornia crassipes*	Magnoliophyta	Pontederiaceae	Terrestrial
83.	*Erigeron karvinskianus*	Magnoliophyta	Asteraceae	Terrestrial
84.	*Eupatorium adenophorum*	Magnoliophyta	Asteraceae	Terrestrial
85.	*Galinsoga quadriradiata*	Magnoliophyta	Asteraceae	Terrestrial
86.	*Hyptis suaveolens*	Magnoliophyta	Lamiaceae	Terrestrial
87.	*Ipomoea carnea*	Magnoliophyta	Convolvulaceae	Terrestrial
88.	*Lantana camara*	Magnoliophyta	Verbenaceae	Terrestrial
89.	*Leucaena leucocephala*	Magnoliophyta	Fabaceae	Terrestrial
90.	*Leersia hexandra*	Magnoliophyta	Poaceae	Terrestrial
91.	*Mikania micrantha*	Magnoliophyta	Asteraceae	Terrestrial
92.	*Oxalis latifolia*	Magnoliophyta	Oxalidaceae	Terrestrial
93.	*Mimosa pudica*	Magnoliophyta	Mimosaceae	Terrestrial
94.	*Parthenium hysterophorus*	Magnoliophyta	Asteraceae	Terrestrial
95.	*Pistia stratiotes*	Magnoliophyta	Araceae	Terrestrial
96.	*Senna tora*	Magnoliophyta	Caesalpiniaceae	Terrestrial
97.	*Senna occidentalis*	Magnoliophyta	Caesalpiniaceae	Terrestrial
98.	*Spermacoce alata*	Magnoliophyta	Rubiaceae	Terrestrial

S/N	Species	Phylum	Family	System
99.	*Xanthium strumarium*	Magnoliophyta	Asteraceae	Terrestrial

The Global Invasive Species Database list of invasive alien species for Nepal was first used to provide a complete list of species in Nepal. This list was then verified by assessing the list against the IUCN Red-List (version 2019-2) for birds, mammals, arthropods, and mollusks. Jha et al (1989) provides a comprehensive list of fish species for the Narayani Basin in the Chitwan district was used for identifying any invasive fish species in the RoW (Table 5.2-32).

Table 5.2-32: Invasive Animal Species Identified Within Nepal

S/N	Species	Phylum	Family	System	Comments
1.	*Acridotheres tristis*	Chordata	Sturnidae	Terrestrial	Naturalized
2.	*Channa marulius*	Chordata	Channidae	Freshwater	
3.	*Clarias batrachus*	Chordata	Clariidae	Freshwater	
4.	*Columba livia*	Chordata	Columbidae	Terrestrial	Naturalized
5.	*Corvus splendens*	Chordata	Corvidae	Terrestrial	Naturalized
6.	*Ctenopharyngodon idella*	Chordata	Cyprinidae	Freshwater	
7.	*Cyprinus carpio*	Chordata	Cyprinidae	Freshwater	
8.	*Hemidactylus frenatus*	Chordata	Gekkonidae	Terrestrial	

5.2.10 Segment-Specific Biodiversity Values Summary

Table 5.2-33 provides a segment-by-segment breakdown of specific information relative to the ETP RoW.

Table 5.2-33: ETP Segment-Specific Biodiversity Baseline Data Summary

India Border to New Butwal Segment	New Butwal to New Damauli Segment	New Damauli to Ratmate Segment	Ratmate to New Hetauda Segment	Ratmate to Lapsiphedi Segment
Conservation Significant Species (IUCN Red List CR, EN, VU & NT; Nepal Red list CR, EN, VU & NT) Detected				
Herpetofauna				

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India Border to New Butwal Segment	New Butwal to New Damauli Segment	New Damauli to Ratmate Segment	Ratmate to New Hetauda Segment	Ratmate to Lapsiphedi Segment
• Chitwan Frog (Hylarana chitwanensis)	• Chitwan Frog (*Hylarana chitwanensis*) • Elongated Tortoise *Indotestudo elongata*) • Tricarinate Hill Turtle (*Melanochelys tricarinata*)	• Chitwan Frog (*Hylarana chitwanensis*) • Burmese Python (*Python bivittatus*)	• Chitwan Frog (*Hylarana chitwanensis*) • Python (*Python bivittatus*) • King Cobra (*Ophiophagus Hannah*) • Elongated Tortoise (*Indotestudo elongata*)	• Chitwan Frog (*Hylarana chitwanensis*)
Mammals				
• Northern Red Muntjac (*Muntiacus vaginalis*)	• Asiatic Black Bear (*Ursus thibetanus*) • Sloth Bear *Melursus ursinus*) • Common leopard (*Panthera pardus*) • Northern Red Muntjac (*Muntiacus vaginalis*) • Assam Macaque (*Macaca assamensis*)	• Common leopard (*Panthera pardus*) • Leopard cat (Prionailurus bengalensis) • Northern Red Muntjac (*Muntiacus vaginalis*)	• Sloth Bear (*Melursus ursinus*) • Tiger (*Panthera tigris tigris*) • Leopard cat (*Prionailurus bengalensis*) • Bengal fox (*Vulpes bengalensis*) • Dhole (*Cuon alpinus*) • Chinese Pangolin (*Manis pentadactyla*)	• Common leopard (*Panthera pardus*) • Leopard cat (*Prionailurus bengalensis*) • Bengal fox (*Vulpes bengalensis*) • Large Indian Civet (*Viverra zibetha*) • Northern Red Muntjac (*Muntiacus vaginalis*) • Chinese Pangolin (*Manis pentadactyla*)
			• Indian Pangolin (*Manis crassicaudata*) • Asiatic Elephant (*Elephas maximus*)	
Birds				
• Himalayan Griffon (*Gyps himalayensis*)	• Himalayan Griffon (*Gyps himalayensis*)	• Himalayan Griffon (*Gyps himalayensis*)	• Asian Openbill (*Anastomus oscitans*)	• Himalayan Griffon (*Gyps himalayensis*)

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India Border to New Butwal Segment	New Butwal to New Damauli Segment	New Damauli to Ratmate Segment	Ratmate to New Hetauda Segment	Ratmate to Lapsiphedi Segment
• White-Rumped Vulture (*Gyps bengalensis*) • Cinereous Vulture (*Aegypius monachus*) • Steppe Eagle (Aquila nepalensis) • Greater Spotted Eagle (*Clanga clanga*) • Indian Spotted Eagle (*Clanga hastate*) • Asian Woollyneck (*Ciconia episcopus*) • Black Stork (*Ciconia nigra*) • Lesser Adjutant (*Leptoptilos javanicus*) • Sarus Crane (*Antigone Antigone*) • Grey Francolin (*Francolinus pondicerianus*) • Alexandrine Parakeet (*Psittacula eupatria*)	• Egyptian Vulture (*Neophron percnopterus*) • Red-Headed Vulture (*Sarcogyps calvus*) • White-Rumped Vulture (*Gyps bengalensis*) • Slender-Billed Vulture (*Gyps tenuirostris*) • Cinereous Vulture (*Aegypius monachus*) • Steppe Eagle (*Aquila nepalensis*) • Asian Woollyneck (*Ciconia episcopus*) • Black Stork (*Ciconia nigra*) • Lesser Adjutant (*Leptoptilos javanicus*) • Sarus Crane (*Antigone Antigone*) • Demoiselle Crane (*Grus virgo*) • Great Slaty Woodpecker (*Mulleripicus pulverulentus*) • Sarus Crane (*Antigone Antigone*) • Alexandrine Parakeet (*Psittacula eupatria*) • Brown Fish Owl (*Ketupa zeylonensis*)	• Steppe Eagle (*Aquila nepalensis*) • Great Hornbill (*Buceros bicornis*) • Demoiselle Crane (*Grus virgo*) • Indian Peafowl (*Pavo cristatus*)	• Great Cormorant (*Phalacrocorax carbo*)	• Egyptian Vulture (*Neophron percnopterus*) • Red-Headed Vulture (*Sarcogyps calvus*) • Steppe Eagle (*Aquila nepalensis*) • Lesser Fish Eagle (*Ichthyophaga humilis*) • White Tailed Sea Eagle (*Haliaeetus albicilla*) • River Lapwing (Vanellus duvaucelii) • Yellow-Wattled Lapwing (*Vanellus malabaricus*) • Asian Woollyneck (*Ciconia episcopus*) • Demoiselle Crane (*Grus virgo*) • Ibisbill (Ibidorhyncha struthersii) • Great Cormorant (Phalacrocorax carbo)

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India Border to New Butwal Segment	New Butwal to New Damauli Segment	New Damauli to Ratmate Segment	Ratmate to New Hetauda Segment	Ratmate to Lapsiphedi Segment
Flora				
		• Maire's Yew (*Taxus mairei*) • Rose wood (Dalbergia latifolia)	• East Himalayan Yew (*Taxus wallichiana*)	• Maire's Yew (*Taxus mairei*) • Chirayita (Swertia chirayita)

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5.3 SOCIOECONOMIC AND CULTURAL ENVIRONMENT

This chapter provides an overview of the existing socioeconomic and cultural environment of the area affected by the ETP. A brief country-level socioeconomic profile is provided for context, in Section 5.3.1. Section 5.3.2 presents a brief profile of affected districts which is followed by profiles of affected municipalities in section 5.3.3. Sections 5.3.4 to 5.3.9 discuss socioeconomic profiles of people in the Area of Direct and Indirect Impact (Project area) based on household survey, focus group discussions and key informant interviews.

A detailed socioeconomic baseline of all project-affected households including 187 Seriously Project Affected Households (SPAFs) with 943 persons will be included in the Resettlement Action Plan (RAP), based on a census survey of affected areas. Four RAPs are planned to be developed for this project, as noted below:

RAP Package 1: Ratmate Substation Area and access road;

RAP Package 2: TL Segment from India Border to New Damauli (IB–ND);

RAP Package 3: TL Segment from New Damauli to Ratmate (ND–NB and NB–RTE); and

RAP Package 4: TL Segment from Ratmate to New Hetauda and, TL Segment from Ratmate to Lapsiphedi (RTE–NH and RTE–LAP).

At the time of preparing this document, the RAP survey for RAP Package 1 had been completed and a summary of the findings, has been included in 5.3.8 (in the baseline for Ratmate Substation). The summary is based on a survey that covers all affected households within the proposed Ratmate substation footprint, whereas the socioeconomic baseline is based on a random sample survey of 499 households. RAPs will be an integral part of this EIA and will be endorsed by the GoN (MCA-Nepal Board).

5.3.1 Nepal: Socioeconomic Context

Nepal is spread across an area of 147,181 square kilometers and is divided into three ecological zones: Mountain, Hill, and Terai. Administratively, Nepal is divided into 7 provinces, 77 districts, six metropolitan cities, 11 sub metropolitan cities, 236 municipalities, 460 rural municipalities, and 6,743 wards. The ETP passes through three provinces (Bagmati Province, Gandaki Province, and Lumbini Province), 1 sub-metropolitan city, 10 municipalities, 19 rural municipalities, and 98 wards. It passes through two of three ecological zones—Hills and the Terai.

5.3.1.1 Demography

According to the National Population and Housing Census of 2011[1], the total population of Nepal was 26.49 million (female: 13.64 million and 12.85 million) in 2010. The population of

[1] This is the latest national census data available. The next national population census is due in 2021.

estimated to be 29.49 million during the fiscal year 2018/19. Women constitute about 51.5 percent of total population of Nepal. Similarly, there were 5,427,302 households in Nepal, which reflects an average household size of 4.9 persons per household. Population density was 180 persons per square kilometer. The sex ratio, which is defined as the number of males per 100 females, was 94.2. Population density was highest in the Terai followed by the Hill, and then Mountain ecological zones. Average household size was highest in Terai and lowest in the Hill zone.

Table 5.3-1 presents demographic information for three provinces affected by the ETP. The share of Bagmati Province, Gandaki province, and Lumbini Province in total population of Nepal was about 21 percent, 9 percent, and 17 percent, respectively. The sex ratio of men to women was highest in Bagmati Province followed by Lumbini Province and Gandaki Province.

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Table 5.3-1: Nepal: Population, Population Density, and Sex Ratio

Administrative Unit	Population	Number of Households	Average Household Size	Area (km²)	Population Density (persons/ km²)	Sex Ratio
Nepal	26,494,504	5,427,302	4.9	147,181	180	94.2
Ecological Zone						
Mountain	1,781,792	364,120	4.89	51,817	34.38	93.84
Hill	11,394,007	2,534,430	4.50	61,345	185.73	91.36
Terai	13,318,705	2,528,752	5.27	34,019	391.50	96.66
Province						
Bagmati	5,529,452	1,270,797	4.35	20,300	272	98.77
Gandaki	2,403,757	578,219	4.16	21,504	112	83.08
Lumbini	4,499,272	885,203	5.08	22,288	219	90.73

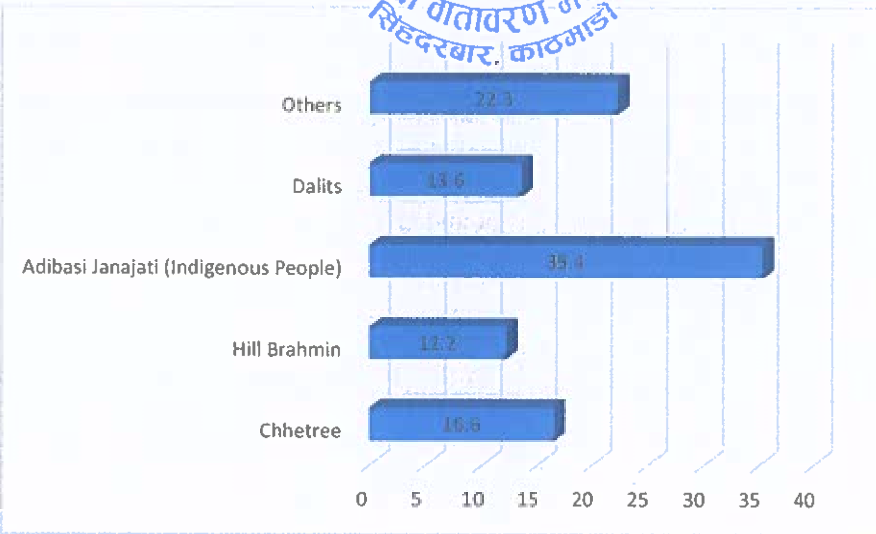
Source: CBS 2012; Province level data from www.cbs.gov.np.

5.3.1.2 Caste and Ethnicity

The caste and ethnic composition of the country includes Brahmin, Chettri, Dalits, and 59 Adivasi Janajati groups, and others (Figure 5.3-1). Chettri is the largest caste/ethnic group with 16.6 percent of population followed by Brahmin, which constitute about 12.2 percent of population. Two other caste/ethnic groups deserve special attention due to their historical marginalization and social exclusion: Dalit and Adivasi Janajati. The 2011 population census has categorized 21 caste-groups as Dalit, most of whom live in the Hills and Terai. Hill Dalit include Kami, Damai/Dholi, Sarki, Gaine, and Badi. *Terai Dalit includes* Chamar/Harijan/Ram, Mushar, Dushad/Paswan/Pasi, Khatwe, Dhobi, Bantar/Sardar, Chidimar, Dhandi, Dhankar/Dharikar, Dom, Halkhor, Kalar, Natuwa, Sarbaria, and Tatma/Tatwa. Dalit constitutes about 14 percent of the population of Nepal.

The *National Foundation for Development of Indigenous Nationalities Act 2002*[2] defined Adivasi Janajati (indigenous nationalities) as a group or community with its own mother tongue and traditional customary practices, distinct cultural identity, social structure and oral or written history and recognized a total of 59 different groups as indigenous nationalities in Nepal. Based on the 2011 National Population and Housing Census, indigenous people constituted about 35.4 percent of total population of Nepal. However, the census considered only 47 Indigenous groups as 'Indigenous' and the remaining 12 Indigenous communities were included in 'Others' category.

² Source: Nepal Rajpatra (Nepal Gazette) February 7,2002.



Source: CBS 2012

Figure 5.3-1: Caste/Ethnicity Composition of Population (percent of total population)

5.3.1.3 Economy and Poverty

In the Fiscal Year (FY) 2018/19, Nepal's Gross Domestic Product (GDP) at current prices was USD 30.5 billion which is about 0.05 percent of total world GDP (CBS, 2019). Nominal GDP per capita was USD 1,034 in 2018/19. The average annual growth rate of real GDP during 2014 to 2018 period was 4.8 percent. Nepal recorded a GDP growth rate of 6.8 percent in the FY 2018/19 at basic prices and the average growth rate over the last decade remained at 4.6 percent. Despite a steady decline, the agriculture with its share of 26.5 percent, continued to remain the largest contributor to the national economy, followed by wholesale and retail trade (14.4 percent), real estate, renting and business activities (11.5 percent) and construction (7.8 percent). Agriculture still provides employment to about 60 percent of the population.

Poverty

Nepal Living Standards Surveys (NLSS) are the standard reference sources for measurement of income poverty in Nepal. Incidence of poverty, also called headcount rate of poverty, is defined as the proportion of people living below poverty line, which is defined as the minimum amount of income needed to satisfy basic food and non-food needs of people. In 2010, poverty line in Nepal was set at NPRs 19,261 per person per year (CBS, 2011). Based on this poverty line, about 25.2 percent of population was considered living below the poverty line in Nepal in 2010. The headcount ratio of poverty in Bagmati Province, Gandaki Province, and Lumbini Province was 20.6 percent, 21.0 percent, and 25.3 percent respectively.

In 2017, the National Planning Commission (NPC), the apex advisory body of the Government of Nepal for development policy and the Oxford Poverty and Human Development Initiative (OPHI) computed a multi-dimensional measure of poverty. Based on this study, which considered three dimensions: education, health, and living standards, the headcount ratio of multi-dimensional poverty in Nepal was 28.6 percent in 2014 (NPC and OPHI, 2018). Similarly, the incidence of multi-dimensional poverty in Bagmati

Province, Gandaki Province, and Lumbini Province was 12.2 percent, 14.2 percent, and 29.9 percent respectively.

Human Development Index (HDI) and Human Poverty Index (HPI) are other indicators of development and poverty situation. Nepal Human Development Report (2014) computed HDI and HPI for Nepal using 2011 NLSS III and Population census data (NPC and UNDP, 2014). Based on the report, HDI and HPI for Nepal were 0.490 and 31.12 respectively and the per capita income was USD 1,160 in purchasing power parity (PPP) dollar.

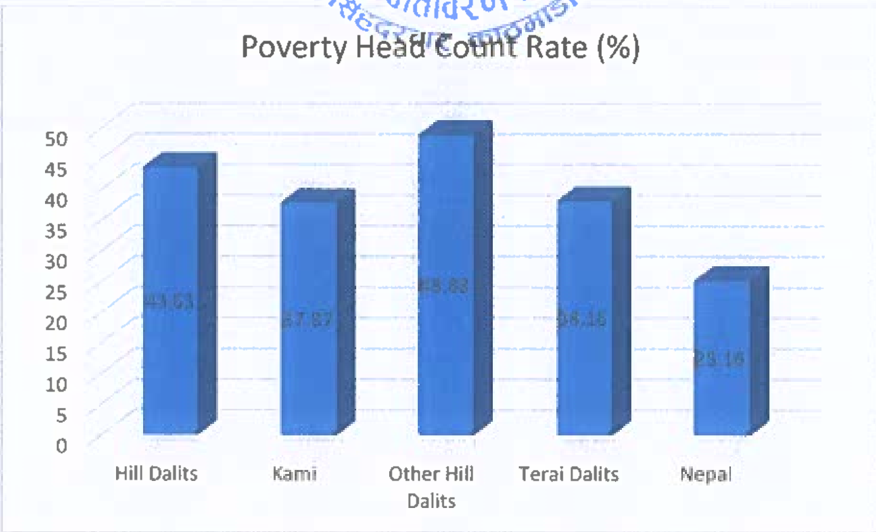
HDI for Nepal in 2018 was 0.579 and was ranked 148 out of 189 countries covered by the report. HDI value for male was 0.612 compared to 0.549 for female (UNDP, 2019).

Poverty and Social Groups

Incidence of poverty is highest for the Dalit caste/ethnic group among all caste/ethnic groups of Nepal, and highest for other Hill Dalit (Figure 5.3-2). The head count poverty rate of the Hill Dalit was 1.7 times higher than that the national average. HDI for Dalits was 0.434 compared to a national average at 0.490. HDI for the Hill Dalit (0.446) is slightly higher than that of the Terai Dalit (0.400). Per capita income (in PPP$) for all Dalit, Hill Dalit, and Terai Dalit was USD 755, USD 805, and USD 616, respectively (NPC and UNDP, 2014).

In 2011, the incidence of poverty for indigenous people (24.6 percent) was slightly lower than the national average poverty rate (25.2 percent). However, poverty rates varies greatly among various indigenous groups. Poverty rate for Chepangs (40.4 percent) was four times higher than the poverty rate for the Newar (10.3 percent). Per capita income for all indigenous people excluding Newar was USD 844 in purchasing power parity (PPP). Per capita income for Hill indigenous people (including Newar), and Terai indigenous people were USD 1,051 and USD 822 in purchasing power parity. Per capita income for Newar was USD 1,522 (PPP).

HDI values show a similar picture. HDI for all indigenous people (excluding Newar), Hill indigenous people (including Newar), Terai indigenous people, and Newar were 0.482, 0.509, 0.473, and 0.565 respectively (NPC and UNDP 2014).



Source: CBS 2011

Figure 5.3-2: Incidence of Poverty among Dalit population in Nepal

5.3.1.4 Education

The literacy rate in Nepal is 65.9 percent, according to National Population Census 2011 (Table 5.3-2). The male literacy rate is significantly higher at 75.1 percent, while female literacy is at 57.4 percent. The literacy rates of all three ETP affected provinces were higher than the national average.

Table 5.3-2: Literacy Rate of Population 5 Years and Above in 2011

Province	Total (%)	Female (%)	Male (%)
Bagmati	74.9	67.0	82.0
Gandaki	74.8	67.7	83.5
Lumbini	66.4	58.3	75.5
Nepal	65.9	57.4	75.1

Source: MEST 2017

Nepal has more than 35,601 schools (including government and private schools). In Nepal, based on reports from the Government of Nepal (MEST 2017), 7,391,524 students were in enrolled in Grades 1 to 12.

5.3.1.5 Health and Sanitation

Health infrastructure in Nepal included a network of public and private health facilities. In FY 2018/19, public health facilities included 125 hospitals, 203 primary health care centers, and 3,805 health posts. In addition, there are 384 Ayurvedic health facilities (MoF, 2019). These government health facilities are complemented by 1,822 non-public health facilities (DoHS 2017–2018). Health workforce in the country comprised 2,640 doctors, 20,653 nurses, 14,347 health assistants, and 52,000 female community health volunteers (MoF, 20190).

The largest source of drinking water for households as reported by the last Census of Nepal, was tap or piped water. Other sources of drinking water included: tube well/hand pump (35.1 percent); covered well/kuwa (2.4 percent); uncovered well/kuwa (4.7 percent); spout water (5.7 percent); river/stream (1.1 percent); and others (3.1 percent).

About 61 percent of households had access to toilets as per the last national census, out of which 8.3 percent had flush toilet connected with public sewerage system, 33.5 percent had flush toilet with septic tanks, 19.5 percent had ordinary toilets, and 38.2 percent had no toilet facilities.

5.3.1.6 Access to Electricity

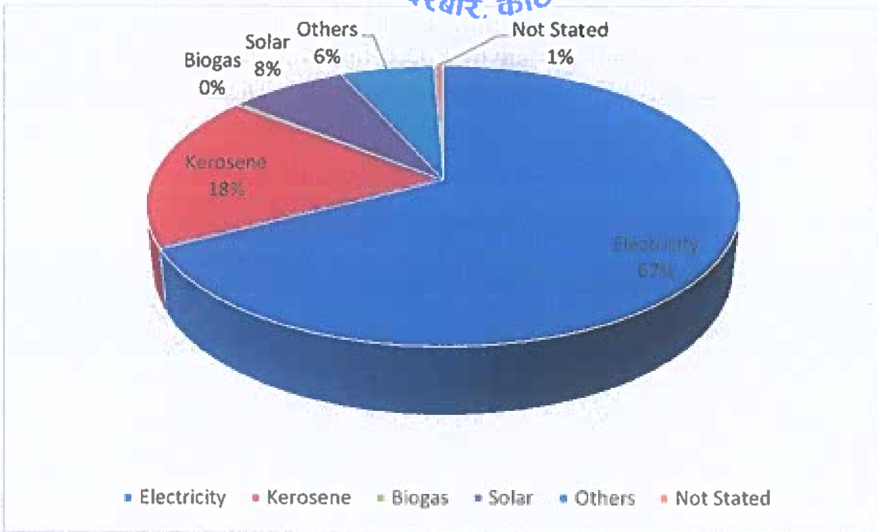
According to Nepal Electricity Authority (NEA), 77.8 percent of the total households have access to electricity till mid-March of FY 2018/19 from NEA grid and off-grid sources (Grid connected—77.5 percent and isolated—0.3 percent). Access to electricity was highest in Bagmati Province and lowest in Karnali Province (Table 5.3-3).

Table 5.3-3: Access to Electricity

Provinces	Percent of Households with access to electricity
Province 1	75.9
Province 2	79.8
Bagmati	90.3
Gandaki	87.4
Lumbini	81.0
Karnali	27.0
Sudurpashchim	58.9
Nepal	77.8

Source: NEA 2019

Figure 5.3-3 shows different sources of energy used by households for lighting. About 67 percent of households used electricity for lighting which was followed by kerosene (18 percent), solar (7 percent), and other sources.



Source: CBS 2012

Figure 5.3-3: Nepal—Households by Sources of Energy for Lighting

5.3.1.7 Culture

Nepal is rich in cultural resources. As per 2011 Population census, 123 languages are spoken as mother tongue. 44.4 percent of population has Nepali as their mother tongue. This is followed by Maithili (11.7 percent), Bhojpuri (6 percent), Tharu (5.8 percent), Tamang (5.1 percent), Newar (3.2 percent), Magar (3.0 percent), and others. Ten types of religion are practices in Nepal. Hinduism is the main religion (81 percent of population), which is followed by Buddhism (9 percent), Islam (4.4 percent), Kirat (3.1 percent), Christianity (1.4 percent), and others. Places of worships, burial sites, and chautaras (resting places) are scattered all over Nepal. Nepal has 10 world heritage sites and 10 Ramsar sites.

Major festivals celebrated in Nepal include: Bada Dashain, Chaite Dashain, Tihar, Lhosar, Teej, Rishi Panchami, Shiva Ratri, Bala Chaturdasi, Ram Nawami, Krishna Janmashtami, Thulo Ekadashi, Janai Purnima, Maghe Sakranti, Saune Sakranti, Baishake Purnima, Kuse Ausi, Phagu Purnima, Dhanya Purnima, Bala Chatrudasi, Chandi Purne, Kartike Purnima, Yomari Purne, Eid al-Fitr and Christmas.

5.3.2 Affected Districts

The ETP Project affects ten districts of Nepal. Six of these districts lie in Bagmati Province, two lie in Gandaki Province, and two in Lumbini Province. Brief profiles of affected districts are provided below. These profiles draw on the National Population and Housing Census 2011 data and various district level publications.

5.3.2.1 Demography

The total population of 10 ETP districts is 4,874,013 (12,849,041 males and 13,645,463 females), which is about 18.3 percent of the total population of Nepal (Figure 5.3-4).

Women constitute about 51.0 percent of the total population. Average population density for all 10 districts is 70 persons per square kilometer. Population density is highest in Kathmandu district and lowest in Sindupalchowk district. The average household size is 4.35. The average sex ratio is 96.27 percent. Sex ratio is highest for Kathmandu and lowest for Palpa.

Table 5.3-4: Demographic Information of ETP Districts

District	Area (Square km)	TL Length (km)	Households (km)	Population Total	Population Density	Sex Ratio
Nawalparasi West	1313.16	33.7	61859	331,904	47.11	94.09
Nawalparasi East	1118.9	8.4	66934	311,604	59.82	84.57
Palpa	1373	26.4	59291	261,180	43.18	79.70
Tanahu	1546	71.4	78309	323,288	50.65	79.73
Chitwan	2238.39	7.5	132462	579,984	59.18	92.75
Dhading	1926	55.7	73851	336,067	38.34	88.55
Makawanpur	2426	40.3	86127	420,477	35.5	96.67
Nuwakot	1121	55.6	59215	277,471	52.82	91.78
Sindupalchowk	2542	10.1	66688	287,798	26.23	92.58
Kathmandu	395	4.8	436344	1,744,240	1104.67	109.84
Total	15999.45	313.9	1121080	4,874,013	70.07	96.27

Source: CBS 2012 (www.cbs.gov.np)

5.3.2.2 Caste and Ethnicity

Table 5.3-5 presents caste/ethnicity distribution of population. Hill Brahmin is the dominant caste/ethnic group followed by Chettri, Tamang, Newar, Magar, and others. There are variations among districts. Tamang is the dominant caste/ethnic group in Sindupalchowk, Nuwakot, Dhading, and Makawanpur. Magar is the dominant caste/ethnic group in Tanahu, Palpa, and Nawalparasi (East of Bardaghat Susta), and Nawalparasi (West of Bardaghat Susta).

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Table 5.3-5: Caste/Ethnicity Composition of Population in ETP Districts (Percent of Total Population)

District	Brahman-Hill	Chettri	Tamang	Magar	Newar	Gurung	Rai	Chepang	Tharu	Kami	Damai/Dholi	Sarki	Others
Kathmandu	23.51	19.94	11.03	4.02	21.97	2.62	2.28	0.03	1.06	1.06	0.71	0.35	11.44
Sindupalchowk	10.33	18.23	34.25	1.71	11.11	1.02	0.06	0.00	0.00	3.88	1.90	1.53	15.99
Nuwakot	18.94	12.60	42.84	2.30	7.44	1.03	3.59	0.00	0.05	3.16	1.73	1.72	4.60
Dhading	14.98	14.72	22.09	8.52	9.40	5.54	0.66	4.31	0.08	4.18	2.54	4.83	8.13
Makawanpur	14.09	10.71	47.82	4.51	6.20	0.68	1.90	4.57	0.26	2.88	0.83	0.35	5.19
Chitwan	28.56	11.36	7.97	4.83	5.22	6.75	0.68	5.00	10.92	4.88	2.09	1.24	10.50
Tanahu	11.87	11.70	1.31	26.94	7.68	11.55	0.26	0.12	0.13	7.85	3.38	4.31	12.92
Palpa	17.46	7.90	0.08	52.30	3.46	0.22	0.05	0.00	0.20	6.72	1.95	3.18	6.47
Nawalparasi East	23.80	7.68	1.42	29.06	2.87	2.92	0.00	0.00	11.79	5.44	2.49	0.96	0.00
Nawalparasi West	11.57	4.83	0.52	17.46	1.08	1.94	0.00	0.00	11.79	4.16	1.00	0.45	31.67
Total	19.78	14.24	15.22	10.11	11.70	3.40	1.35	1.31	3.73	3.34	1.51	1.37	12.94

Source: CBS 2012

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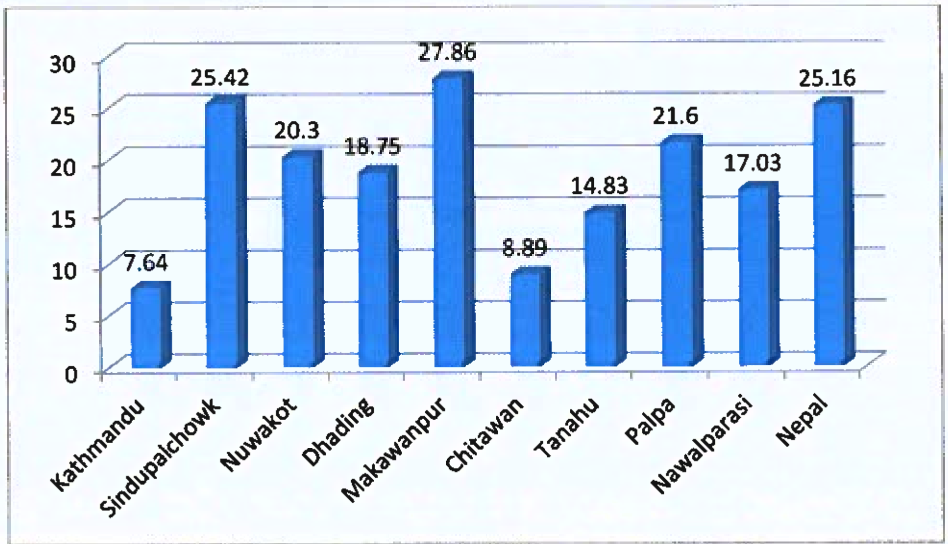
5.3.2.3 Poverty in ETP Districts

Poverty levels in most ETP districts were below national average (25.2 percent). Poverty levels in Sindupalchowk (25.4 percent) and Makawanpur (27.9 percent) exceeded national average. Poverty level was lowest in Kathmandu and highest in Makawanpur. However, the district level poverty rates may not reflect actual poverty rates of the ETP Project area. For example, even though the average district level incidence of poverty of Chitwan district is only 8.9 percent, the poverty level of Icchakamana rural municipality through which ETP transmission lines passes is expected to be much higher. Similarly, the incidence of poverty in Kailash and Rakshirang rural municipalities of Makwanpur district is expected to be higher than the district average.



Source: CBS and World Bank 2013

Figure 5.3-4: Incidence of Poverty in ETP Districts

5.3.2.4 Access to Electricity

Table 5.3.6 shows access to electricity from NEA grid and off-grid sources in ETP districts. Access to electricity was highest in Kathmandu district and lowest in Nawalparasi East district.

Table 5.3-6: Access to Electricity

District	Percent of Households with access to electricity
Nawalparasi (West of Bardaghat Susta)	85.1
Nawalparasi (East of Bardaghat Susta)	66.1
Palpa	75.9
Tanahu	89.3
Chitwan	83.2
Dhading	74.7
Makawanpur	78.6
Nuwakot	94.4
Sindupalchowk	87.9
Kathmandu	99.1

Source: NEA 2019

5.3.3 Affected Local Levels (Rural Municipalities (RM)/ Municipalities)

The ETP alignment affects 18 rural municipalities, 11 municipalities, and one sub-metropolis from 10 districts. This section presents profiles of affected local levels.

5.3.3.1 Nawalparasi District (West of Bardaghat Susta)

The ETP affects one rural municipality and three municipalities in this district.

Palhinandan Rural Municipality

This Rural Municipality (RM) covers an area of 44.7 square kilometers. This RM has 6 wards. The India Border to New Butwal (IB-NB) transmission line (TL) segment passes through three wards of this rural municipality (Wards 1, 2, and 3). Table 5.3-7 presents population and number of households of this rural municipality and wards traversed by ETP TL. There are 5,881 households in this rural municipality with a total population of 35,429. The total population of three affected wards is 17,909 (male: 8,705 and female: 9,204).

Ramgram Municipality

This municipality covers an area of 128.3 square kilometers. Ramgram municipality has 18 wards out of which six wards are traversed by the ETP TL. There were 10,282 household with a population of 56,845 in 2011 (Table 5.3-7). The sex ratio is 96. The total population of affected wards was 13,391.

Sunwal Municipality

This municipality covers an area of 139.1 square kilometers. It has 13 wards out of which three are affected by the ETP. In 2011, there were 12,018 households in this municipality with a total population of 55,790 (Table 5.3-7). The sex ratio is 85. There are 996 households with a population of 4,870 in the affected wards.

Bardaghat Municipality

This municipality covers an area of 162.1 square kilometers, including 13 wards, of which only one ward is affected by the Project (Table 5.3 7). The sex ratio was 84.4 for both the municipality and the affected ward.

Table 5.3-7: Households and Population of Affected Municipality/Rural Municipality of Nawalparasi (West of Bardaghat Susta)

Ward Number	Area (km^2)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Palhinandan Rural Municipality						
1		3.144	822	5,003	2,472	2,531
2		1.281	1,086	6,148	2,963	3,185
3		0.618	1,079	6,758	3,270	3,488
Total of the affected wards		5.403	2,987	17,909	8,705	9,204
Total of the RM	44.7	5.403	5,881	35,429	17,311	18,118
Ramgram Municipality						
1		0.613	414	2,214	1,092	1,122
8		1.175	384	2,125	1,009	1,116
11		1.162	294	1,586	759	827
12		1.553	405	2,107	1,036	1,071
13		0.856	260	1,429	695	734
17		4.996	927	5,359	2,626	2,733
Total of the affected wards		10.355	2,684	14,820	7,217	7,603
Total of the Municipality	128.3	10.355	10,282	56,845	27,852	28,993
Sunwal Municipality						
11		6.457	1,134	5,348	2,335	3,013
12		1.290	1,249	5,729	2,672	3,057
13		7.288	996	4,870	2,253	2,617
Total of the affected wards		15.03	2,130	10,218	4,588	5,630
Total of the Municipality	139.1	15.03	12,018	55,790	25,585	30,205
Bardaghat Municipality						
2		3.843	1,180	5,501	2,518	2,983
Total of the affected wards		3.843	1,180	5,501	2,518	2,983
Municipality Total	162	3.843	13,415	61,472	28,137	33,335

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

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5.3.3.2 Nawalparasi (East of Bardaghat Susta)

The ETP affects only one rural municipality in this district.

Binayee Tribeni Rural Municipality

This RM covers about 288.1 square kilometers of area which is about 22 percent area of the district. It has seven wards out of which only two wards are are affected by the ETP TL. Table 5.3-8 presents the number of households and population of this RM. There are a total of 6,918 households with a total population of 32,943 (male: 14,774 and female: 18,169). The population of affected wards constituted about 25 percent of the total population of the municipality. Major caste/ethnic groups include Magar, hill Brahmin, Chettri, Kami, Kumal, Newar, Damai, Gurung, Sarki, Tamag, ana Tharu. Dumkibas and Tribeni are major market centres in this RM.

Table 5.3-8: Households and Population of Bianyee Tribeni Rural Municipality

Ward Number	Area (km²)	TL Length (km)	Households (Number)	Population		
				Total	Male	Female
3		1.492	953	4,927	2,181	2,746
5		6.830	611	3,340	1,540	1,800
Total of the affected wards		8.322	1564	8,267	3,721	4,546
RM Total	288.1	8.322	6,916	32,943	14,774	18,169

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.3 Palpa District

The ETP alignment affects one rural municipality and one municipality in this district.

Nisdi Rural Municipality

This rural municipality is located at southeastern part of Palpa district. It covers an area of 194.5 square kilometers. There are 7 wards in this rural municipality, out of which 3 are affected by the ETP. Table 5.3-9 presents number of households and population of the RM and its affected wards. There are 3,891 households with a population of 22,661 (Female: 12,396; Male: 10,215). 86 percent of the population belong to Magar ethnic group which is followed by Dalits (7.1 percent), Brahmin/Chettri (3.0 percent), Newar (1.1 percent), and others (1.9 percent).

Nisdi khola, Arungkhola, and Boudikhola are major rivers flowing through this RM. None of the households in the entire gaunpalika are connected to national grid yet. However, there are 4 micro-hydro and 20 peltric sets with an installed capacity of 66.3 kW that are providing electricity to parts of this RM. There is also a 1200 watt wind power plant that provides electricity to Nisdi rural municipality office and health post nearby. A community rural electrification scheme is trying to bring national grid connection.

Rampur Municipality

Rampur municipality covers an area of 123.34 square kilometers. There are 10 wards in this municipality, out of which 4 are within the NB-ND TL Project area. Table 5.3-9Table 5.3-9: presents the number of households and population in affected wards.

This municipality has 8,132 households with a population of 35,396 (female: 19,958 and male: 15,438). Sex ratio is 77.35. Major caste/ethnicity groups include Magar (29 percent); Brahmin (25 percent); Thakuri (7 percent); Newar (7 percent); Kami (7 percent); Kumal (6 percent); Chettri (5 percent); Sarki (3 percent); and others. Dalits (Kami, Sarki, and Damai) constitute about 13 percent of population.

Located along the banks of Kaligandaki River, Rampur is a fertile vally surrounded by hills. It has good irrigation facility. This municipality has good fair-weather road connections to Siddhartha, Prithvi, and the East-West Highways.

Table 5.3-9: Households and Population of Affected Municipality/Rural Municipality of Palpa District

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Nisdi Rural Municipality						
5	20.52	4.448	751	3,824	1,655	2,169
6	23.77	5.620	453	2,545	1,150	1,395
7	43.43	6.039	576	3,754	1,711	2,043
Total of the affected wards	87.72	16.107	1780	10,123	4,516	5,607
RM Total	194.49	16.107	3,891	22,611	10,215	12,396
Rampur Municipality						
1	17.89	1.944	1,000	4,266	1,815	2,451
2	12.27	3.992	437	2,014	855	1,159
3	16.56	2.677	871	3,734	1,625	2,109
4	9.58	1.723	885	3,831	1,652	2,179
Total of the affected wards	56.3	10.336	3,193	13,845	5,947	7,898
Municipality Total	123.34	10.336	8,132	35,396	15,438	19,958

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.4 Tanahu District

The ETP affects one municipality and four rural municipalities in this district.

Ghiring Rural Municipality

This rural municipality covers an area of 126 square kilometers. There are total 5 wards, out of which 4 are affected by the ETP. In 2011, there were 4,137 households in this RM with a total population of 19,318 (Table 5.3-10). Population of the affected wards was about 77 percent of total population of the RM.

Rishing Rural Municipality

This rural municipality covers an area of 215 square kilometers. There are total 8 wards in this RM, out of which 4 are affected by the ETP TL. Table 5.3-10 presents the number of households and population of the RM and its ETP affected wards. Population of the affected wards was about 49 percent of the total population of the RM.

Vyas Municipality

This municipality is located at about 50 kilometers east of Pokhara. The headquarters of Tanahu district, Damauli, is lies in this municipality. It covers an area of 248 square kilometers. There are total 14 wards in this municipality, out of which three wards are affected by the ETP.

There are 18,339 households with a total population of 70,335 (female: 39,075 and male: 31,260). Sex ratio is 80. Caste/ethnicity distribution includes Magar (19.5 percent); Brahmin (15.2 percent); Chettri (13.7 percent); Gurung (8.8 percent); Newar (8.7 percent); Kami (7.6 percent); Darai (4.4 percent); Sarki (4.4 percent); Damai (3.6 percent); Thakuri (1.8 percent); Musalman (2.4 percent); Kumal (1.8 percent); Bote (1.1 percent); Sanyasi (1.0 percent); Dura (0.9 percent); and others (5.9 percent).

Bandipur Rural Municipality

Bandipur RM is named after Bandipur, a famous hilly touristic town in Nepal. It covers an area of 102 square kilometers. It has 6 wards out of which 4 wards are affected by the ETP (Table 5.3-10). It has a total population of 20,013. The total population of four affected wards is 3,074. The total length of the ETP transmission line in this municipality is 7.0 kilometer.

Abukhaireni Rural Municipality

This RM covers an area of 128 square kilometers and six wards. Prithvi Highway passes through this RM. Chhimkeswori temple is located in this RM. The total length of ETP transmission line in this municipality is 16.6 kilometer. The total population of the RM is 20,768.

Table 5.3-10: Households and Population of Affected Municipality/Rural Municipality of Tanahu District

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Ghiring Rural Municipality						
1	19.26	1.431	981	4,189	1,815	2,374
2	31.39	5.520	757	3,617	1,550	2,067
3	22.64	5.944	753	3,532	1,493	2,039
5	11.79	5.902	767	3,624	1,492	2,132
Total of the affected wards	85.08	18.797	3258	14,962	6,350	8,612
RM Total	126	18.797	4,137	19,318	8,225	11,093
Rishing Rural Municipality						
1	28.37	5.443	744	4,075	1,810	2,265
7	23.14	3.633	710	3,295	1,307	1,988
6	18.16	2.846	568	2,912	1,248	1,664
8	14.27	3.533	508	2,475	1,049	1,426
Total of the affected wards	83.94	15.455	2530	12,757	5,414	7,343
RM Total	215	15.455	5,215	25,870	11,140	14,730
Vyas Municipality						
1	8.92	0.545	2,460	8,932	3,942	4,990
13	26.07	5.778	979	3,978	1,815	2,163
14	24.49	2.328	703	2,825	1,217	1,608
Total of the affected wards	59.48	8.651	4,142	15,735	6,974	8,761
Municipality Total	248	8.651	18,339	70,335	31,260	39,075
Bandipur Rural Municipality						
2	18.02	1.269	982	4,065	1,806	2,259
3	15.52	2.217	575	2,424	1,098	1,326
4	10.5	0.451	984	3,944	1,812	2,132
6	30.47	3.101	533	2,336	1,000	1,336
Total of the affected wards	74.51	7.038	3074	12,769	5,716	7,053
RM Total	102	7.038	4,853	20,013	9,048	10,965
Abukhaireni Rura Municipality						
4	21.93	5.920	448	2,264	1,057	1,207

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Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
5	26.05	3.143	356	1,887	841	1,046
6	34.65	7.583	521	2,499	1,090	1,409
Total of the affected wards	82.63	16.645	1325	6,650	2,988	3,662
RM Total	128	16.645	4,911	20,768	9,504	11,264

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.5 Chitwan District

The ETP affects only one rural municipality in this district.

Icchyakamana Rural Municipality

This RM covers an area of 166.7 square kilometers. It has 7 wards, out of which 4 are affected by the ETP transmission line. Population of affected wards constitute about 57.5 percent of total population of the RM (Table 5.3-11). Chepang (33.3 percent) is the largest caste/ethnic group, followed by Gurung (26.7 percent) and Magar (12.0 percent). Indigenous people constitute more than 80 percent of total population of this RM. Ichhyakamana Temple is located in this RM. Muglin is the main market centre.

Table 5.3-11: Households and Population of Ichhakamana Rural Municipality

Ward Number	Area (km²)	TL length (km)	Households (Number)	Population		
				Total	Male	Female
2	37.48	3.497	622	3,544	1,821	1,723
3	21.29	0.276	651	3,153	1,573	1,580
5	13.14	2.219	835	3,982	1,990	1,992
6	31.48	1.596	652	3,694	1,815	1,879
Total of the affected wards	103.39	7.588	2760	14,373	7,199	7,174
RM Total	166.73	7.588	4,778	25,002	12,460	12,542

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.6 Dhading District

The ETP affects one municipality and five rural municipalities in this district.

Benighat Rorang Rural Municipality

This RM covers an area of 192.94 square kilometers (Table 5.3-12). There are total 10 wards in this RM, out of which 8 wards are affected by ETP transmission line. Total area of affected wards is about 74 percent of the total area of this RM. The total population of this rural municipality is 31,475. Population of affected wards constitutes about 78 percent of rural municipality population. Chepang is the largest caste/ethnic group with 31.6 percent of total population which is followed by hill Brahmin (11.2 percent), Chettri (10.5 percent), Tamang (10.2 percent), Magar (8.4 percent), Newar (7.0 percent), Kami (4.9 percent), Gurung (4.0 percent), Damai/Dholi (3.0 percent) and Sarki (2.6 percent).

Gajuri Rural Municipality

This RM covers an area of 138.66 square kilometers (Table 5.3-12). There are total 8 wards, out of which only one ward is affected by the ETP. The total population of the RM is 27,084. Tamang is the largest caste/ethnic group with 25.5 percent of the population followed by Chettri (16.5 percent), Hill Brahmin (14.5 percent), Chepang/praja (14.5 percent), Dalits (11.5 percent), Newar (5.6 percent), Magar (5.1 percent) and others. The population of affected ward is about 14 percent of the total population of the rural municipality.

Nilakantha Municipality

This municipality covers an area of 197.7 square kilometers (Table 5.3-12). There are total 14 wards in this municipality, out of which only one ward is affected by the ETP. The total population of the municipality is 58,515. Newar is the largest caste/ethnic group with 17.6 percent of population followed by Hill Brahmin (16.4 percent), Gurung (16.4 percent), Dalits (13.3 percent), Chettri (12.0 percent), Magar (10.6 percent), Tamang (7.7 percent), and others.

Siddhalekh Rural Municipality

This RM covers an area of 106.35 square kilometers (Table 5.3-12). There are total 7 wards in this rural municipality, out of which two are affected by the ETP. The total population of the RM is 23,729. Magar is the largest caste/ethnic group with 19.6 percent of population followed by Dalits (18.3 percent), Hill Brahmin (18.3 percent), Newar (16.5 percent), Chettri (7.1 percent), Ghale (6.2 percent), and others.

Galchhi Rural Municipality

This RM covers an area of 118.82 square kilometers (Table 5.3-12). There are total 8 wards, out of which two are affected by the ETP. The total population of the RM is 25,655. Tamang is the largest caste/ethnic group with 22.4 percent of population followed by Hill Brahmin (18.4 percent), Dalits (16.7 percent), Chettri (14.5 percent), Magar (12.2 percent), Newar (7.9 percent), Gharti/Bhujel (3.1 percent), and others.

Thakre Rural Municipality

There are total 11 wards in this RM, out of which 4 are affected by the ETP. The total population of the RM is 32,914. Tamang is the largest caste/ethnic group followed by 35.87 percent of population followed by Chettri (21.0 percent), Hill Brahmin (19.3 percent), Dalits (6.7 percent), Magar (3.4 percent), Newar (3.1 percent), Rai (2.8 percent), Gharti/Bhujel (2.1 percent), and others.

Table 5.3-12: Number of Households and Population of Affected Municipality/Rural Municipality of Dhading District

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Benighat Rorang Rural Municipality						
3	10.88	1.965	884	3,895	2,002	1,893
4	18.99	4.042	474	2,452	1,205	1,247
5	11.21	0.150	765	3,370	1,647	1,723
6	20.73	0.647	418	2,299	1,131	1,168
7	9.52	3.734	518	2,479	1,217	1,262
8	23.43	2.599	425	2,412	1,200	1,212
9	19.04	1.680	631	3,223	1,599	1,624
10	28.17	8.678	811	4,521	2,243	2,278
Total of the affected wards	141.97	23.495	4926	24,651	12,244	12,407
RM Total	192.94	23.495	6,169	31,475	15,660	15,815
Gajuri Rural Municipality						
2	15.93	2.965	792	3,742	1,855	1,887
Total of the affected wards	15.93	2.965	792	3,742	1,855	1,887
RM Total	139.28	2.965	5,600	27,084	13,311	13,773
Nilakantha Municipality						
5	20.88	2.663	994	4,588	2,084	2,504
Total of the affected wards	20.88	2.663	994	4,588	2,084	2,504
Municipality Total	197.7	2.663	13,984	58,515	26,510	32,005
Siddhalekh Rural Municipality						
6	18.79	3.279	629	2,944	1,372	1,572
7	15.3	4.745	854	3,992	1,869	2,123
Total of the affected wards	34.09	8.024	1483	6,936	3,241	3,695
RM Total	106.35	8.024	5,138	23,729	10,965	12,764
Galchhi Rural Municipality						
2	14.84	2.034				
3	10.71	3.391				
8	23.22	4.292	694	3,434	1,653	1,781
Total of the affected wards	29.55	9.717	694	3,434	1,653	1,781

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
RM Total	118.82	9.717	5,410	25,655	12,342	13,313
Thakre Rural Municipality						
1	9.76	2.5	555	2,785	1,363	1,422
2	10.44	3.087	893	4,572	2,261	2,311
3	16.09	2.675	697	3,429	1,699	1,730
11	11.07	0.219	439	2,129	1,043	1,086
Total of the affected wards	47.36	8.481	2584	12,915	6,366	6,549
RM Total	96.41	8.481	6,927	32,914	16,053	16,861

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.7 Makawanpur District

The ETP affects one sub-metropolis, one municipality, and two rural municipalities in this district.

Thaha Municipality

Thaha Municipality is located about 65 kilometers from Kathmandu. Tribhuvan Highway passes through this municipality. This municipality is blessed with popular tourist destinations such as Daman and Simbhanjyang, and fertile land in Palung valley. Table 5.3-13 presents area, number of households, and population. There are total 12 wards in this municipality, out of which only one ward affected by the ETP. Major caste/ethnic groups include Tamang (46.8 percent), Newar (20.0 percent), Chettri (19.6 percent), Brahmin (4.4 percent), Magar (2.1 percent), Kami (1.6 percent) and Gurung (1.2 percent).

Kailash Rural Municipality

There are total 10 wards in this rural municipality, out of which 5 are affected by the ETP (Table 5.3-13). This RM has a total population of 23,922. Major caste/ethnic groups include Tamang (67.2 percent), Chepang (16.9 percent), Chettri (4.6 percent), Magar (2.4 percent), Kami (2.6 percent), and Gurung (2.1 percent).

Raksirang Rural Municipality

This RM covers an area of 226.7 square kilometers (Table 5.3-13). There are total 9 wards in this rural municipality, out of which only one ward is affected by the ETP. The total population of the RM is 26,192. Major caste/ethnic groups include Tamang (50.5 percent), Chepang (37.4 percent), Chettri (3.9 percent), Kami (2.5 percent), and Magar (1.7 percent).

Hetauda Sub-Metropolis

There are total 19 wards in this Sub-metropolis, out of which 4 are affected by the ETP. The total population of this sub-metropolis is 152,875. Major caste/ethnic group include Tamang

(30.9 percent), Brahmin (26.4 percent), Chettri (13.8 percent), Newar (8.7 percent), Magar (4.3 percent), Kami (3.1 percent), Rai (2.0 percent), and Musalman (1.0 percent).

Table 5.3-13: Households and Population of Affected Municipality/Rural Municipality of Makawanpur District

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Thaha Municipality						
8	21.31	5.098	659	3,272	1,584	1,688
Total of the affected wards	21.31	5.098	659	3,272	1,584	1,688
Municipality Total	191.12	5.098	8,928	41,623	19,811	21,812
Kailash Rural Municipality						
3	14.65	2.219	357	2,191	1,125	1,066
4	19.46	5.167	439	2,532	1,259	1,273
5	43.51	4.656	544	3,009	1,456	1,553
6	16.31	5.224	439	2,336	1,142	1,194
Total of the affected wards		17.266	2351	13,102	6,502	6,600
RM Total	204.48	17.266	4,263	23,922	11,943	11,979
Raksirang Rural Municipality						
1	22.63	4.801	445	2,669	1,297	1,372
Total of the affected wards		4.801	445	2,669	1,297	1,372
RM Total	226.7	4.801	4,557	26,192	13,110	13,082
Hetauda Sub-Metropolis						
1	14.86	0.036	331	1,831	931	900
3	15.56	5.718	1,422	6,453	3,070	3,383
11	9.66	3.076	1,708	7,863	3,889	3,974
19	47.04	3.326	1,728	8,550	4,208	4,342
Total of the affected wards		12.15	5189	24,697	12098	12599
Sub-Metropolis Total	261.59	12.15	34,270	152,875	74,964	77,911

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

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5.3.3.8 Nuwakot District

The ETP affects one municipality and four rural municipality in this district.

Tarakeswor Rural Municipality

This RM covers an area of 72.6 square kilometers. There are total 6 wards, out of which two are affected by the ETP (Table 5.3-14: The RM has a total population of 15,719. Major caste/ethnic groups include Tamang (38.1 percent), Brahmin (25.4 percent), Newar (11.2 percent), Chettri (8.1 percent), Magar (3.6 percent), and Dalits (9.4 percent).

Belkotgadi Municipality

Belkotgadi municipality covers an area of 155.6 square kilometers (Table 5.3-14). It has 13 wards out of which ETP passes through 8 wards. The total population of affected wards constitute about 54 percent of the population of this municipality. Major caste/ethnic groups include Brahmin (40.5 percent), Tamang (29.8 percent), Chettri (8.6 percent), Newar (5.2 percent), Rai (4.5 percent), and Dalits (7.3 percent).

Likhu Rural Municipality

This RM covers an area of 47.9 square kilometers (Table 5.3-14). It has six wards out of which ETP passes through three wards. There were 3,629 households with a total population of 16,852. Major caste/ethnic groups include Rai (25.4 percent), Brahmin (22.5 percent), Chettri (14.0 percent), Newar (12.0 percent), Tamang (8.4 percent), and Magar (7.6 percent).There were 8,069 people in three affected wards, which is about 48 percent of RM population.

Panchakanya Rural Municipality

Panchakanya RM covers an area of 53.5 square kilometers (Table 5.3-14). It has five wards out of which ETP passes through only one ward. There were 3,321 households with a total population of 15,945 in 2011. The affected ward (ward 5) covers an area of 14.4 square kilometers and has total population of 3,238. Major caste/ethnic groups include Tamang (28.6 percent), Chettri (28.2 percent), Brahmin (13.6 percent), Rai (7.6 percent), and Dalits (8.3 percent).

Shivapuri Rural Municipality

This RM is located at southeastern part of Nuwakot. It covers an area of 101.5 square kilometers (Table 5.3-14). It has eight wards out of which ETP passes through five wards. The total length of transmission line within this rural municipality is 15.0 kilometers. The total population is 20,769. Major caste/ethnic groups include Tamang (57.0 percent); Chettri (13.8 percent); Brahmin (11.8 percent); Gurung (5.5 percent); Newar (5.5 percent); Kami (2.3 percent); Damai (1.8 percent); and Magar (1.2 percent).

Table 5.3-14: Households and Population of Affected Municipality/Rural Municipality of Nuwakot District

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
Tarakeswor Rural Municipality						
2	7.67	3.385	505	2,432	1,143	1,289
4	17.01	1.279	639	2,804	1,269	1,535
Total of the affected wards	24.68	4.664	1144	5,236	2,412	2,824
RM Total	72.62	4.664	3,511	15,719	7,034	8,685
Belkotgadi Municipality						
12	10.04	3.103	519	2,666	1,334	1,332
10	8.72	1.935	582	2,926	1,448	1,478
9	10.24	1.458	581	3,104	1,495	1,609
8	11.39	3.870	690	3,182	1,497	1,685
7	11.51	7.206	822	3,793	1,769	2,024
6	14.29	0.166	553	2,872	1,396	1,476
5	9.62	2.872	689	3,310	1,543	1,767
Total of the affected wards	75.81	20.61	4,436	21,853	10,482	11,371
Municipality Total	155.6	20.61	8,099	40,698	19,602	21,096
Likhu Rural Municipality						
3	10.82	5.650	692	3,654	1,717	1,937
5	5.24	2.341	393	1,815	841	974
6	9.72	4.114	619	2,600	1,241	1,359
Total of the affected wards	25.78	12.105	1,704	8,069	3,799	4,270
RM Total	47.88		3,629	16,852	7,807	9,045
Panchakanya Rural Municipality						
5	14.44	2.761	705	3,238	1,569	1,669
Total of the affected wards	14.44	2.761	705	3,238	1,569	1,669
RM Total	53.47	2.761	3,321	15,945	7,711	8,234
Shivapuri Rural Municipality						
1	20.35	4.187	688	2,976	1,402	1,574
2	9.73	2.618	448	2,085	1,005	1,080
5	16.52	5.291	788	3,524	1,629	1,895

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Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
7	10.4	0.254	533	2,449	1,197	1,252
8	12.14	2.607	592	2,638	1,264	1,374
Total of the affected wards	69.14	14.957	3,049	13,672	7,899	7,175
RM Total	101.5	14.957	4,676	20,769	9,752	11,017

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.3.9 Sindhupalchok District

The ETP affects only one municipality in this district.

Melamchi Municipality

This municipality covers an area of 158.2 square kilometers (Table 5.3-15). There are total 13 wards in this in this municipality, out of which four are affected by the ETP. About 10.1 kilometer of ETP transmission line passes through wards 1, 2, 3, and 4 of this municipality. There are 10, 097 households in the municipality with a total population of 45,343 (female: 21,729 and male: 23,614). Tamang is the largest caste/ethnic group with 32.3 percent of total population followed by Chettri (25.4 percent), Brahmin (20.3 percent), Dalit (9.1 percent), Newar (4.1 percent), Danuwar (3.0 percent), Majhi (2.1 percent) and others.

Table 5.3-15: Households and Population of Melmachi Municipality

Ward Number	Area (km²)	TL Length	Households (Number)	Population		
				Total	Male	Female
1	9.33	2.802	722	3,171	1,497	1,674
2	4.4	1.222	352	1,581	769	812
3	14.53	1.578	576	2,484	1,174	1,310
4	19.13	4.480	718	3,439	1,563	1,876
Total of the affected wards	47.39	10.082	2368	10,675	5,003	5,672
Municipality Total	158.17	10.082	10,097	45,343	21,729	23,614

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

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5.3.3.10 Kathmandu District

The ETP affects only one municipality in this district.

Shankharapur Municipality

This municipality is located at the northeastern part of Kathmandu district. It covers an area of 60.2 square kilometers. There are nine wards in this municipality, out of which three are affected by the ETP transmission line.The total population of the municipality was 25,338 (Table 5.3-16). The population of the affected wards is 7,943. Hill Brahmin is the largest caste/ethnic group with 23.5 percent of population, followed by Newar (22.0 percent), Chettri (19.9 percent), Tamang (11.0 percent), Magar (94.0 percent), Gurung (2.6 percent), Rai (2.3 percent), and others.

Table 5.3-16: Households and Population of Shankharapur Municipality

Ward Number	Area (km²)	TL Length (Km)	Households (Number)	Population		
				Total	Male	Female
1	15.96	1.899	830	4,047	1,991	2,056
2	8.18	1.283	392	1,860	897	963
3	10.18	1.575	463	2,036	1,005	1,031
Total of the affected wards	34.32	4.757	1685	7,943	3,893	4,050
Municipality Total	60.21	4.757	5,406	25,338	12,346	12,992

Source: www. cbs.gov.np/population-of-753-local-unit/; Area from municipality websites; TL length – Project calculation.

5.3.4 Socioeconomic Profile of TL Impact Area: Analysis of Aggregated Field Survey Data

Field surveys were conducted in the Project Area of Direct and Indirect Impact (affected municipalities and wards) to collect primary information needed to prepare socioeconomic and cultural baseline using methodology outlined in Chapter 3. The survey tools included household surveys, focus group discussions, and key informant interviews. Figure 5.3.5 shows locations of settlements where surveys were conducted. In addition, a household census was conducted for 101 households who would be affected by the acquisition of land for Ratmate Substation. Sections 5.3.4 to 5.3.9 present a socioeconomic profile of the Project area.

5.3.4.1 Demographic Profile

The aggregated household survey data, covered 2,435 people in 499 households in the ETP affected area. The average household size is 5.5 and the sex ratio is 105.8 percent. Caste/ethnic composition of the surveyed households includes Adivasi Janajati (63 percent); Brahmin/Chettri (13 percent); Dalit (8 percent); Newar (5 percent); and others (9 percent), of which the Terai/Madhesi caste groups comprised 4 percent.

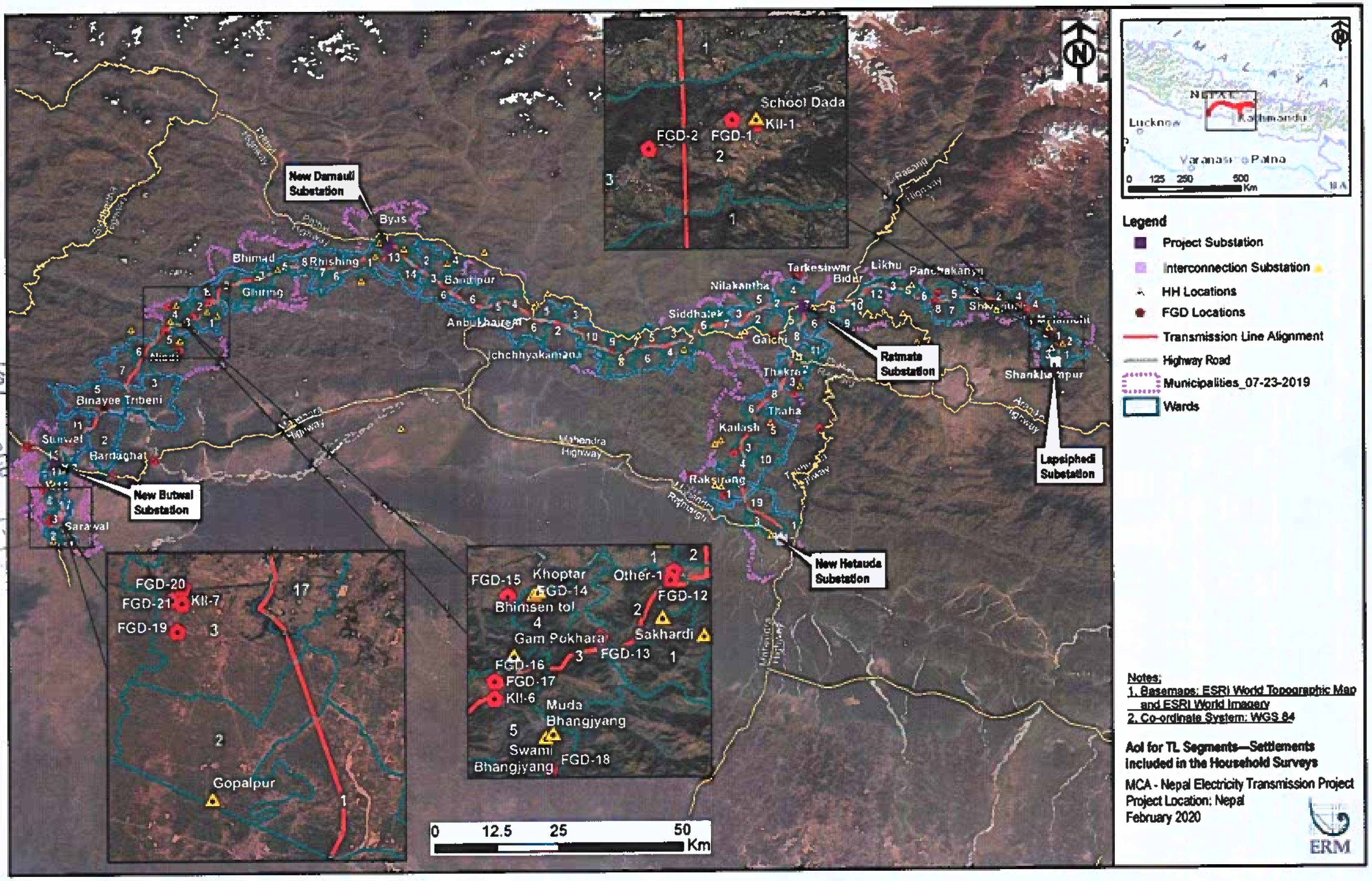


Figure 5.3-5: Project area for TL Segments—Settlements Included in the Household Surveys

5.3.4.2 Basic Services

Drinking Water

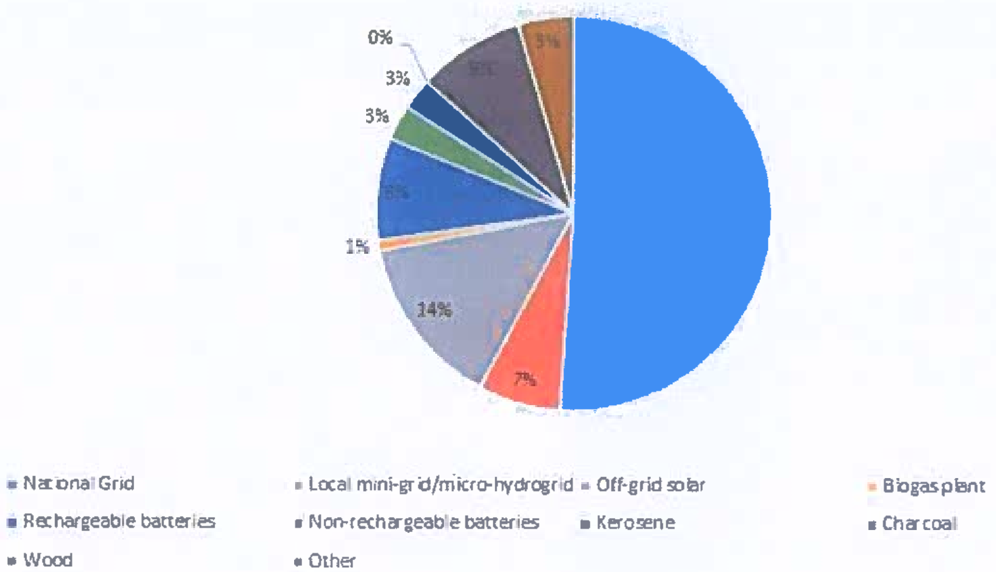
Sources of drinking water for households surveyed are as follows: piped private taps (62 percent); public taps (21 percent); hand pumps (7 percent); river/stream (8 percent); well (1 percent); and other sources (1 percent).

Sanitation

91 percent of surveyed households had access to toilet facilities, of which 69 percent had modern/semi-modern toilet facilities.

Sources of Energy

58 percent of surveyed households reported use of the electricity from grid and off-grid sources for lighting (Figure 5.3-6).



Source: Household Survey 2019

Figure 5.3-6: Households by Sources of Energy for Lighting

5.3.4.3 Economy

Land Ownership

In the population surveyed, 98 percent of the households had access to land, whether owned or rented. Approximately 74 percent of the households that had access to land, reported using their own land, while 17 percent of the households reported a share cropping or agreement for use of land, followed by 3 percent of the households reporting a rent agreement for cultivation of land not belonging to the cultivators.

Of the 46 households that reported no ownership of land (landless households), 29 were Adivasi Janajati, 4 Dalit and the remaining were from other caste/ethnic groups.

Occupation & Livelihood

Most men in the surveyed households reported farming as their primary occupation (Table 5.3-17). Almost all women reported housework as their primary occupation.

Table 5.3-17: Primary Occupation by Gender

Primary Occupation	Males	Females
Farming	300	54
Homemaker[1]	0	333
Foreign Employment	10	No data
Skilled Labour	12	01
Wage Labour	25	02
Unskilled Labour	17	04
Retail trade	05	02
Livestock rearing	09	02
Government job	07	00
Regular salaried job	10	00
Retired	20	02

Source: Household Survey 2019

[1] The category "homemaker" includes women; regardless of marital status; who are engaged in unpaid household chores as a primary occupation.

Table 5.3.18 below provides a comparison of the reported livelihood across different social groups. As the table shows the dependence of Adivasi Janajati and Dalits on farming and foreign employment is higher than Brahmin-Chettri households. Brahmin/Chettri depended more on salaried jobs than other social groups, whereas Dalits depended more on wage labor than other social groups.

Table 5.3-18: Livelihood Profile by Social Groups

Ethnic/ Caste Group	Farming (%)	Handicrafts (%)	Salaried Job (%)	Business/ Trade (%)	Foreign Employment (%)	Fishing (%)	Wage Labor (%)	Livestock (%)	Informal Trade (%)	Pension (%)	Rental Income (%)	Others (%)
Brahmin/ Chettri	37.7	32.2	8.3	2.2	4.3	0.0	2.5	1.4	0.0	0.0	0.0	6.9
Dalit	42.5	36.2	4.8	1.4	7.7	0.0	3.9	0.0	0.0	0.0	0.0	0.0
Janajati	44.7	32.3	3.5	3.2	4.6	1.4	2.3	0.5	0.3	0.0	0.4	0.4
Newar	44.7	35.1	0.0	0.0	6.4	0.0	0.0	4.3	0.0	3.2	0.0	0.0
Other	50.4	32.2	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Terai/ Madhesi Other Castes	16.1	13.4	2.7	11.6	0.0	0.0	11.6	0.0	0.0	0.0	0.0	7.1

Source: Household Survey 2019

Common Property Resources

Common property resources (CPR) provide supplementary sources of livelihood and cultural services to people. Major CPRs along the ETP alignment area include forests (community, leasehold, and government managed), and rivers/springs. ETP transmission line passes through 112 community forests and 8 leasehold forests. These forests provide fuelwood, timber, materials for animal bed, roofing materials, and non-timber forest products to households living nearby. Livestock farming, amrisho plantation, bamboo plantation, livestock and vegetable farming is also practiced within leasehold forests.

Some ethnic groups such as Tamang and Gurung are highly dependent on forest for cultural practices. For example, Tamang community in Shivapuri rual municipality reported that they require a special tree for their religious ceremony which they obtain from nearby national forest. They also reported that many of the Tamang community have their "Gumba" (Buddhist temple) inside community forest. These gumba are basically the major religious and cultural sites of the Tamang community. In almost all the interaction with the forest user groups, they have reported that they do have their Gumba inside the Community Forest.

Household Income

Table 5.3-19 shows the sources of cash income and their relative contribution to overall incomes of the households surveyed. Remittances from family members working abroad was the primary source of household income. Household income repored in the table does not take account of production used for household consumption.

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Table 5.3-19: Sources of Income

SN	Income Source	Percentage of Total Household Income
1	Remittance from Abroad	28
2	Skilled work	19
3	Business	15
4	Government service	9
5	Private Service	9
6	Unskilled work	8
7	Other	12

Source: Household survey 2019

Household Expenditure

The households surveyed on an average reported food as their highest category of expenditure, with 24 percent of total expenditure arising from food related expenses (Table 5.3-20). This estimation was only for money-based transactions and were based on the respondent's recall. Loans were the second highest category of expenditure, with it contributing 15 percent to overall expenditure/outflows. Other major expense categories included education, healthcare, social functions, clothing, and transport.

Table 5.3-20: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Food	24
2	Interest and loans repayment	15
3	Education	12
4	Healthcare	10
5	Social functions	10
6	Clothing	9
7	Transport	7
8	Other	13

Source: Household survey 2019

5.3.4.4 Education

Literacy rate among surveyed population was 75 percent (male: 83 percent and female: 67 percent). Iliteracy was highest in Adivasi Janjati group. The highest level of education attained by household members was as follows: primary (35 percent), lower secondary (25 percent), secondary (23 percent), school leaving certificate (12 percent), graduate (4 percent), and post graduate (1 percent).

5.3.4.5 Health

Major health infrastructure in the Project area includes district hospitals, primary health care centres, and health posts. Female Community Health Volunteers (FCHV) are important part of health professionals. Households in the Project area have also access to modern health facilities in Kathmandu, Bharatpur, and Pokhara.

5.3.4.6 Gender & Social Inclusion

The sex ratio across the households surveyed was 106.

Differences in Education and Literacy for Men and Women

As indicated earlier, household survey results show that female literacy rate is lower than the male literacy rate. More girls drop out after the completion of primary schools than boys. Focus group discussions (FGD) with women during field survey highlight the following reasons (unranked) for higher drop-out rates for girls:

- Economic constraints of the household (making girls take up household work, care of younger siblings, and help with agricultural tasks) is considered a more productive use of their time, than attending school.
- If schools (especially secondary level schools) are not located within a reasonable (safe) walking distance from their home, girls tend to drop out. There are fewer secondary and higher secondary level schools in rural areas, so lack of proximity is a constraint for girls.
- It is conventionally acceptable for boys to be sent to schools with hostels (boarding schools), for higher education beyond the secondary level, whereas girls are usually not sent to boarding schools that are far away from their home, or distant ones that require additional transportation costs to be incurred.
- Marriage and motherhood, which typically occur at a relatively young age, is another reason identified for girls stopping education (usually at secondary level).
- In areas where schools do not have adequate provisions of girls' toilets with running water, girls will drop out or stop education when they reach puberty.

The above reasons have contributed to lower educational attainment among girls in Nepal, including in the Project area, and have long-term impacts on their ability to access economic and other opportunities (e.g., healthcare), participate in key decisions (whether at home or outside), hold and acquire assets, and take up leadership roles.

Occupation and Migration

Economic dependence of women on male members of the household is an impediment to their ability to make decisions and participate more equally in household affairs as well as in society, at large. While women carry the burden of (unpaid) household work, care of children and the elderly, and unpaid labor in agriculture and other primary occupations in rural areas, they have been identified to have low participation in key decisions within the household. A range of reasons have been identified through household surveys and FGDs for these trends, including:

- Limited formal education among women reduces their employment opportunities, particularly opportunities outside of agriculture;
- Rural women tend to know only their community dialect, which acts as a barrier when communicating with people outside of their community. This prevents women from moving outside of their settlement and seeking new employment opportunities; and
- Risk of human trafficking further restricts women's mobility outside of their settlement.

Ownership of Land and Assets

Only 19 percent of surveyed households reported female ownership of land. The following trends were observed during focus group discussions;

- In FGDs in rural areas, it was noted that women tend to own land in the absence of a male head of household, who may be deceased, working away from home, or away for other reasons for many years. This is as women are seen to be care-takers of inherited property, which most likely will be passed down to male children (who may not be of age). In households with male heads, it is rare for a female family member to own land. However, in urban or urbanizing areas, some women stated that they had come to have assets in their name in recent years, due to the change in regulations (where a discounted registration fee was charged if the land/asset was being registered in a women's name).
- Households dependent on foreign remittances from family members working outside the country will sometimes have women members who own land, as they are the ones who look after agriculture and land in the absence of their husbands. This money is invested in buying land as a means to provide economic security for the family when the migrants return to their village.
- Women who are single, widowed, divorced, separated/left, older adults, or disabled rarely come to inherit agricultural land or residential property, if a male heir is present in the family.
- Traditional norms (inheritance follows patrilineal succession) often continue to dictate how land, especially agricultural land, is bequeathed, among most ethnic groups in Nepal. Women have traditionally been excluded from decisions related to land and assets and are only now beginning to find some say in such matters, as reported in discussions in several areas along the TL Project area.
- When women separate from abusive husbands, especially in rural areas, they may not have the wherewithal to demand their share of assets and reportedly (as discussed during FGDs) find little support from their families. It was stated during consultations, that community groups, like CFUGs may make special concessions for such women and grant

them a bigger share of resources (e.g., firewood, fodder). This, however, is little recompense for the loss of their share in family land and assets.

Income and Access to Credit

Income and access to credit is another dimension of economic dependence where women are usually involved with non-paid work of economic value (e.g., agriculture, animal husbandry). Where they do earn money from paid jobs, (e.g., low-paid unskilled labor), their wage-rates are typically lower than those paid to men doing the same or similar work (e.g., construction work, agricultural and farm labor, etc.). The following trends were noted:

- The average family income is lower in female headed households than those headed by men, in 4 out of 9 districts in the Project area, based on data from the household survey.
- Although women spend significantly greater time undertaking farm-based activities when compared to men, the monetary gains from the sale of farm-products are negotiated, collected, and retained by the men in the family.
- Although most women consulted along the TL Project area said they were consulted and participated in decisions at the household level, they were rarely involved in decisions relating to big expenditure (like purchase/ sale of cattle or vehicle).
- Women reported having bank accounts only when they are part of a Self-Help Group, Farmers Group, or other similar groups or cooperatives, as it is a condition of the collective. Whereas men tend to have individual bank accounts for personal transactions. In the Terai region, more women who were Self Help Group or Farmer Group members regularly accessed the bank, when compared to men. Most women reported accessing SHGs for small loans whereas men (depending on the region) borrowed from local money lenders or cooperative banks.

The reasons identified for the above trends include the following:

- This continues and reinforces the traditional normative systems and gender roles, where men deal with money, income, and expenditure.
- Most women do not own assets to put up as collateral for a bank loan. Most women who had taken loans in the Project area had only taken small loans that they could easily secure through SHGs or Farmer Groups.

Trafficking in Persons

About 21 percent of the surveyed households have heard or know of cases of TIP pertaining to women for the sex trade than other type of reason. Among the 96 known cases, it showed that 65 of the trafficking victim for sex trade were women, 29 were children and only 2 were men. Similarly, the 41 known cases of trafficking for labor showed, 12 victims were women, 13 were children and 16 were men. A clear potential Project related TIP risk is associated with demand for sex workers, and also unfair working conditions specifically towards unskilled women or involving of a child as labor.

Social Inclusion

Major indigenous groups in the Project area include Tamang, Magar, Newar, Gurung, Rai, Chepang, and Tharu. Major Dalit groups in the Project area include Kami, Damai/Dholi, Sarki, and Chamar/Harijan.

5.3.4.7 Culture

Nepali was the primary language (mother tongue) for 59 percent of the households surveyed followed by Tamang (18 percent), Magar (7 percent), Chepang (5 percent).[3]

5.3.5 Socioeconomic Analysis for India Border to New Butwal Substation TL Segment

This section presents the socioeconomic status for the Indian Border to New Butwal substation (IB–NB) TL Segment. The IB–NB Segment is entirely contained within one district, Nawalparasi (West of Bardaghat Susta) district, and includes nine wards across one rual municipality (Palhinandan) and two municipalities (Ramgram and Sunwal).

5.3.5.1 Demographic Profile

In this TL segment, 40 households were surveyed as part of the socioeconomic baseline survey. The total population of these 40 households was 205 (Table 5.3-21). The average household size was 5.95, with 20 households reporting six or more family members. The largest household size in the surveyed population was reported to be with 14 family members, and the smallest with 2 family members.

Table 5.3-21: Demographic Profile of Households Surveyed in the IB–NB Segment

Settlement	Local Level	District	Total Population of households surveyed	Total Households surveyed
Pachgaun	Ramgram Nagarpalika	Nawalparasi District	138	27
Gopalpur	Palhi Nandan Gaunpalika	Nawalparasi District	51	9
Harkatta	Sunwal Nagarpalika	Nawalparasi District	16	4
		Total	205	40

Source: Household Survey 2019

About 45 percent of the surveyed households belonged to the Terai Madeshi caste/ethnic group, which includes Thakur/Hajam, Yadav, and Teli; while 26 percent of the surveyed households belonged to the Adivasi Janajati group, which includes Tharu and Newar. Dalit

[3] Out of 499 households, 497 households responded to question on primary language.

(Chamar/Harijan) comprised about 3 percent of surveyed population. About 10 percent of the surveyed households were Brahmin/Chettri.

5.3.5.2 Basic Services

House Ownership

All surveyed households owned houses. Most of the houses in the area were made of mud-brick, while a few structures were concrete structures.

Toilet and Sewer Facilities

All the households reported to have toilet facilities, of which 97 percent reported having a modern (western style) /semi modern (pit latrine) style toilet. It was reported that open defecation was not practiced in the IB–NB Segment.

Drinking Water

Only 5 percent of the surveyed households had access to piped drinking water. Approximately 89 percent of the surveyed households used hand pumps (sourcing ground water) as a primary source of drinking water.

Waste Management Practices

Urban settlements in the IB–NB Segment report household solid waste collection systems. However, after collection, most waste is dumped in unsecure landfills; one dumping site was reported in Ramgram Ward 8. Waterlogging due to a lack of well-maintained drainage systems was reported in urban settlements. In rural settlements in the IB–NB Segment, there are no organized systems for waste collection or disposal. Typically, in this area, biodegradable waste is collected in a manure pit, and all other kinds of waste are burned for volume reduction and disposal.

Status of Roads and Bridges

The IB–NB Segment has comparatively better connectivity, as it is in the Terai Region. Major roads include East-West Highway, Postal Highway, Bhairahawa-Bhumahi Chowk Road, Sunwal-India Border (Mahespur) Road, and Sunwal-Parasi Road. These roads are in relatively good condition.

Existing Power Sources and Facilities

The main energy source used in the IB–NB Segment for lighting was electricity from the national grid (85 percent of the surveyed households). Other sources of energy for lighting were rechargeable batteries (10 percent), solar (3 percent), and other sources (12 percent).

Communication

The households surveyed in the IB–NB Segment, reported that their main communication channels were TV, radio and mobile phones. About 78 percent owned TVs, and 13 percent

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owned radios. Mobile phones and internet access were reported as the primary means of awareness and communication among all age groups.

Police or Security Agencies

According to consultations along the Project area and at the municipality and ward level, a higher presence of police stations and police booths was reported in the IB–NB Segment, due to its proximity to the Nepal–India border.

5.3.5.3 Economy

Livelihoods and Employment

Within the sample households surveyed in the TL Project area, the working population, defined as persons between 15 to 59 years of age, comprised of 140 individuals out of which 75 were females and 65 were males. Working population constitute about 68 percent of the total population of the surveyed households.

Farming was the primary occupation of 42 percent (59 individuals) of the working population. Wage labor (14 percent) and salaried jobs (10 percent) made up the other two predominant occupations of the households surveyed. A high proportion of women out of the total working women's population were homemakers[4] (36 percent or 27 women), this comprised of 19 percent of the total working population.

In the IB–NB Segment, it was reported that 53 percent of the households surveyed depended on agriculture, 43 percent on livestock rearing, and 28 percent on unskilled labor and remittances from family members working in other areas (who sent money back home). Two people (one each from Pachgaun and Gopalpur) in the working-age population were unemployed.

Land Ownership

The average size of land holding in the IB–NB Segment across the households surveyed was approximately 23 ropani (about 1.2 ha). About 40 percent of the households who had access to land owned less than 9.8 ropani (about 0.5 ha) land each, while 7 percent did not own farmland.

Agriculture

Major crops cultivated, as reported in the survey were, paddy (36 percent or 31 households), mustard (21 percent or 18 households), wheat (16 percent or 14 households), lentils (12 percent or 10 households). Other crops reported were chickpea, peas, potato, sugarcane, sweet potato, garlic and onion. Of the total households surveyed 12 (30 percent) households reported a shortfall in meeting their household food requirement from their own fields.

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[4] Homemakers refers to women; regardless of marital status; who are engaged in unpaid household chores.

Irrigation

Approximately 30 percent of the households surveyed were dependent on shallow tube wells for irrigation, followed by 23 percent that were dependent on ponds and rivers.

Livestock Ownership

Livestock is an important asset and a source of cash income for 48 percent (19 out of 40 households) of the households surveyed. Buffalo and goat are the commonly reported animals owned by households. The households in Gopalpur reported no poultry or ducks held in the form of assets and none of the households in Pachgaun held any cattle and none of the households in Harkatta held any ducks. Buffalo, goat, and poultry were the only income-generating animals in the past year.

Industry

The following manufacturing units/factories (small and medium enterprises) were reported: plywood industry, paper industry, small rice mills, sawmills and furniture making units.

Common Property Resources

There are two community forests in the RoW of this TL segment. There was little community dependence on forests in IB-NB segment. Forest products were not reported as a source of income. However, forest produce was collected and used, by nine households (out of 40). Resources used in the surveyed settlements included firewood, Khar (which is used for bedding and to insulate roofs), and fodder for animal grazing. None of the female-headed households collected or used forest products. Given this, impacts relating to community forests are likely to be of low significance for this TL Segment.

Approximately 47 percent of the households surveyed in the IB–NB Segment reported a dependence on river and springs for water for self-consumption. Combined with the response of water shortages during the hot summer months (March–May), this may be an issue of greater significance in terms of Project impacts.

Household Income

In the IB–NB Segment, 40 percent of the households surveyed earned a monthly income of less than NPR 20,000, about 30 percent earned between NPR 20,000 and 70,000, and about 15 percent earned more than NPR 200,000.

Table 5.3-22 present income sources among the households surveyed. Agriculture (53 percent of households surveyed) was main source, followed by livestock rearing (43 percent of households surveyed), unskilled work and remittance (each 28 percent of households surveyed), businesses (25 percent of households surveyed), government allowance (23 percent of households surveyed), and skilled work (18 percent of households surveyed).

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Table 5.3-22: Sources of Income

SN	Income Source	Proportion of Surveyed Households Reporting Source
1	Remittance from Aboard	25
2	Skilled Work	17
3	Business	13
4	Civil Servant (Govt.) Service	8
5	Private Service	8
6	Unskilled Work	7
7	Government Allowance (Old age, Disability, etc.)	3
8	Income from Rent (house, land etc.)	3
9	Pension	3
7	Interest from Bank	3
8	Agricultural Labor	2
9	Mining/Quarrying	1
10	Professional Fees (trainer, auditor, Pandit)	1

Source: Household survey 2019

Household Expenditure

It was reported that 45 percent of the households surveyed had an annual expenditure of between NPR 100,000 and 200,000, 20 percent between NPR 200,000 – 400,000, and 25 percent with an annual expenditure between NPR 400,000 and 800,000. Table 5.3-23 shows the various types of expenditure incurred by the households surveyed. The highest proportion of their expense was for paying interest and loans.

Table 5.3-23: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Interest and Loans repayment	22
2	Transportation	16
3	Food	14
4	Education	11
5	Social functions	11
6	Agricultural inputs	7
7	Clothing	6
8	Other	14

Source: Household survey 2019

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Financial Institutions

In the IB–NB Segment, 80 percent of the surveyed population had savings, of which 44 percent of the respondents had deposited their savings in a bank, 50 percent in cooperatives, and 16 percent with self-help groups. Most women also have access to credit from thrift groups, like *Amma Samuha*, and cooperatives. Over 25 percent of the households surveyed were part of *Amma Samuha*, and 48 percent of the households surveyed had one or more members that were part of cooperative societies.

5.3.5.4 Education

Populations in all wards have access to both institutional (private) and community (public) schools, but households often prefer to send their children to institutional schools. It is the financial status of the household, rather than the gender of child, that determines whether they are sent to an institutional or community school. Households reported that they no longer discriminate between their sons and daughters regarding education; and, in recent years, more girls tend to complete schooling and attend college than boys. This was supported by discussions with the local community, which suggested that there were more girls attending school as compared to boys.

Literacy Rate

About 82 percent of people above 6 years of age indicated that they were literate. Male literacy rate (90 percent) was higher than the female literacy rate (70 percent). Note that this trend in literacy levels in the IB–NB Segment may be attributable to the higher proportion of population living in municipalities (two of the three local levels are municipalities). The literacy rate of the households surveyed in relatively urban Harkatta (94 percent) and Pachgaun (80 percent), are higher than in rural Gopalpur which has a literacy rate of 67 percent.

Consultation in the Project area found that most children of school-going age (5 to 6 years and above) were registered at school. A range of factors, such as financial constraints, limited availability, distance to schooling facilities after primary level, low parental educational levels, and the need to help with housework or field work, contributed to children dropping out after completing primary school. The majority of the surveyed population that reported dropouts (41 percent) also reported economic hardship as a reason for dropping out.

5.3.5.5 Health

In the IB–NB Segment, both private and public healthcare facilities are available. People reported a preference for the village health posts and private hospitals, particularly for minor health issues. The most frequently reported diseases during the household survey included common fever, common cold, typhoid, and respiratory tract infections. FGDs with the community further brought out the presence of uterine problems as well as gastric problems. None of the respondents reported a prevalence of sexually transmitted diseases in the IB–NB Segment.

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5.3.5.6 Gender and Social Inclusion

Sex Ratio

The sex ratio was 99 males for every 100 females in the households surveyed within an area. This sex ratio is higher in comparison to the national and district level averages.

Female Headed Households, and Female Ownership of Land and Property

Of the households surveyed in the IB–NB Segment, it was reported that females headed 7 percent of the households. Of the female-headed households, two households owned land and one household did not own land.

Differences in Education, Literacy, and Income Generation for Men and Women

In the IB–NB Segment, according to consultations with women and youth groups, boys drop out primarily for employment and financial reasons, whereas girls drop out primarily because of marriage and elopement.

The household survey results in the IB–NB Segment show that the number of men engaged in income generation is significantly higher as compared to the number of women (doing paid work). Also, the occupational profile of males is more varied when compared to the female occupational profile. More men are engaged in skilled labor and salaried jobs; whereas none of the women surveyed are engaged in these types of jobs. According to the consultations with women's groups and the local community, daily wage rate for women is lower than that of men by at least NPR 50 to 100 per day. Gender equity, based on the household surveys and FGDs in the IB–NB Segment, is a particular problem.

Indigenous People and Dalit

Tharu and Magar are major indigenous groups. Major Dalit groups in this TL segment are Chamar/Harijan/Ram and Kami.

Trafficking in Person

Three out of 36 survey respondents said they know about sex trafficking locations.

5.3.5.7 Culture

A discussion on culture-related aspects is presented below, including, languages used, religions practiced, Indigenous knowledge, cultural and archeological sites.

Languages Used

About 71 percent of the surveyed households reported Nepali as their primary language followed by Bhojpuri (28 percent) and Newari (3 percent). Bhojpuri is commonly spoken in areas directly across the border (in India). Even among Bhojpuri speaking population, younger people are increasingly speaking Nepali as their first language.

Religious Practices

All households surveyed in IB-NB segment practiced Hinduism.

Cultural & Archaeological Sites, Traditional Places, and Festivals

Table 5.3-24 lists all sites of cultural, religious, and/or archaeological significance in the IB–NB Segment. These have been considered and avoided as part of the Project design process to minimize the impacts on the local community.

Table 5.3-24: Sites of Cultural, Archeological, and Traditional Importance and Festivals for Population in the IB–NB Segment Project Area

District/Municipality/ Village/Ward	Tangible/Intangible Cultural Heritage		Comments
Nawalparasi, Ramgram-5	Temples	Baba Barda Goriya Samsarkot Devi Temple	
	Historical site	Devdaha	Maternal home of Lord Buddha's mother
	Stupa	Ramgram Stupa	
Nawalparasi, Ramgram-2	Temples	Asharkote Temple	The Temple is of Tharu Community, in the mountain region.
Nawalparasi, Binayee Tribeni -5	Temples	Siddha Baba, Durga Devi, Maula Devi, Rama Devi, Dhara Devi	These Temples are located inside the forest area in Deurali.
Nawalparasi, Ramgram	Temples	Brahamkamal Naal Bandani Temple Shivalya Temple	
Nawalparasi	Tree	Kol Vriksha	It is believed to cure leprosy.

Source: EIA Field Survey 2019

5.3.6 Socioeconomic Analysis for New Butwal to New Damauli Substation TL Segment

The Project area in this TL Segment includes 23 wards across four municipalities and four rural municipalities in four districts, extending from New Butwal Substation (Sunwal municipality) in Nawalparasi West district, traversing Nawalparasi East and Palpa districts, to the New Damauli Substation site in Tanahu district.

5.3.6.1 Demographic Profile

In this TL segment Project area, 92 households were surveyed (Table 5.3-25). The total population of these 92 households was 435 persons. The average household size was 5.1 and 29 households reported six or more family members. The largest household size was one with 13 family members, while the smallest reported one family member.

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Table 5.3-25: Number of Households Surveyed in the NB–ND Segment

Settlement	Local Level	District	Total No. of Households Surveyed	Total Persons in Surveyed Households
Bhataudi	Sunwal Nagarpalika	Nawalparasi West	8	37
Bhimsen	Nisdi Gaunpalika	Palpa	4	12
Gam Pokhara	Nisdi Gaunpalika	Palpa	1	4
Muda Bhangjyang	Nisdi Gaunpalika	Palpa	3	14
Phukul Dada	Nisdi Gaunpalika	Palpa	5	18
Pipaldada	Nisdi Gaunpalika	Palpa	3	13
Pokharathar	Nisdi Gaunpalika	Palpa	6	26
Shakhardi	Nisdi Gaunpalika	Palpa	8	34
Swami Bhanjyang	Nisdi Gaunpalika	Palpa	7	33
Kewarapani	Nisdi Gaunpalika	Palpa	6	33
Khoptar	Rampur Nagarpalika	Palpa	7	42
Katahare	Ghiring Gaunpalika	Tanahu	8	39
Newapani	Ghiring Gaunpalika	Tanahu	4	24
Uwathok	Ghiring Gaunpalika	Tanahu	6	30
Lokma	Rishing Gaunpalika	Tanahu	6	33
Pachodi	Rishing Gaunpalika	Tanahu	5	21
Aadampani	Vyas Nagarpalika	Tanahu	5	22
		Total	92	435

Source: Household Survey 2019

The caste/ethnicity composition of population in households surveyed included Adivasi Janajati (62 percent); Brahmin/Chettri (11 percent); Newar (7 percent); Dalit (2 percent); Trai Madeshi (2 percent); and others (15 percent).

5.3.6.2 Basic Services

House Ownership

Nearly 98 percent of the household survey respondents said that they owned their house. Only 2 percent of the households resided in rented accommodations. A variety of types of houses were seen through the NB–ND Segment.

Toilet and Sewer Facilities

All of the surveyed households in the NB–ND Segment had access to toilet facilities, and approximately 90 percent of the households have access to semi-modern (pit latrine) and modern (western) style toilets. As reported by the community through consultations in

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Tanahu, the increased use of toilets by the community has had a positive impact in reducing water-borne diseases like dysentery and diarrhea.

Drinking Water

About 34 percent of the surveyed households had access to piped drinking water. 54 percent of the households relied on public tap for their drinking water needs. 8 percent used streams and springs as a source of drinking water. According to a discussion with a community group in Rhising, people have to travel an hour each way to fetch drinking water, as there is no public tap near their settlement. It has also been reported that households living at the top of the hills are the worst off, as they have to travel along uneven paths to access water sources and then carry the water home uphill.

Waste Management Practices

It was reported that across the three districts in the NB–ND Segment, there were no wastewater treatment plants. In Nawalparasi and Palpa, solid household waste in urban areas is collected by the municipality. Ramgram–8 (in Nawalparasi) has one dumping site. In Palpa district, waste collected is dumped in Sani Marai, Rampur-5. In Tanahu district, Vyas municipality has the segregation facility for solid waste.

Status of Roads and Bridges

Major roads in this segment include: Narayanghat-Butwal section of East-West Highway, Daunne-Arungkhola-Nisdi-Rampur Road, Rampur-Ghiring-Bhimad Road, and Bhimad-Rishing-Damouli Road. Except for East-West Highway, all other roads operate only in dry season. Based on consultations with the local community, the roads within the villages, including paved and unpaved roads, are not being maintained.

Existing Power Sources and Facilities

Approximately 57 percent of the households surveyed in the NB–ND Segment use electricity from the National Grid for lighting. According to consultations, with the community in Rishing and Rampur, electricity supply in the settlement is affordable but not reliable. Strong winds and the rainy season cause disruptions in power supply. Approximately 56 percent of households surveyed in the NB–ND Segment reported use of solar power for lighting, but not for the purpose of using television, cooking, and other activities.

Communication

In the NB–ND Segment, 79 percent of the heads of households have mobile phones, of which 24 percent have access to internet. People viewed communication as greatly improving their daily life through better access to news and information. Social media platforms such as radio, Facebook, and Viber are commonly used. Mobile phone ownership is now perceived as a necessity and not a luxury.

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Police or Security Agencies

The households in the NB–ND Segment all had access to either an Area Police Post or a temporary Police Post. According to consultations at the municipality level, it was reported that in all three districts in the NB–ND Segment, state police are deployed to provide security.

5.3.6.3 Economy

Livelihoods and Employment

The total working population in the households surveyed in the TL Project area was 284 individuals, which is about 65 percent of the surveyed population. Farming is the main economic activity for all social groups. FGDs with farmers in Palpa showed that there is a *Parma* system, which is an exchange of labor among neighboring households within a community during the agricultural season. The daily wages for agricultural labor are NPR 700 to 800 per day for males and NPR 400 per day for females, indicating a wage gap of 75-100 percent.

About 17 percent (both men and women) of those surveyed were employed in the formal sector, which is defined as employment with regular wages and includes payment of income tax. Based on the household survey, income from foreign employment (remittances from abroad) was reported by 57 percent of households. This was followed by income from agricultural labor (on fields of larger landowners), which was reported by 51 percent of households.

5.3.6.3.1.1 Land Ownership

All households surveyed in the NB–ND Segment owned land. The average size of land holding is 2 to 2.5 ropani. The land ownership across the different social groups indicates larger land holdings amongst the Brahmin-Chettri community in comparison to the Dalit and Adivasi Janajati groups.

Agriculture

Approximately 72 percent of the household's surveyed (66 households) reported a dependence on agriculture for either income or self-consumption. Major crops cultivated, as reported in the survey were maize (31 percent or 54 households), paddy (21 percent or 37 households), millet (12 percent or 21 households), finger millet (5 percent or 8 households), and wheat (4 percent or 7 households). Other crops reported were sweet potato, cauliflower, mustard, potato, banana, black gram, and cabbage. Important cash crops include garlic, potato, lentil, black gram, gram, and soybean. Consultations with farmers in Rampur (Palpa) revealed that there are three crop cycles. Paddy is harvested during June-July, wheat is harvested from January to March, and maize is harvested from end of March to April. Almost the entire production of rice, maize, and millet is consumed by the households. Of the total households surveyed, 67 73 percent (67 households) reported a shortfall in meeting their household's food requirement from their own production.

Irrigation

The major sources of irrigation used by the community in the NB–ND Segment are ponds, rivers, springs, and canals. Irrigation is a major problem faced by the community, in the hilly and mountainous areas. Lower-lying settlements have an advantage, as the rivers and streams are easily accessible for irrigation. Upland farmlands in hilly areas are largely rain-fed, however, when rainwater is unavailable, farmers use pipes to collect water for irrigation from nearby streams.

5.3.6.3.1.2 Livestock Ownership

Livestock is another important source of cash income for the farmers in the NB–ND Segment. Common livestock include buffalo, goats, chickens, and pigs. Poultry is increasingly becoming popular. The livestock owned by households is used for commercial sale (sale of animals, meat, milk, and eggs) along with self-consumption.

Industry

In the NB–ND Segment small and medium industries like plywood, paper, small rice mills, sawmills, and furniture were reported. Palpa District had no industries in the NB–ND Segment apart from the individual level small scale industries such as ice cream, grill, and furniture shops in the Rampur municipality. In Tanahu, the primary form of industries are furniture shops, grill industries and crushers. In Nawalparasi, the dominant form of industries is plywood and paper industry. The exact location of these industries was not mapped as part of this baseline.

Common Property Resources

There are 32 community forests and two leasehold forests along the RoW of this TL segment.

Household Income

Among the households surveyed in the NB–ND Segment, 82 percent disclosed income related information. Table 5.3-26 lists major sources of cash income. Remittance was the largest source of cash income followed by civil service, business, and other sources. About 16 percent said they earn some income by selling their agricultural produce. About 23 percent of the surveyed Adivasi Janajati households earned some income by selling surplus agricultural produce.

Table 5.3-26: Sources of Income

SN	Income Source	Percent of Total Surveyed Households
1	Remittance	49
2	Civil service	13
3	Business	10
4	Skilled work	7

SN	Income Source	Percent of Total Surveyed Households
5	Pension	5
6	Unskilled work	4
7	Other	12

Source: Household Survey 2019

Household Expenditure

Table 5.3-27 presents major expense categories of the households surveyed, with food representing the biggest expense.

Table 5.3-27: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Food	25
2	Healthcare	14
3	Interest and loans repayment	12
4	Education	11
5	Clothing	10
6	Social function	8
7	Agricultural inputs	7
8	Other	13

Source: Household Survey 2019

Financial Institutions

Most households in the NB–ND Segment use savings and credit services at cooperative societies, with fewer people using banks. Approximately 20 percent (of the households surveyed in the NB–ND Segment) preferred to save in cooperative society and 10 percent preferred to save in banks. The most common reason for borrowing is for household expenses like food and rations. Many households also took loans for businesses and house construction. These aspects will be taken into account while developing the resettlement and rehabilitation strategies.

5.3.6.4 Education

The surveyed population unlike the national and district trends, reported a female literacy rate of 91 percent, which is higher than the male literacy rate at 71 percent, and the national average female literacy rate. The highest level of education attainment was reported at the primary school level. It was reported that economic hardship (37 percent) was the primary reason for dropping out of school, followed by marriage (19 percent).

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5.3.6.5 Health

Consultation with community members revealed that for major diseases, 80 percent of the households surveyed in the NB–ND Segment reported dependence on private clinics and hospitals, while only 33 percent depended on government health institutions. Major ailments like cholera, tuberculosis, malaria and uterus linked infections (for women) were reported in the NB–ND Segment. Of the households surveyed, approximately 17 percent reported typhoid, common fever, cholera and respiratory tract infections.

Gender and Social Inclusion

The sex ratio among the surveyed population was 95.2 percent.

Female Headed Households, Female Ownership of Land and Property

Female ownership of property was limited in the NB–ND Segment, but 77 percent of households did report joint ownership with their spouses. Of the households surveyed in the NB–ND Segment, the lowest ownership of households by women was reported in Nawalparasi district, where only 5 percent female-headed household owned a house (1 out of 19 households).

Differences in Education, Literacy, and Income Generation for Men and Women

The gaps between overall literacy and female literacy at the district level in the NB–ND Segment are 7 percentage points. About 11 percent of the surveyed persons identified themselves as illiterate. Of those who identified as literate, about half were males and half females.

Indigenous People and Dalits

Magar is the main Indigenous group in this segment. Major Dalit groups in this are Kami and Damai / Dholi.

Trafficking in Person

Only one out of 84 survey respondents said they know about sex trafficking locations.

5.3.6.6 Culture

A discussion on culture-related aspects is presented below, including, languages used, religions practiced, Indigenous knowledge, cultural and archeological sites.

Language

About 70 percent of households surveyed reported Nepali as their mother tongue, which was followed by Magar (26 percent), Gurung (2 percent), Tharu (1 percent), and Newari (1 percent).

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Religious Practices

About 91 percent of population in surveyed households practiced Hinduism which was followed by Buddhism (8 percent), and others (1 percent).

Cultural & Archaeological Sites, Traditional Places, and Festivals

The table below lists all sites of cultural, religious, and/or archaeological significance in NB–ND Segment. As discussed earlier, these sites have been avoided as part of the Project design to minimize impact (discussed in later chapters of this document).

Table 5.3-28: Sites of Cultural, Archeological, Traditional Importance and Festivals in the NB–ND Segment

Location	Tangible/Intangible Cultural Heritage	Comments
Tanahu, Rhishing-1	Water fall	About 100-150 people come daily from Damauli Bazaar area to see this waterfall.
Tanahu, Ghiring-1	Bhantar Paleontological sites	Saligram fossils found in the Kali Gandaki river.
Tanahu, Ghiring-2	Thanimai Temple Bhimsen Temple	
	Kotghar historical site	Magar people worship Kotghar during Dashain, Ram Nawami, and Nwagi.
	Kordnau Temple historic site	Located in Gajurkot.
Tanahu, Ghiring-3	Thaney Devi Temple	Located inside huge Temple.
	Archalkot religious forest	Magar people worship in Thaniban during various festivals throughout the year.
Tanahu, Rishing-6	Jyamire Mai Temple	Old Temple built by ancient Kings during the period of 2200-2400 BC (as per local legends).
	Kalika Mai Temple	It is situated in Awhale Community forest, in the village Maidansora.
Tanahu, Rishing-7	Durga Bhawani Temple	
Tanahu, Rishing-8	Rani Pokhari lake	It holds historical significance.
Tanahu, Ghiring	Arambhakot's Balaa Temple, Thani Temple, Akala Devi Temple, Satung Devi Temple	

Location	Tangible/Intangible Cultural Heritage	Comments
Palpa, Rampur-1	Tapu Dham Temple	Hindu worship and collect shaligram here.
	Chagadi waterfall	
Palpa, Rampur-4	Sita Kund Temple	Significance from Ramayan
Palpa, Nisdi-5	Namsurka tourist site	Proposed tourist area which may have historical significance.
Palpa, Nisdi-6	Lake Dada	Proposed tourist area which may have historical significance.
Nawalpur, Binayee Tribeni-5	Samsarkot Devi Temple	This Temple is located in Dhurkut.
Nawalpur	Dipchuli Barchuli Temple	Magar and Tharu community worship this temple.
Nawalpur, Binayee Tribeni area	Tribeni dham religious site	Holds a great significance to the Hindu religion.

Source: EIA Baseline Survey 2019

5.3.7 Socioeconomic Analysis for New Damauli to Ratmate TL Segment

This section presents the socioeconomic profile of the identified Project area from ND (Ward 1, Vyas Administrative Unit, Tanahu District) to the Ratmate (RTE) Substation (Ward 7, Belkotgadhi Administrative Unit, Nuwakot District). The ND–RTE Segment includes 31 wards across three municipalities, and eight rural municipalities from four districts: Dhading, Chitwan, Tanahu, and Nuwakot.

5.3.7.1 Demographic Profile

152 households were surveyed in this TL segment during baseline survey using a structured questionnaire. The total population of these households was 800 (Table 5.3-29). The average household size was 5.3

Table 5.3-29: Number of Households Surveyed in the ND–RTE Segment

Settlement Name	Administrative Unit	District	Total Households Surveyed	Total Population of Households Surveyed
Foksing	Icchyakamana Gaunpalika	Chitwan	6	39
Furkedada	Icchyakamana Gaunpalika	Chitwan	2	11
Kharpan	Icchyakamana Gaunpalika	Chitwan	16	88

Settlement Name	Administrative Unit	District	Total Households Surveyed	Total Population of Households Surveyed
Panni Ghatta	Icchyakamana Gaunpalika	Chitwan	2	12
Bhaisegauda	Benighat Rorang Gaunpalika	Dhading	7	42
Bhirpani	Galchhi Gaunpalika	Dhading	8	38
Chilauney Pani	Benighat Rorang Gaunpalika	Dhading	4	22
Dangbang	Benighat Rorang Gaunpalika	Dhading	11	67
Dhalan Tol	Galchhi Gaunpalika	Dhading	4	18
Dharapani	Siddhalek Gaunpalika	Dhading	7	41
Dudethati	Gajuri Gaunpalika	Dhading	9	42
Majh gaun	Galchhi Gaunpalika	Dhading	14	80
Mijar gaun	Benighat Rorang Gaunpalika	Dhading	8	33
Bakhrafarm	Bandipur Gaunpalika	Tanahu	8	34
Bhakkedada	Vyas Nagarpalika	Tanahu	8	32
Bhoteshwar	Abhukhaireni Gaunpalika	Tanahu	6	38
Gaubesi	Abhukhaireni Gaunpalika	Tanahu	16	87
Tinpate	Bandipur Gaunpalika	Tanahu	8	30
Battar	Bandipur Gaunpalika	Tanahu	8	46
		Total	152	800

Source: Household Survey 2019

Caste/ethnic composition of the population in households surveyed in the ND-RTE segment included Adivasi Janajati (64 percent); Brahmin/Chettri (10 percent); Newar (7 percent); Dalit, including Damai/Dholi and Kami (18 percent); and others (2 percent). About 22 percent (34) of the household's survey self-identified with the Gurung ethnic group, 18 percent (28) as Magar, and 9 percent (14) as Chepang.

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5.3.7.2 Basic Services

House Ownership

The percentage of homes (97 percent) owned in the ND–RTE Segment is substantially higher than the percentage of rented homes. A variety of types of houses were seen through the ND–RTE Segment.

Toilet and Sewer Facilities

Based on the household survey, 93 percent of households in the ND-RTE Segment had toilet facilities, of which 73 percent reported having a modern (western) style toilet and 27 percent reported having traditional toilets with a soak pit.

Drinking Water

About 66 percent of the households surveyed in ND-RTE segment had access to private piped drinking water. 15 percent of the households used public tap and 14 percent used stream/river/spring for drinking water. The remaining 4 percent used other sources.

Waste Management Practices

The household survey, and subsequent field visits, found that there were no wastewater treatment plants or waste collection facilities in the ND–RTE Segment. Typically, biodegradable waste is collected in a manure pit and the non-biodegradable waste is burned or is disposed in common areas.

5.3.7.2.1.1 Roads and Bridges

Major black-topped roads in this segment include Damauli-Mugling-Galchhi section of Prithvi Highway, Davighat-Galchhi Road, Mugling-Narayanghat Road, and Prithvi Highway-Dadhingbesi Roads. Other motorable roads that operate only during dry season include Damauli-Ghumaune Road, Damauli-Bandipur Road, and Abukhaireni-Chhimkeswori Road. It was observed that residents typically need to walk for several hours (3 to 4 hours) to reach an all-season road.

Existing Power Sources and Facilities

Approximately 81 percent of the households are connected to the national gird.

Communication

According to the consultations with the local community, most of the people in the ND–RTE Segment own mobile phones with internet access, especially youth. Most of the households have access to Wi-Fi at home and data on their mobile phones. The internet, along with television and radio, serves as the most common sources of information. Youth are active on social media through applications such as Viber and Facebook. Mobile network and data service quality has also reportedly improved over the years, which has increased the community's use of, and dependence on mobile phones.

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Police or Security Agencies

The households in the ND–RTE Segment have access to either an Area Police Post or a temporary Police Post.

5.3.7.3 Economy

Livelihoods and Employment

The total working population in the households surveyed in the TL Project area was 486 individuals (female: 222 and male: 264) which is about 61 percent of the surveyed population. In the households surveyed in at the ND–RTE Segment, 40 percent of the population depended on agriculture. In recent years, some people have also taken up other economic activities: driving, running provision stores, and labor work abroad. Only 5 percent reported foreign employment as a primary occupation in the households surveyed. Of these, 37 were male and two were female.

5.3.7.3.1.1 Land Ownership

The average land holding of the surveyed households was about 9.83 Ropani (approximately 0.5 hectare). The majority of the surveyed population are small and marginal farmers. Landless households were reported in Bakhrafarm and Adampani. Some households (with small holdings) use communal lands in Kharpan, Icchayakamana, which are not privately owned. This is based on an informal understanding within the community about who has the informal rights over the land parcels and is decided based on need.

Agriculture

Major crops cultivated, as reported in the survey were maize (28 percent or 133 households), millet (12 percent or 58 households), paddy (10 percent or 50 households), finger millet (7 percent or 34 households), sweet potato (9 percent or 44 households), tomato (5 percent or 23 households), garlic (4 percent or 21 households). Other crops reported were mustard, soya bean, wheat, black gram, buckwheat, and cauliflower. Other key crops include oranges, beans, bananas, and turmeric. Ginger and potato are cash crops.

Rice is planted in April (chait) and harvested in June; the second cycle is planted in June and then harvested in October-November. Maize is planted in May and harvested in July-August. Potatoes are planted in December-January and harvested in March-April. Most of the production is done without the use of pesticides.

Increasingly, households in this area are engaging in agriculture as a commercial activity (with surplus and cash crops for sale) as opposed to the previous subsistence farming; there is a parallel reduction in traditional farming practices. These changes have mostly been seen in Gajuri, Dhading and in Vyas, Tanahu: this improvement in agricultural techniques and use of improved seeds has resulted in an overall improvement in productivity and incomes. Most family members are engaged in agriculture with women working more on garden farming and

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subsistence farming. Of the total households surveyed 119 (78 percent) households reported a shortfall in meeting their household food requirement from their fields.

Irrigation

About 20 percent of the surveyed households are dependent on rivers and natural streams for irrigation. Of all the households surveyed, 3 percent use canals.

5.3.7.3.1.2 Livestock Ownership

Livestock is an important source of cash income for farming households. The most common livestock holdings are goats, poultry, and buffalo for household needs and not commercial purposes. Boars and pigs are kept solely for commercial purposes. Some households also practice fish farming in Tanahu. According to the local community, typically, only households with greater than 20 poultry, 2 cattle/buffaloes, or 10 goats are able to sell products such as eggs, milk, and meat commercially; all other households consume the products in-house.

Industry

Furniture, steel grills, rice mills, saw mills, crushers, masala factory, tea and spices packing factories are some of the industries found in this TL segment. There is a crusher in Abhukhaireni. In Chitwan, a rice mill a masala factory, and a tea and spices packing factory were reported. Dhading reported multiple small manufacturing activities such as furniture, rice mills, and sand mining, among others. Similarly, Nuwakot reported to have saw mills and grain mills along with furniture shops. Nuwakot also reported a *Duna Tapari* business—making disposable plates by pressing broad leaves.

Common Property Resources

There are 36 community forests and 6 leasehold forests in the RoW of this TL segment.

Household Income

The average annual income reported from the households surveyed was about NPR 300,000. Table 5.3-30 shows main sources of cash income. Remittance was the largest source of cash income followed by skilled works, unskilled works, and others. About 48 percent of surveyed households also earned some income from the sale of agricultural produce. About 53 percent of Janajati households earned income from the sale of agricultural produce.

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Table 5.3-30: Sources of Income

SN	Income Source	Percentage of Total Household Income
1	Remittance from abroad	33
2	Skilled work	28
3	Unskilled work	8
4	Business	7
5	Civil service	5
6	Agricultural labor	4
7	Other	15

Source: Household survey 2019

Household Expenditure

Of the households surveyed in the ND–RTE Segment, 27 percent reported an annual expenditure of NPR 100,000 to 200,000, with food being the primary expenditure (Table 5.3-31).

Table 5.3-31: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Food	31
2	Education	12
3	Interest and loans repayment	12
4	Healthcare	11
5	Clothing	11
6	Social function	8
7	Transport	6
8	Other	9

Source: Household Survey 2019

Financial Institutions

Approximately 66 percent of those surveyed in the ND–RTE Segment have opened a bank account. About 11 percent of the households surveyed in the ND–RTE Segment reported having taken a loan from cooperatives and 13 percent from credit groups like *Amma Samuha* or women's groups and cooperative societies. Another 13 percent of those surveyed borrow from banks, and only 8 percent of those surveyed rely on local moneylenders.

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5.3.7.4 Education

Approximately 69 percent of the households surveyed in the ND–RTE Segment are reported to be literate (male literacy rate: 80 percent; and female literacy rate: 64 percent). Of the ethnic groups in the area, the highest literacy rates were reported by the Brahmin, Chettri and Gurung households.

5.3.7.5 Health

In the ND–RTE Segment, both private and public healthcare are available. The most common diseases reported by the surveyed households are common fever, diarrhea, skin rashes/itches, and high blood pressure. According to the discussion with the local community in Vyas, Tanahu, Fisling, Dhading, and Icchayakamana, Chitwan, while men typically report health problems related to high blood pressure, gastric issues, and diabetes, women typically report health problems related to reproductive health (e.g., ovarian cysts). Two people reported having a sexually transmitted disease.

5.3.7.6 Gender and Social Inclusion

The sex ratio for populations in households surveyed in the ND-RTE segment was 115.6.

Differences in Education, Literacy, and Income Generation for Men and Women

In the households surveyed in the ND–RTE Segment, more women than men were illiterate, with approximately 46 percent of the illiterate population was female compared to approximately 22 percent among males. Dropouts were more common among boys than girls. Of the households surveyed in the ND–RTE Segment, it was reported that the female to male ratio within the working population is 47. Despite the relatively even gender distribution, the household survey results suggest that the number of men engaged in income generation is significantly higher as compared to the number of women. The occupational profile of males is more varied when compared to the female occupational profile. More men are engaged in skilled labor and regular salaried jobs than women.

Indigenous Peoples and Dalits

Gurung is the main Indigenous group in this segment, constituting 22 percent of the sample population. Other Indigenous people groups found in the segment are—Magar, Chepang, and Tamang. Major Dalit groups in this are Damai/Dholi and Kami, constituting 9 and 5 percent of the surveyed population respectively.

Trafficking in Person

Only one out of 116 survey respondents said they know about sex trafficking locations.

5.3.7.7 Culture

A discussion on culture-related aspects is presented below, including, languages used, religions practiced, Indigenous knowledge, cultural and archeological sites.

Languages Used

About 66 percent of the household surveyed reported Nepali as their primary language, which was followed by Gurung (13 percent), Magar (9 percent), Chepang (8 percent), Newar (3 percent), and Tamang (2 percent).

Religious Practices, Rituals, and Tribes

Hinduism is the religion with the largest following in the ND–RTE Segment, followed by Buddhism, Christianty, and Islam.

Cultural and Archaeological Sites, Traditional Places, and Festivals

Table 5.3-32 below lists all sites of cultural, religious, and/or archaeological significance in the ND–RTE Segment.

Table 5.3-32: Sites of Cultural, Archeological, Traditional Importance and Festivals in the ND–RTE Segment

District/Municipality/ Village/Ward	Tangible/Intangible Cultural Heritage	Comments
Nuwakot, Ratmate	Cremation area Chihan Danda cremation area	Used by Tamang community. Located in a forest
Dhading, Nilakantha-5	Koshi Khola	River with spiritual significance
Dhading, Galchi-2	Bhakta Bachchhala Devi Temple Ban Devi Temple	Located in Baseri.
	Tori Kharka Devi	Located in Torikharka
	Ban Devi Mandir	The Temple is inside religious forest in Baseri.
Dhading, Galchi-3	Bhimsen Temple	Located in Pokhari Thok.
	Panchakanya Temple	Located in Amdanda
	Chhage khola	Located in Haraa Tar
	Chhagekhola Jharana waterfalls	Located in Haraa Tar
	Ghupteyshower Gufa Cave	Located in Pokharithok
Dhading Galchhi-2	Barbhanjyang	Place where Jatra/Mela are organized
Dhading, Gajuri-2	Bhadrakali Temple Shiva Temple	Located in Majuwa
	Tasi Chhoiling Gumba Monastery	Located in Mathilo Majuwa
	Phurkeykhola Maranghat cremation site	Located in Phurkeyhola
	Bihani Pump Maranghat cremation site	Located in Bihani Pump
	Gumba Danda graveyard	Located in Gumba Danda

District/Municipality/ Village/Ward	Tangible/Intangible Cultural Heritage	Comments
Dhading, Benighat Rorang-4	Kot Devi Temple Dumrey Kalika Temple Gaumati Than Temple Mohariya Kalika Temple	
	Richok View Park	Recreation site
Dhading, Benighat Rorang-5	Kul Deuta Mandir	Located in Jana Gaun
Dhading, Benighat Rorang-7	Bageshowri Temple	Located in Basnet Gaun
	Manakamana Temple	Located in Madhus Bas
	Thapaliya Kul Deuta Than	Located in Chaptar
	Bageshowri Mandir Jatra/Mela	Located in Basnet Gaun
Dhading, Benighat Rorang-8	Shai Bung Danda Bhadra Chuli Danda	Recreation sites located in Bidhang
	Shagankha Devi Temple	Located in Bidhang
	Manakamana Temple	Located in Chailing
	Thana Bhyang Temple, Ratna Mala Temple Bhadkhara Devi Temple	
	Ghupteyshower Cave Nohak Cave	Located in Dungwang
Dhading, Benighat Rorang-9	Shankha Devi Temple	Located in Thingmag
	Mankamna Mandir	Places where Jatra/Mela are organized, located in Pipaldanda
	Chihan Danda graveyard	Located in Pipaldanda
Dhading, Benighat Rorang-10	Ratbichchhe Temple	Located in Tekwang
	Banincha Temple	Located in Dungey
	Palas Danda Temple	Located in Mangrang
	Kot Kalika Temple	Located in Kot Gaun
	Baspur Devi Temple	Located in Baspur
	Gairang Gumba Monastery	Located in Gairang
	Ratbichchhe Temple	Places where Jatra/Mela are organized, located in Tekwang
	Bageshowri Than	Places where Jatra/Mela are organized, located in Durani
	Kot Gadi (Purano killa of 22-24 states)	Historic site located in Kot Gaun
	Baspur Gurung Chihan	Local in Baspur
	Chihan Danda	Located in Mangrang

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District/Municipality/ Village/Ward	Tangible/Intangible Cultural Heritage	Comments
	Gairang Chihan	Located in Tekwang
Chitwan, Ichchhyakamana-2	Pathivara Temple	Located in Mayatar
Chitwan, Ichchhyakamana-3	Ichchhyakamana Temple	
Chitwan, Ichchhyakamana-6	Lamojharana waterfall	
Tanahu, Abhukhaireni-5	Manethan Temples	Gurung community visit this Temple when there is a death in the family.
Tanahu, Bandipur	Khadka Devi Temple	More than 200 years old Temple. Others include Mahalaxmi Temple, Gumba and Thanimai.
Tanahu, Bandipur-2	Sukaura festivals/jatras	Gurung community celebrate Lhosar; Newar community celebrate Lakhe, Gaijatra.
Tanahu, Vyas-13	Seti River	
Tanahu, Vyas	Chimkeswori Temple	Located in Chaapri

Source: EIA Baseline Survey 2019

5.3.8 Socioeconomic Analysis for Ratmate Substation

This section presents a socioeconomic profile of the Project affected districts, municipalities, and wards that fall within the identified Ratmate Substation[5] site, based on the consultations and survey work undertaken for the development of the Resettlement Action Plan (RAP). While the detailed baseline is included in the RAP document, a summary of the socioeconomic baseline, based on a socioeconomic survey of all Project affected households. This substation area is located within one ward of Belkotgadhi municipality in Nuwakot district.

5.3.8.1 Demographic Profile

In the Project Area, 101 households were surveyed. The average family size of the household surveyed is 5.5 people per household. The total population was 554 (male: 276 and female: 278).

5.3.8.1.1.1 Settlement Patterns

The Project impacted area consists of four main settlements: Dhansar, Nandutar, Haadikhola and Amlitar. Dhansar settlement has expanded in a linear manner along and around the access

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[5] At the time of preparing this document, the RAP survey for RAP Package 1 had been completed and a summary of the findings, has been included in 4.3.4.11 (in the baseline for Segment New Butwal to Ratmate Substation (NB-RTE)). The summary is based on a survey that covers all affected households within the proposed Ratmate substation footprint, whereas the socioeconomic baseline is based on a small sample survey of 499 households.

road, the Galchi-Trishuli-Mailung Highway. While Dhansar has a linear pattern, Haadi Khola settlement is clustered in one area with houses close together and the fields beyond and around the settlement. These fields divide Dhansar and Haadi Khola. Haadi Khola is named as such as it has a main "khola" or stream passing through it. Nandutar settlement developed around the "chautri", a common public space for gatherings where people from all nearby settlements came and main meetings were held. Amlitar has a scattered pattern with an irrigation channel flowing through it.

5.3.8.2 Basic Services

5.3.8.2.1.1 Home Ownership

All surveyed households owned houses. Of the affected structures in the Project Area 56 percent were residential structures, and 22 percent agricultural structures approximately 6 percent of the affected structures had both residential and commercial uses. Commercial structures constituted approximately 10 percent of structures affected in the Project Area.

Approximately 56 percent of the affected structures had cement floors with bricks, stones, and wood also used in the construction. About 26 percent of the structures had only cement floors and 17 percent had cement and brick floors. The second most used materials for flooring was mud, with approximately 22 percent of structures having mud floors. Approximately 86 percent of the structures had CGI sheet roofs with either RCC, wood, stone, or by itself, with 81 percent of structures with roof using only CGI sheets, and 14 percent of structures with RCC slab roofing.

5.3.8.2.1.2 Toilet and Sewer Facilities

Almost all of the houses (only one household did not have a toilet) surveyed had separate toilets which were reported to be in use. An approximate 99 households (99 percent) of the households reported toilets with a septic tank, and 1 percent reported a dry latrine. Sewerage networks are absent in the village hence, toilets are connected to soak pits and septic tanks where necessary.

5.3.8.2.1.3 Drinking Water

The water supply in the Project Area arose from three main sources: public water supply (72 percent or respondents), streams (25 percent), and wells (3 percent).

5.3.8.2.1.4 Existing Waste Management Practices

In the Project impacted area it was noted that the practice was to collect and burn the collected waste. There as no waste collection, segregation and disposal mechanism.

5.3.8.2.1.5 Roads and Bridges

The Project impacted area is connected to the Galchi-Trishuli-Mailung Highway through the Chabbise-Dabalee-Deopeepul Road. Apart from the main Galcchi Trishuli Highway near the Project Area, no other road was paved or could be classified as *pucka or* 'all weather road'.

The village Dhansar was connected to the main Highway through an access road, that was not paved and *kaccha*. Haadikhola and Nandutar settlements were not connected through a motorable road, though there was a cattle trail and small paths that made it accessible.

5.3.8.2.1.6 Existing Power Sources and Facilities

All households reported using the public electricity supply for their energy uses, and reported a connection from the National Grid.

5.3.8.3 Economy

5.3.8.3.1.1 Livelihoods and employment

Approximately 56 percent of the households in the Project Area had individuals who reported agriculture as their primary occupation (Figures 5.3-7 and 5.3-8). It was reported that 98 individuals from the affected community reported agriculture as their primary occupation. The individuals who reported agriculture as their primary occupation, 69 percent did not report any other source of economic activity or income. It was noted that those who reported agriculture as their primary source of income, 20 percent also reported livestock rearing as their secondary occupation.

Only 2 percent of the surveyed population reported livestock rearing as a primary occupation, whereas 24 percent of those who reported a secondary occupation, reported livestock as their secondary occupation. Livestock rearing is used as a means to supplement the income of the households.

Within the category of nonagricultural employment, 28 percent of the households had individuals who reported business and commercial activities as their primary occupation. About 21 percent of the households had individuals who reported foreign employment as their primary occupation. Lastly 18 percent of households had individuals who reported wage labor as their primary occupation.

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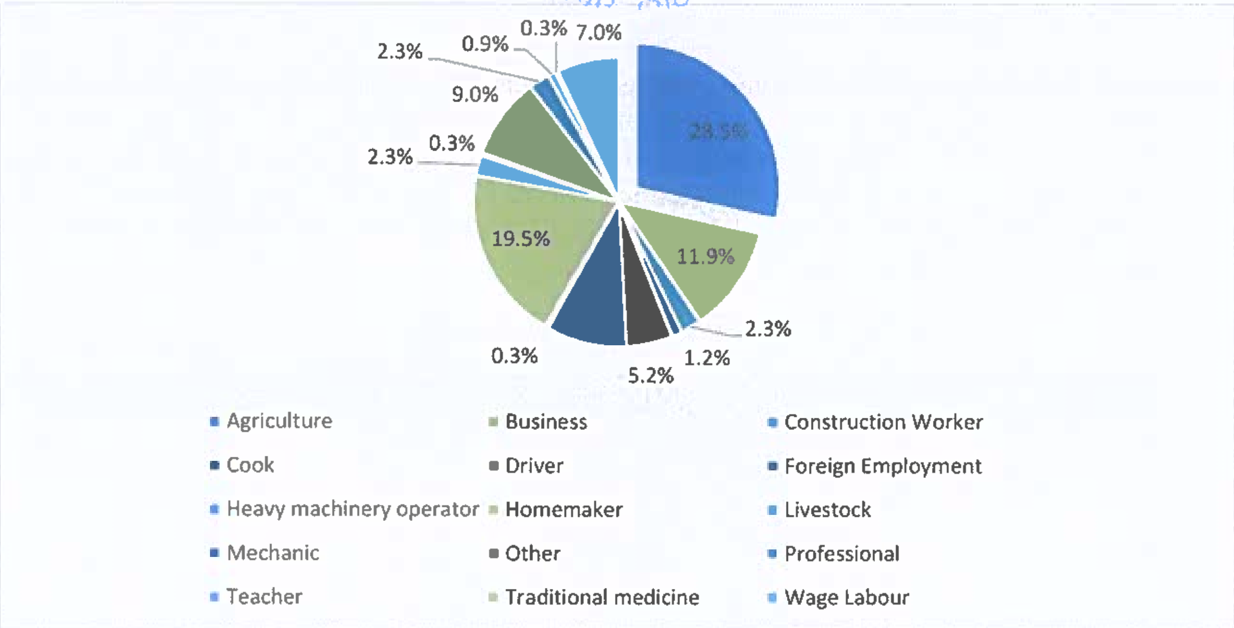
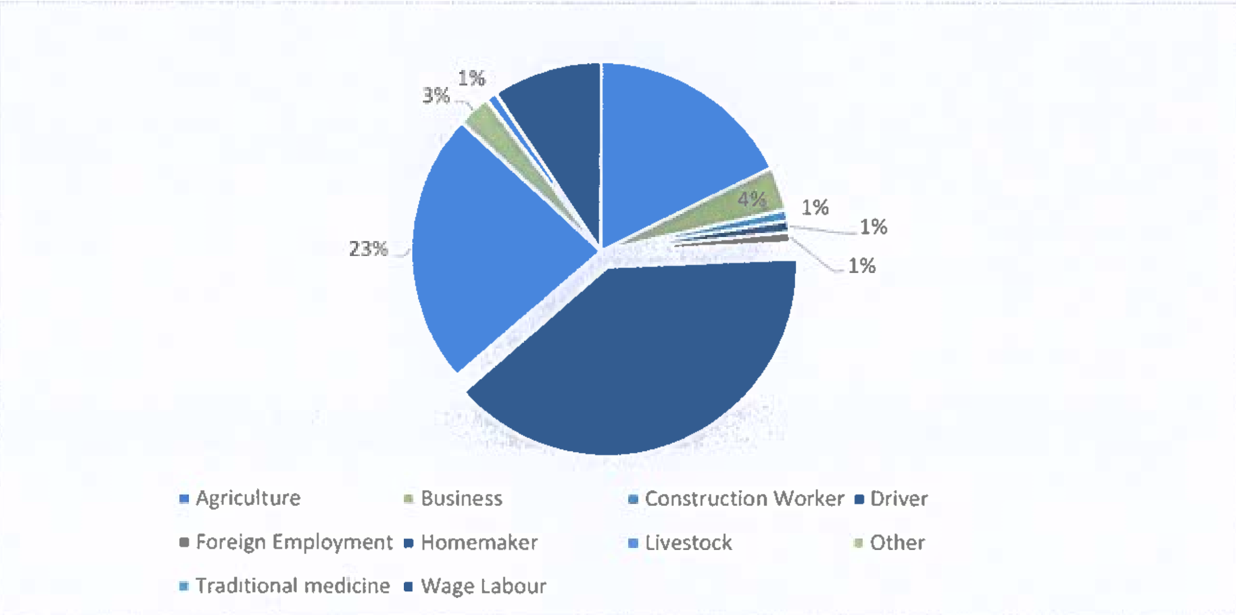


Source: RP 1, Resettlement Surveys, Sept-Oct 2019

Figure 5.3-7: Distribution of type of Occupation of Individuals in the Affected Community (Primary Occupation)



Source: RP 1, Resettlement Surveys, Sept-Oct 2019

Figure 5.3-8: Distribution of type of Occupation of Individuals in the Affected Community (Secondary Occupation)

5.3.8.3.1.2 Land Ownership

Table 5.3-33 presents land holding patterns of affected households, which indicates that 12 percent were landless, with most (83 percent) of the landless households belonging to Adivasi Janajati group and 12 percent belonging to the Dalit group. Out of 215 parcels of land in the area, 58 percent of households reported the owner is also the user of the parcel, and 91 parcels, while 42 percent reported the owner had leased their land, or the land was being used by a registered or unregistered tenant.

Table 5.3-33: Land Holding Pattern across Social Groups

Land Holding	Adivasi Janjati	Brahmin	Chettri	Dalit	Total
No Land	10 (83%)	0 (0%)	0 (0%)	2 (17%)	12 (12%)
Under 0.1 ha	3 (37.5%)	3 (37.5%)	2 (25%)	0 (0%)	8 (8%)
0.1 to under 0.2 ha	7 (47%)	3 (20%)	5 (33%)	0 (0%)	15 (15%)
0.2 to under 0.5 ha	20 (69%)	6 (21%)	3 (10%)	0 (0%)	29 (29%)
0.5 to under 1 ha	11 (55%)	6 (30%)	2 (10%)	1 (5%)	20 (20%)
1 to under 2 ha	10 (76%)	1 (8%)	1 (8%)	1 (8%)	13 (13%)
2 to under 3 ha	3 (100%)	0 (0%)	0 (0%)	0 (0%)	3 (3%)
3 to under 4 ha	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (1%)
Total	64 (64%)	20 (20%)	13 (13%)	4 (4%)	101 (0%)

Source: RP 1, Resettlement Surveys, Sept-Oct 2019

5.3.8.3.1.3 Irrigation

It was reported that 84 percent of parcels were irrigated by using the Haadi Khola (stream) and 16 percent were irrigated by springs.

5.3.8.3.1.4 Livestock Ownership

Most households owned livestock for self-consumption as well as for sale of surpluses.

Table 5.3-34: Livestock in the Project Area

Livestock	Percentage of Total Livestock
Buffalo	26%
Cow, Ox, Calves	16%
Goat	32%
Pig	1%
Poultry	26%

Source: RP 1, Resettlement Surveys, Sept-Oct 2019

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Industry

The Project impacted area has a large commercial entity, namely Nuwakot Itta Bhatti (NIB). The NIB is brick making operation located in Amlitar settlement, with land leased from all around the Project area. The operations of the industry run from October to May, hiring approximately 500 to 600 seasonal workforce every year.

Common Property Resources

Within the Project Area, resources were shared amongst the community. The main CPR were Bhed Khola CFUG and irrigation canal.

5.3.8.3.1.5 Household Income

The average annual household income of the Project area was reported [6] to be NPR 1,207,528. Table 5.3-35 below reflects the average household income levels across various categories for analysis. The average income of those that are likely to be physically displaced is lower than that of the economically displaced household. This can be because 58 percent of the landless population is physically displaced. It was also noted that Dalit households and women led households have a lower average annual income than any other categories. This reflects their vulnerability and the potential for them experiencing adverse impacts more severely, with lower capacities to withstand economic shocks. The highest average annual income reported was for the potentially economically displaced category. While 42 percent of the landless belong to the economically displaced category, this is a small percentage of the overall economically displaced. Further it was seen that the economically displaced tended to have land in the Project area, which was being used by other households or individuals or on rent to commercial entities.

Table 5.3-35: Average Annual Household income for different categories of Affected Community

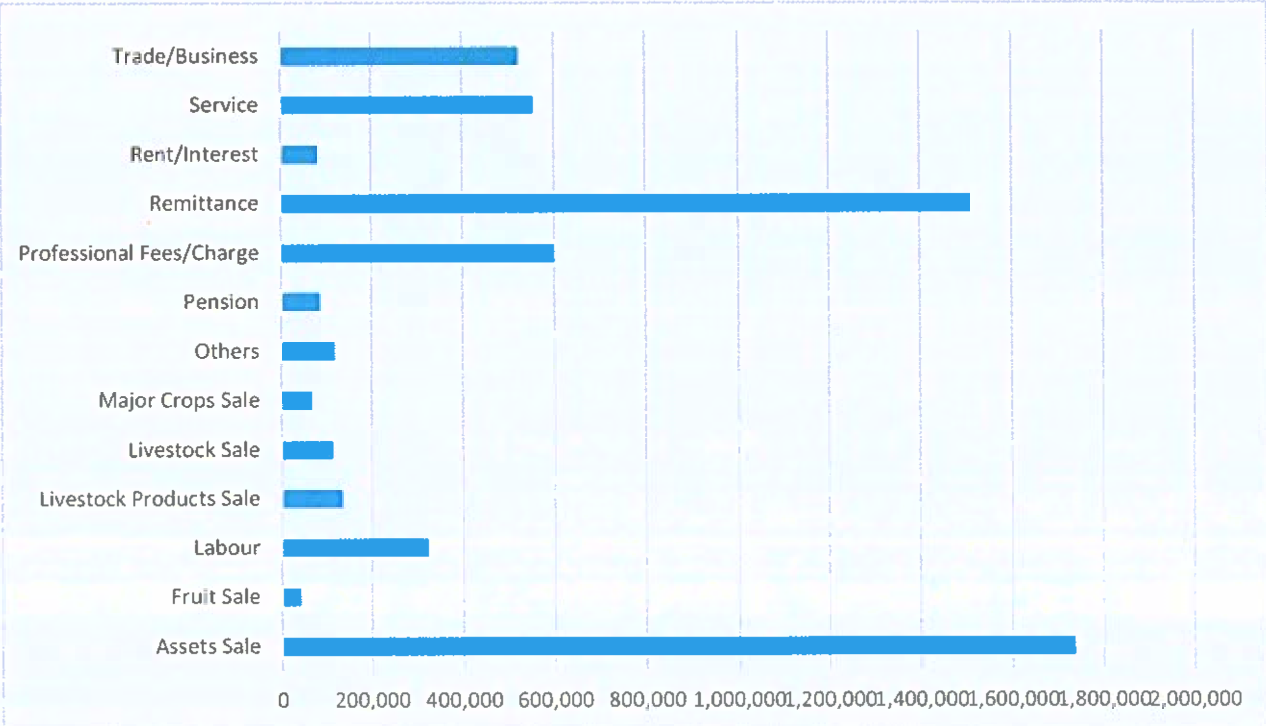
Categories	Average Annual Household Income (NPR)
Affected Community	1,207,528.7
Impact wise	
Economically displaced	1,403,019.7
Physically displaced	838,888.6
Gender of Head of Household	
Female	587,600
Male	1,351,170.7

[6] Income and expenditure reporting in socioeconomic surveys are presented with several caveats as people report these from memory, consult other family members, or may decide to over/under report for other reasons (unstated or unknown).

Categories	Average Annual Household Income (NPR)
Social Group	
Adivasi Janjati	1,275,350
Brahmin	1,285,650
Chettri	107,476.9
Dalit	306,950

Source: RP 1, Resettlement Surveys, Sept-Oct 2019.

Figure 5.3-9 presents sources of income. Major sources of income include asset sales (30 percent of total income), remittances (26 percent), professional fees (10 percent), service (9 percent), trade (9 percent), and wage labor (5 percent).

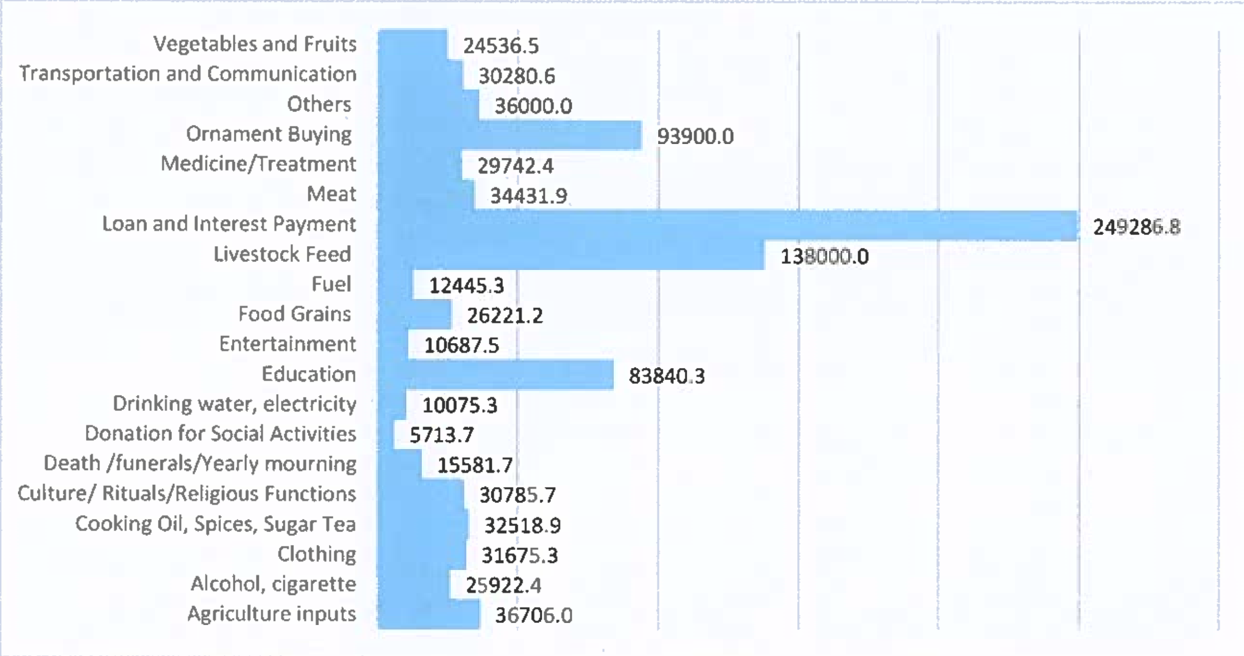


Source: RP 1, Resettlement Surveys, Sept-Oct 2019

Figure 5.3-9: Average income from different sources for the Affected Community

Expenditure

The key heads of expenditure as reported by the affected community ranges from expenditure incurred on loans/rent, housing, food, clothing, entertainment, travel, education, and health care. Broad estimates of net disposable household income were reported to be in the range from NPR 18,000 to 3,440,000 per annum with an average of NPR 512,834 per month depending upon the size of the household, number of earning members, and land and asset ownership. Figure 5.3-10 below shows average expenditure across different categories. Major expenditure categories are for loans and interest payment, livestock feed, ornament buying, and education.



Source: RP I, Resettlement Surveys, Sept-Oct 2019

Figure 5.3-10: Average Expenditure Across Different Categories

5.3.8.3.1.6 Financial Institutions

An approximate 92 percent of the community reported having a bank account, and 87 percent of the community reported having some kind of savings in banks (63 percent), cooperatives (22 percent), and In-house savings (2 percent).

5.3.8.4 Education

Approximately 75 percent of the affected population surveyed were literate. This is higher than the national literacy report of 65.9 percent and also significantly higher than the district literacy rate of 59.8 percent as reported by the Census of Nepal 2011. Male literacy rate (84 percent) is higher than the female literacy rate (67 percent).

5.3.8.5 Health

Across the affected community the main illnesses reported were fever and flu. Apart from flu and fever, the older population reported illnesses such as arthritis and asthma, middle aged population illnesses reported were arthritis, diabetes, diarrhea, and respiratory diseases, and illnesses reported among children were diarrhea and pneumonia. Other illnesses reported by a small percentage of the population were also UTI, Typhoid, and Cancer. Health care facilities included government hospitals, health posts, pharmacy, and private medical centres.

5.3.8.6 Gender and Social Inclusion

The sex ratio of the affected community based on the household survey was 99.3. The Project impacted area reported 19 households that were led by women.

5.3.8.6.1.1 Different Experiences of Men and Women

Approximately only 19 percent of the households in the Project Area, were led by women, this followed by the lower average annual income of women led households, reflect the difference in experience of men and women. Further difference in education opportunities and occupation cement these differences. Some of this is discussed in the section below.

5.3.8.6.1.2 Differences in Education, Literacy, and Income Generation for Men and Women

As per data collected, it was reported that women had a higher rates of illiteracy; 40 percent of women dropouts were due to marriage, followed by 15 percent due to household chores, cementing their traditional role, and lowering the opportunity for women to break from these traditional roles. Women headed households also had a lower average landholding size than that of men headed households.

As reported the predominant occupations reported by women were home maker and agricultural activities. Approximately 30 percent of working age women reported being a homemaker as their primary occupation, and 18 percent of working age women reported being a home maker as their secondary occupation. The women who reported homemaking as a secondary occupation predominantly reported agriculture and livestock as their primary occupation.

Indigenous People

The main ethnic group found in the affected community was found to be Adivasi Janajatis, forming 61 percent of the total population. Within the Adivasi Janajati groups, 32 households or 33 percent of the affected community households self-identified as belonging to the Tamang ethnic group. The other Adivasi Janjati ethnic groups found in the affected community were Newar and Rai, both consisting of 11 households or 11 percent of the affected community each.

5.3.8.7 Culture

Languages Used

About 88 percent of population in surveyed households reported Nepali their mother tongue followed by Tamang (11 percent) and Newari (1 percent).

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Religious Practices

Hinduism is the most commonly practiced religion in the households surveyed with 68 percent of population practicing it. This is followed by Buddhism (26 percent), and Christianity (6 percent).

Cultural & Archaeological Sites, Traditional Places

The main cultural site noted in the Ratmate Project impacted area was Chihan Danda. Chihan Danda is a place in the Bhed Khola CFUG, which is a cremation site for the Tamang community in and around the vicinity. Tamang people from about 10 nearby villages said they use this site to cremate their dead.

5.3.9 Socioeconomic Analysis for Ratmate to New Hetauda Substation TL Segment

This section presents the socioeconomic profile of the RTE–NH TL Segment. The RTE–NH Segment includes 11 wards across 4 municipalities from two districts. This segment starts in Ward 5 Belkotgadhi Administrative Unit, Nuwakot District a mountainous and hilly area and goes south through Ward 11, Hetauda Administrative Unit, Makwanpur District, which includes hilly forests and the Terai. This segment includes Hetauda Substation, which is in Hetauda Nagarpalika, an urban municipality in Makwanpur District. Though largely rural, Hetauda is the largest town (Upamahanarpalika) in the RTE–NH Segment.

5.3.9.1 Demographic Profile

87 households were surveyed in this TL segment during baseline survey using a structured questionnaire. The total population of these 87 households was 430 (Table 5.3-36). The average household size was 6.3, with 35 households reporting seven or more family members. The largest household size in the surveyed population was reported to be with 16 family members, and the smallest with 1 family member.

Table 5.3-36: Number of Households Surveyed in the RTE–NH Segment

Settlement Name	Administrative Unit	District	Total Households Surveyed	Total Population of Households Surveyed
Barahitar	Rakshirang Gaunpalika	Makawanpur	15	70
Goldhunga	Hetauda Nagarpalika	Makawanpur	12	72
Krishna Mandir	Hetauda Nagarpalika	Makawanpur	4	16
Nigranag	Hetauda Nagarpalika	Makawanpur	2	11
Okalche	Kailash Gaunpalika	Makawanpur	9	47
Ruparang	Kailash Gaunpalika	Makawanpur		64

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Settlement Name	Administrative Unit	District	Total Households Surveyed	Total Population of Households Surveyed
Shahid Smarak	Hetauda Nagarpalika	Makawanpur	17	81
Pragati	Hetauda Nagarpalika	Makawanpur	5	21
Bagaicha	Thakre Gaunpalika	Dhading	5	19
Chhotekharkha	Thakre Gaunpalika	Dhading	6	29
		Total	87	430

Source: Household Survey 2019

Caste/ethnic composition of the population in households surveyed included Adivasi Janajati (80.5 percent); Brahmin/Chettri (11.5 percent); Dalit (Kami) (4.6 percent); and others (3.4 percent). The main ethnic groups in the households surveyed include Tamang (55 percent) and Chepang (19 percent).

5.3.9.2 Basic Services

House Ownership

Nearly 95 percent of the respondents said they owned their house and only 5 percent of the households resided in rented accommodations. A variety of types of houses were seen through the RTE–NH Segment. Construction material choices vary by location (hilly areas or plains), rural and urban areas and the affordability and preferences of families. The types of houses (permanent and kuccha) also have an inherent vulnerability to natural hazards. During the April 2015 Gorkha earthquake that struck Nepal, numerous buildings and houses were destroyed. In this area, 67 percent of the surveyed households stated that their residential structures sustained damages due to the earthquake.

Toilet and Sewer Facilities

Almost all the people surveyed who had toilet facilities also had water supply. However, most did not have proper drainage facilities for domestic wastewater disposal. Domestic wastewater (from toilets and kitchens) is discharged directly to the nearby river or into agricultural fields.

Drinking Water

About 64 percent of the households had access to piped drinking water, 29 percent used public taps, and 2 percent relied on stream/river/spring for drinking water.

Existing Waste Management Practices

It was reported that across the three districts in the RTE–NH Segment, there were no wastewater treatment plants. In Makwanpur, solid waste from households in urban area is collected by municipality office and dumped near the bank of Rapti River in ward 10. In Dhading, there is no system of solid waste collection, thus the waste generated is directly disposed in the nearby river.

Roads and Bridges

Major roads in the RTE–NH Segment include Naubise-Palung-Simbhanjyang-Bhainse-Hetauda (Tribhuvan Highway), Palung-Dandabas-Kalikatar Road, Palung-Dandabas-Prithvi Highway, Tribhuvan Highway-Namatar-Kalikatar Road, and Hetauda-Manahara-Raksirang Road. The condition of roads was reported to be very poor. The roads within the villages, including paved and unpaved roads, are not being maintained.

Existing Power Sources and Facilities

Frequent seasonal disruptions to the electricity supply are reported because of strong winds/storms and the long time it takes to make repairs and restore the power supply.

Communication

Of the total population surveyed through the household surveys, more than 70 percent adults use mobile phones with an internet connection. Five households have landline phones. Mobile phones and internet access were reported as the primary means of awareness and communication among all age groups.

Police or Security Agencies

All the areas in the RTE–NH Segment had access to either an Area Police Post or a temporary Police Post. Note that in Makwanpur, state police are deployed in Hetauda to provide security in the city.

5.3.9.3 Economy

Livelihoods and Employment

The total working population was 283 individuals (female: 134 and male: 148), which constituted about 66 percent of the population surveyed. In the RTE–NH Segment, it was report that 57 percent of the households surveyed depended on agriculture, and 21 percent on skilled and wage labor. Remittances are received by households whose members have migrated to other areas for employment and send money back regularly.

Land Ownership

Along the RTE–NH Segment, almost 100 percent of the surveyed households in Dhading district and 88 percent in Makwanpur district have reported that they own land. The average land holding size is about 10 Ropani (0.5 ha), which is much lower than the national average in Nepal, which is 56 Ropani (2.9 ha) in rural areas (USAID n.d.).

Agriculture

Approximately 82 percent or 71 of the households surveyed reported a dependence on agriculture for either income or self-consumption. Major crops cultivated, as reported in the survey were, maize (33 percent or 64 households), millet (17 percent or 33 households), paddy (8 percent or 16 households), potato (7 percent or 13 households), sweet potato (6 percent or 12 households), cauliflower (5 percent or 9 households, onion (4 percent or 8 households). Other crops reported were mustard, garlic, wheat, black gram, banana, and coffee.

Maize is the staple crop in the surveyed area, and an important constituent of the area's food security. In recent years, there is a preference to move from maize production to vegetable crops, which fetch higher incomes for farmers. In Kailash municipality (Hetauda district), farmers obtained better yields and incomes five years ago after they moved to growing cash crops like potatoes and mustard. Of the total households surveyed 62 (71 percent) households reported a shortfall in meeting their household food requirement from their fields.

Irrigation

Irrigation is one of the major problems faced by the community, in the hilly and mountainous areas. Lower-lying settlements have an advantage, as the rivers and streams are easily accessible to proximate farmlands, most of which are irrigated. Upland farmlands are largely rain-fed. In upland areas, farmers use pipes to collect water for irrigation from nearby streams.

Livestock Ownership

Livestock is an important source of cash income for farming households. Common livestock include cows, buffalo, goats, sheep, and pigs. In the RTE–NH Segment, almost 100 percent of the households surveyed owned livestock. Majority of the households own poultry, mainly for sale, followed by goat, cow and then buffalos. Cows and buffalos are reared for milk.

Industry

In the RTE–NH Segment, industries like paper factory, small mills, electric pole factory, sand crusher factory, sand mine, sawmills, and furniture industries were reported.

Common Property Resources

There are 12 community forests in the RoW of this TL segments. No leasehold forests are affected. The communities near the forest are dependent on forests for fodder, timber, fuel, food, Khar (insulation and cattle bedding), and non-commercial animal grazing.

Household Income

Table 5.3-37 presents main sources of household income. Skilled work is the largest source of household income accounting for 22 percent of total household income. This was followed by unskilled work (20 percent), remittance (18 percent), business (12 percent), private service (9 percent), civil service (5 percent), and others (14 percent). About 29 percent of households reported income from sale of agricultural produce.

Table 5.3-37: Sources of Income

SN	Income Source	Percentage of Total Household Income
1	Skilled work	22
2	Unskilled work	20
3	Remittance from abroad	18
4	Business	12
5	Private service	9
6	Civil service	5
7	Other	14

Source: Household Survey 2019

All the employed adults in the surveyed households earned above the minimum wages in the RTE–NH Segment. Based on the household survey, nearly 50 percent of the households lie in the income range of NPR 0 to 20,000 per month, about 42 percent lie in the income range of NPR 20,001 to 60,000 per month (USD 182-545), four households have reported monthly income in the income bracket of NPR 60,001 to 100,000 per month (USD 545-909), and only two household is in the income bracket of NPR 100,001 to 200,000 per month (USD 909-1818).

Household Expenditure

Table 5.3-38 presents major expenditure categories, of which food represented the primary expenditure.

Table 5.3-38: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Food	23
2	Loans repayment Transportation	19
3	Social functions	14
4	Education	12
5	Healthcare	7
6	Transport	7
7	Clothing	7
8	Other	11

Source: Household Survey 2019

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Financial Institutions

Nearly 22 percent of the total population of households surveyed in RTE–NH Segment have a bank account. Of these, 53 percent are male and 47 percent female. Most women have access to other thrift groups like *Amma Samuha* and cooperatives for credit.

5.3.9.4 Education

About 76 percent of the surveyed population in RTE-NH segment were literate. Male literacy rate (82 percent) was higher than the female literacy rate (70 percent).

5.3.9.5 Health

Communities usually access the local health post for common health issues as it is often the nearest health facility. Communities, during the survey, highlighted healthcare challenges in RTE–NH Segment, which includes; no ambulance services, lack of transport facilities and the closure of roads in the rainy season due to landslide risk or landslides.

Due to unavailability of transportation in the area, 86 percent of the people have to walk to the nearest healthcare center, and only 14 percent reported using a vehicle to reach a health center. The average time taken by people to reach the nearest health facility on foot is over one and a half hours, and with a vehicle, about half an hour.

The most commonly reported diseases in the area are typhoid, common fever and cold, diarrhea, malaria, cholera, and skin rash/itches. One person reported having a sexually transmitted disease.

5.3.9.6 Gender and Social Inclusion

The sex ratio of population in households surveyed in RTE-NH segment was 89.9.

Female Headed Households, and Female Ownership of Land and Property

There are only 5 female headed households out of a total of 87 surveyed households. Approximately 6 percent of the households surveyed in the RTE–NH Segment were female headed households, all the female headed households' are in the income bracket of NPR 200,001 per annum (USD 1,818) with an average of NPR 669,419 per annum (USD 6,086).

Differences in Education, Literacy, and Income Generation for Men and Women

Dropouts nationally, and as per consultations with communities in the RTE–NH Segment, were more common among boys than girls. The primary data suggests that the number of men engaged in income generation is significantly higher as compared to the number of women. The occupational profile of males is more varied than the female's occupational profile. Specifically, more men are engaged in skilled labor and regular salaried jobs; whereas none of the women are engaged in these jobs.

Indigenous Peoples and Dalits

Tamang is the main Indigenous group in this segment, followed by Chepangs. Major Dalit groups in this segment are Kami, Damai/Dholi, and Sarki.

Trafficking in Person

Six out of 82 survey respondents said they know about sex trafficking locations

5.3.9.7 Culture

Languages Used

About 53 percent of population in households surveyed in this segment reported Tamang as their mother tongue. This was followed by Nepali (30 percent), Chepang (14 percent), Tharu (2 percent), and Newari (1 percent).

Religious Practices

About 45 percent of population in surveyed households practiced Buddhism which was followed by Hinduism (31 percent), Christianity (22 percent), and others (2 percent). Cultural & Archaeological Sites, Traditional Places, and Festivals

Cultural & Archaeological Sites, Traditional Places, and Festivals

Table 5.3-39 lists all sites of cultural, religious, and/or archaeological significance in the RTE–NH Segment.

Table 5.3-39: Sites of Cultural, Archaeological, Traditional Importance and Festivals in the RTE–NH Segment

District/ Municipality/ Village/ Ward	Tangible Cultural Heritage	Comments
Dhading, Galchi-8	Bagha Bachchhala Devi Temple	Located in Katwal Gaun.
	Devi than shrine	Located in Chainpur.
	Danda Gaun Devi Than shrine	Located in Danda Gaun.
	Chihan Danda graveyard	Located in Naya Gaun.
	Picnic Spot	Located at Chuli.
Dhading, Thakre-2	Kali Devi Mandir	Located in Gharti Gaun.
Dhading Thakre-3	Bhumichuli Mandir Temple	Located in Bhimchuli.
	Jhanda Chuli Tourist Site	Jhandachuli is the center point of Thakrey RM, Galchi RM and Thaha RM of Makwanpur, which is within 100 new tourist

District/ Municipality/ Village/ Ward	Tangible Cultural Heritage	Comments
		destination of Nepal Tourism Board.
	Dhyange Bir Gumba Monastery	Located in Thadokhola.
	Agra Khola	
	Mahesh Khola	
Makwanpur, Hetauda-1	Pathibhara Temple	
Makwanpur, Thaha-8	Rekheshwar Temple Sunkali Temple	
	Bathanchuli	Tourist site
	Buddha Murti Monastery	
	Chyandanda, Chhryoden cremation sites	
	Rekheshwar Mela	Jatra organized during Phagupurnima.
Makwanpur, Kailash-3	Guruma Devi Temple	Yearly Jatra organized in Mangsir.
Makwanpur, Kailash-6	Kalikatar River	

Source: EIA Baseline Survey 2019

5.3.10 Socioeconomic Analysis for the Ratmate to Lapsiphedi TL Segment

This section presents the socioeconomic profile of the identified Project area for the RTE–LAP TL Segment. The RTE–LAP Project area includes 26 wards across eight municipalities from three districts. This segment starts in Ward 6, Belkotgadhi Administrative unit, Nuwakot district goes northeast, through Sindupalchowk district and ends in Ward number 3, Shankarapur Administrative Unit, Kathmandu district. This segment includes the Lapsiphedi substation, which is in Shankarapur Nagarpalika in Kathmandu district. This segment largely traverses hilly and mountainous terrain.

5.3.10.1 Demographic Profile

Total number of households surveyed in the Project area of this segment are 128 covering a total population of 550 (Table 5.3-40). The average household size of the surveyed population was reported to be 5.06, with 40 households reporting a family of 6 or more members.

Table 5.3-40: Number of Households Surveyed in the RTE–LAP Segment

Settlement Name	Administrative Unit	District	Total Households Surveyed	Total Population of Households Surveyed
Samrang	Shankarapur Nagarpalika	Kathmandu	4	15
School Danda	Shankarapur Nagarpalika	Kathmandu	4	27
Dharapani	Shankarapur Nagarpalika	Kathmandu	15	62
Dhalan Tol	Kakani Gaunpalikha	Nuwakot	4	27
Dunde Chautara	Likhu Gaunpalika	Nuwakot	3	11
Gairathok	Belkotgadhi Nagarpalika	Nuwakot	6	20
Gairi Tole	Shivapuri Gaunpalika	Nuwakot	13	59
Lama gaun	Kakani Gaunpalika	Nuwakot	8	50
Maidan Tol	Belkotgardhi Nagarpalika	Nuwakot	10	40
Newar Tol	Shivapuri Gaunpalika	Nuwakot	7	32
Satdobato	Shivapuri Gaunpalika	Nuwakot	8	29
Siddhiganesh	Likhu Gaunpalika	Nuwakot	2	11
Khadkachhap	Melamchi Nagarpalika	Sindhupalchowk	6	28
Mathillo Daha Pokhari	Melamchi Nagarpalika	Sindhupalchowk	20	83
Tallo Daha Pokhari	Melamchi Nagarpalika	Sindhupalchowk	18	52
Total			128	546

Source: Household Survey 2019

Caste/ethnicity distribution of surveyed population included Brahmin/Chettri (23 percent), Newar (7 percent), other Janajati (65 percent); and Dalit (5 percent).

5.3.10.2 .Basic Services

House Ownership

About 98 percent of surveyed (126 out of 128) households owned houses. Most houses used stones, muds, wooden poles, and corrugated iron sheets for construction. There are few concrete houses made of bricks, cement, and aggregates near the Lapsiphedi substation area and Naglebhare market.

Drinking Water

About 92 percent of the surveyed households had access to piped drinking water. About one percent of households used public tap and 7 percent used stream/river/spring as sources of drinking water.

Existing Waste Management Practices

The household survey, and subsequent field visits, found that there were no wastewater treatment plants in the RTE–LAP Segment. In Sindhupalchowk, solid waste from the lower and upper Melamchi bazar is collected by municipality officers and dumped on the lower river bank side; around 150 to 200 meters away from the river bank in lack of proper landfill site.

Roads and Bridges

Major roads in this segment include the Lapsiphedi-Bhotechour-Patalebhanjyang Road, Patalebhanjyang-Sherabagar-Chhahare-Dhikure-Gangate Road (Mid-Hill Highway), Gangate-Devighat-Ratmate-Galchi Road, Tokha-Chhahare Road, and Kathmandu-Ranipauwa-Belkotgadi-Devighat Road. Conditions of these roads are relatively good although it becomes difficult for vehicles during rainy season.

Existing Power Sources and Facilities

Approximately 20 percent of the households surveyed within the RTE–LAP Segment are still not connected to electricity due to their remote location. For those with electricity, frequent seasonal disruptions to the electricity supply are common. This is due to strong winds and/ or storms and is exacerbated by the lengthy timeframes for making repairs and restoring the power supply.

Small hydroelectric projects were reported in Nuwakot District. One operational micro hydropower of 5 kilovolts is reportedly located in Jarsingpauwa, Nuwakot District.

Communication

Youth groups, during FGDs, indicated that communication using mobile phones and the internet is expensive and the local networks require development to improve access and reliability. Despite these challenges, mobile phones and internet access were reported as the primary means of awareness and communication among all age groups. Social media platforms, such as Facebook and Viber, are used most commonly, as are, the radio, newspaper, and television.

Police or Security Agencies

The populations in the RTE–LAP Segment had access to either an Area Police Post or a temporary Police Post. It was noted in Sindhupalchowk, Sima Prahari (Border police) are deployed in Bhotechaur to provide security in Ward 1,2,3,4 and Baune Pate to provide security in ward 5,6,7,12,13.

5.3.10.3 Economy

Livelihoods and Employment

The total working population was 370 (female: 181 and male: 189), which is about 68 percent of the surveyed population. The primary source of livelihood reported in the RTE–LAP Segment was agriculture, followed by livestock rearing and skilled labor. Apart from these, the major sources of income among most households were government allowance, agricultural labor, remittances by migrant workers employed outside and businesses. Sixty-two percent of the households surveyed in the RTE–LAP Segment depended on agriculture, 66 percent on livestock rearing, and 40 percent on skilled labor. Remittances are received by households whose members have migrated to other areas for employment and send money back regularly. Outmigration of youth and working age males, in search of better economic opportunities, is a commonly noted trend, reported in FGDs, in the RTE–LAP Segment.

Land Ownership

The average land holding of the surveyed households was about 2.5 Ropani. The majority of the surveyed population are small and marginal farmers. Landless households were reported in Shivapuri, Melamchi, and Belkotgadhi. In Shivapuri, the Gaunpalika has been leasing land to the landless community, mainly Tamang and Dalit.

Agriculture

Approximately 80 percent or 103 households surveyed reported a dependence on agriculture for either income or self-consumption. Households reported cultivating 2 to 3 main crops in a year, with vegetables at various times as the fourth crop. Major crops cultivated, as reported in the survey were, maize (26 percent or 85 households), paddy (20 percent or 64 households), millet (17 percent or 55 households), potato (7 percent or 22 households), wheat (5 percent or 49 households. Other crops reported were sweet potato, finger millet, mustard, onion, cabbage, garlic, and cauliflower.

Of the total households surveyed 60 (47 percent) households reported a shortfall in meeting their household food requirement from their fields.

According to discussions with farmers and the Ward Chair in Melamchi, farmers have started cultivating high-value crops like cardamom, ginger, Basmati rice, and Mansuli rice in recent years. Tea plantations are also gaining popularity in the area due to a high return. Farmers have started cultivating fruits like kiwi in the last two years and returns have been very high.

Irrigation

Irrigation is one of the major problems faced by the community, as reported by in the farmer group FDGs. Lower-lying settlements have an advantage, as the rivers and streams are easily accessible to proximate farmlands, most of which are irrigated. Upland farmlands are largely rain-fed. In upland areas, farmers use pipes to collect water for irrigation from nearby streams.

Livestock Ownership

Livestock is an important source of cash income for farming households. Common livestock include cows, buffalo, goats, sheep, and pigs. In the RTE–LAP Segment, 88 percent of the households surveyed owned livestock. Milk is also reported to be a major source of income for about two thirds of farming households. According to FGDs with youth in Shankarapur, 40 to 50 percent of households own livestock—goats, cows, and buffalo. They sell up to 10 liters of milk daily, which is sold for NPR 50 per liter (USD 0.45). Shankarapur sends about 400 to 500 liters of milk to Kathmandu every day for sale.

Industry

In the RTE–LAP Segment industries like furniture mill, tea processing units, and poultry farms were reported.

Common Property Resources

Forests and rivers/springs are main common property resources. There are 30 community forests in the RoW of this TL segments. There are no leasehold forests. Households mostly depend on community forests for their fuelwood, timber, and other forest product needs. Sixty-three percent of the households surveyed in the RTE–LAP Segment were dependent on springs for their basic water needs, and 27 percent of the households were dependent on rivers.

Household Income

The average annual income reported from the households surveyed was about NPR 300,000. About 41 percent of households surveyed in the RTE–LAP Segment reported an annual income of less than the minimum wage, NPR 161,400. Of the 103 households that reported dependence on agriculture 48 households, also reported an income from agriculture hence, 47 percent of the surveyed population earned an income from agricultural activities (Table 5.3-41).

Of the 83 Janajati households surveyed in this segment, 67 reported dependence on agriculture for income and self-consumption; within this, 27 households reported an income from agriculture, hence 40 percent of Janajati households that depended on agriculture also earned an income from it.

Table 5.3-41: Sources of Income

SN	Income Source	Percentage of Total Household Income
1	Skilled work	19
2	Remittance from abroad Business	18
3	Civil service	13
4	Private service	12
5	Business	8
6	Pension	5
7	Other	25

Source: Household Survey 2019

Household Expenditure

On average, amongst the households surveyed, the highest proportion of expenditure was on food, which accounted for 24 percent of the average total expenditure across all households (Table 5.3-42). The reported annual average expenditure of a household from the sample population was approximately NPR 290,000 (USD 2,636), and the annual average income per household surveyed in RTE–LAP Segment was approximately NPR 300,000 (USD 2,727), indicating no scope for savings.

Table 5.3-42: Household Expenditure Categories

SN	Expenditure Category	Percentage of Total Household Expenditure
1	Food	24
2	Interest and loans repayment	15
3	Education	14
4	Social functions	12
5	Healthcare	9
6	Clothing	9
7	Transport	5
8	Other	12

Source: Household Survey 2019

Financial Institutions

Approximately 20 percent of those surveyed in the RTE–LAP Segment have opened a bank account About 33 percent of the households surveyed in the RTE–LAP Segment reported having taken a loan from cooperatives and 34 percent from credit groups like *Amma Sammu* or women's groups and cooperative societies. About 16 percent of those surveyed borrow from banks, and only 4 percent of those surveyed rely on local moneylenders.

5.3.10.4 Education

Literacy rate was 71 percent. Male literacy rate (82 percent) was higher than the female literacy rate (60 percent). It was reported that the majority of population that reported dropouts (33.5 percent) reported economic hardship as a reason for it.

5.3.10.5 Health

In the RTE–LAP Segment, both private and public healthcare are available. There are also health camps in the settlements for people to access better healthcare. Note that for common health issues, communities usually access the local health post, as it is often the nearest facility. If further investigations or treatment is required, people tend to visit the nearest private hospital. Communities, during the household survey, highlighted concerns about the quality of treatment available at local health posts, including concerns about medicines being frequently unavailable.

The most frequently reported diseases during the household survey included common fever, colds, respiratory tract infections, blood pressure problems, and cholera. Reproductive health is the most common concern among women in the RTE–LAP Segment.

Cholera was one of the most common communicable diseases reported in the RTE–LAP Segment. Limited availability of safe drinking water and safe wastewater disposal could be some of the reasons for this. Within the RTE–LAP Segment, four people reported the presence of sexually transmitted diseases.

5.3.10.6 Gender and Social Inclusion

Female Headed Households, Female Ownership of Land and Property

Women headed 10 percent of the households surveyed in the RTE–LAP Segment. According to the district census data, female ownership in Kathmandu district for both land and house is 14 percent, whereas male property ownership accounted for 77 percent. This trend is similar when compared with the household survey conducted in the RTE–LAP Segment where only 10 percent of females reported ownership of houses.

Differences in Education, Literacy, and Income Generation for Men and Women

In the households surveyed in the RTE–LAP Segment, more women over the age of 40 years than men were educated, whereas below 40 years of age more men were educated. Dropouts nationally, and as per household surveys in the RTE–LAP Segment, were more common among boys than girls. Of the households surveyed in the RTE–LAP Segment, it was reported that the female to male ratio within the working population is 48:52. Despite the relatively even gender distribution, the household survey results suggests that the number of men engaged in income generation is significantly higher as compared to the number of women. The occupational profile of males is more varied when compared to the female occupational profile. More men are engaged in skilled labor and regular salaried jobs; whereas none of the women are engaged in these types of jobs. Wage payment for women is at least NPR 50 to 100 per day lower than men.

Indigenous Peoples and Dalits

Tamang is the main Indigenous group in this segment. Other indigenous groups include Newar, Magar, Gurung, and Rai. Major Dalit groups in this are Kami, Damai/Dholi, and Sarki.

Trafficking in Person

About 16 percent of survey respondents said they know about sex trafficking locations.

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5.3.10.7 Culture

Languages Used

Nepali was reported as the primary language (66 percent) for the majority of the population in the RTE–LAP Segment, followed by Tamang (31 percent), primarily in Sindhupalchowk and Nuwakot, and Newari (2 percent), primarily in Kathmandu.

Religious Practices

Hinduism is the religion practiced by most households (54 percent) in the RTE–LAP Segment, followed by Buddhism (44 percent).

Cultural & Archaeological Sites, Traditional Places, and Festivals

Table 5.3-43 lists all sites of cultural, religious, and/or archaeological significance in the RTE–LAP Segment.

Table 5.3-43: Sites of Cultural, Archaeological, and Traditional Importance and Festivals in the RTE–LAP Segment

Location	Tangible/Intangible Cultural Heritage	Comments
Kathmandu, Shankarapur-1	Ganesh Temple	
	Cremation Site	
	Kulthan	Two sites identified
Kathmandu, Shankarapur-2	Kundeshower Temple	
	3 graveyards	
Kathmandu, Shankarapur-3	Narayan Temple	
	Samden Choiling Gumba	The monastery is in Kulamani.
	Sunuwar Ghat cremation site	This is located at Dovan Khola.
	Narayanthan Jatra festival	This Jatra takes place in Kulamani.
	Narayanthan Jatra	This Jatra is especially organized by Tamang community.
	Kafal Chaur Kulthan	Kafal chaur is also a historical site.
Sindhupalchowk, Melamchi-1	Jhakrigaun Ghat cremation site	Used by Tamang communities.
	Mahadev Khola (Khalde Khola) Jarke Khola	
	Mane historic site	This mane is in Jhakrigaun.

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Location	Tangible/Intangible Cultural Heritage	Comments
	Sacred Rocks	Chisapani Bhang—Jhakrigaun and Kokka Tole.
Sindhupalchowk, Melamchi -2	Mahadev Khola (Khalde Khola) Kathe Khola Thade khola	
	Maha Devisthan shrine	This shrine is in Sayelchhap.
	Devisthan historic site	Sayelchhap
Sindhupalchowk, Melamchi -3	Teej Jatra/Mela	This Mela is organized in Kaule bazaar.
	Thadekhola, Kaule Khola Sindhu River	Kaule dovan
	Gumbas	Worshipped by Gurung community in Dadhathok.
Sindhupalchowk, Melamchi-4	Shiva Temple	This Temple is in Rauta Gaun.
	Devisthan Gumba	This monastery is in Devisthan.
	Loshar Mela	This mela is organized in Devisthan.
	Sindhu River	
	Rauta Kulthan	It is located in Rauta Gaun
	Devisthan Gumba	Archaelogical site located in Devisthan.
Other cultural sites in Melamchi includes Okhreni (jatra is organized here at Kulyan Mandir), Devi than, Krishna Mandir in Deurali, Shiddheswor Mahadev (Cremation place), Lokeshwori Mandir (mela is organized in Magh), and Kalikathan, Dapokhri, Bhumethan Mandir in Dabauri.		
Nuwakot, Likhu 3	Malakot Ganesh Temple	People worship Ganesh on Ganesh Chaturthi.
	Budhishera Mahadev Temple	Located in Pandey Gaun.
	Chun Devi Temple	Located in Bhaladmi Danda.
	Tar Devi Temple	Located in Chaukhuda.
	Niranjana Temple and Nagigadhi Temple	
	Jalapa Than shrine	
	Mathillo Ban	Sedhai Kul than
	Malakot Ghat	Located in Malakot.
	Dhandephedi Ghat	Located in Dhandephedi.
	Tadi Khola Ghat	Located in Dunde.
	Gupteshwore Mahadev Cave	
	Nagigadhi Jalapa	Tourist site
Nuwakot, Likhu-5	Satbishewor Madhev Temple	It was damaged by 2015 earthquake and is in very critical state

Location	Tangible/Intangible Cultural Heritage	Comments
	Niranjanthan	
	Niranjana Bhagawati Temple	Located in Belaspur. Jatra takes place in Ramnawami.
	Saraswati Temple	Located in Siddhiganesh.
	Satbiseshwor Mahadev Temple	Located in Dunde.
	Pathak Kul Than	Located in Dunde Chautara.
Nuwakot, Likhu-6	Mahadevsthan Temple	Located in Birta.
	Bachchhala Sthan Temple	Located in Makai Chaur.
	Brahma Chetra cremation site	
	Bhandari Kul Than	
	Lampati archaeological site	
Nuwakot, Panchakanya-5	Kattikeshwor Temple	
	Dupcheshwor Temple	Located in Budhisera.
	Bachhala Devi Temple	Jatra in Teej & Mangsir Purnima. Located in Situala Gaun.
Nuwakot, Belkotgadhi-5	Kumari Devi Temple and Jhilkeshwor	
	Duipipal Dabali	Duipipal is famous for Gai Jatra where local Newar society celebrate on Janai Purnima for 3 days.
	Sundera Devisthan	Other includes Bramachitra, ghats around the banks of the river, small areas where small jatras are organized.
	Kolpu Khola	ETP crosses Kolpu khola when it enters Dhading district.
Nuwakot, Belkotgadhi-6	Lidekhola Mahadev temple	
Nuwakot, Belkotgadhi-7	Kali Devi Temple	Chettri community of Dhansar worship Kali Devi every Dashain.
	Dudhara Devi Temple	Dudhara Devi is worshipped during Dashain. Located in Jhape.
	Jaljala Devi Temple	Rai community worship Jaljala Devi. It lies at the bottom of Big Pipal tree in Dhansar.
	Shila Devi Temple Ban Devi	
	Gumba Danda	Tamang community celebrate Lhosar here.
	Chihan Danda	Cremation site for Tamang community.
	Jhape Community Forest (Chihan Danda)	Used by Tamang communities for cremation.

Location	Tangible/Intangible Cultural Heritage	Comments
	Chhabise Ghat	Located near RTE Substation. Used by Brahmin, and Chettris for funeral.
	Dhansar Ghat	Located near Substation. Used by Brahmin, Chettri for cremation.
	Chandretar kul than	Chandretar is located in RTE 7.
	Chalpleti kul than	Chapleti is located in RTE 3 which is used by Bandhu Samaj as kulthan.
	Neupanetar kul than	It is located in RTE 4 which is Kulthan of Neupane Bandhu samaj.
	Jhape Khola, Kalchhe Khola, Trishuli River	
	Thulo Khola	
Nuwakot, Belkotgadhi-8	Dhitalmunto kulthan	Adhikari community worship as their Kul dewata.
Nuwakot, Belkotgadhi-9	Gajurel Kulthan	Located in Jamune Chautara.
	Gajurel Kulthan	Located in Karunakar.
Nuwakot Belkotgadhi-10	Niranjana Mai (Maidantol) Temple	Worshipped by Hindus in Dashain.
	Kotbarahi (Putalibazaar) Temple	Worshipped by Hindus in Dashain.
	Radha Krishna & Ram Mandir Temple	Located in Putalibazaar.
	Cremation sites	Located in Basnetgaun.
	Historical Site	Belkotgarhi is supposed to be built during the time of Great King Prithvi Narayan Shah.
Nuwakot Belkotgadhi-10	Basnet Kul than	Located in Basnet Gaun and worshipped by Basnet community.
	Tadi River	River lies within 400 meters of the ETP.
	Belkot River	
Nuwakot Belkotgadhi-12 & Likhu-3	Sindure River	
Nuwakot, Belkotgarhi-12	Basuki Temple	Jatra is organized here during Fagu Purnima.

Source: EIA Baseline Survey 2019.

5.4 PUBLIC OPINION

FGDs, KIIs and public hearings provided opportunities for public to voice their concerns about the ETP project.

5.4.1 Findings of FGDs

Table 5.4-1 summarizes key concerns raised during FGDs by different groups and KIIs with key stakeholders. Details of FGDs and KIIs are included in Annex I-3 and I-4. Findings of FGDs and KIIs are also discussed in Section 5.3. The impact assessment and proposed mitigation measures to address these concerns are addressed in Chapters 7 and 8, respectively.

Table 5.4-1: Summary of FGDs and KIIs by Different Groups

Focus Groups/Key Informants	Major Issues and Potential Benefits Identified
Farmers Group	• Lack of irrigation facilities, collection and storage units for agricultural produce; • Impact on agricultural land; • Communities will benefit from support in the agricultural sector; • Transportation facilities, marketplace for agricultural products; • Improved seeds and fertilizers for commercial agriculture
Women's Group	• Lack of health facilities, especially related to maternal and reproductive health; • Unequal wage distribution among men and women, and economic dependency of women on men; • Perceived health concerns from transmission line project; • Loss of land another major concern amongst women; • Less ownership of property amongst women, and a need for income generating trainings; • Need for drinking water facilities was also expressed in some areas.
Youth Group	• An interest in foreign employment was expressed by youth groups across municipalities; • Employment and skill trainings are a priority amongst this group; • High rate of school dropout and drug addiction was reported amongst youths in some areas.
Adivasi/Janajati Group	• Lack of adequate basic infrastructure including health, education, irrigation and drinking water facilities; • Impact on land and cultural resources; • Declining interest in traditional skill related work was expressed during these meetings.

Community Forest Users Group	• Ensure proper mitigation measures for impact on community forest; • Management of forest fire; • Identify land for afforestation programs nearby; • Promotion of forest-based enterprises, lack of irrigation facilities and a need for vocational trainings was expressed during the consultations with CFUGs.
Leasehold Forest Users Group	• Agriculture and livestock-based trainings and access to the market are some of the key concerns expressed by Leasehold Forest Users Group (LFUGs).
Local Government	• Lack of adequate basic infrastructure including health, education, irrigation and drinking water facilities, road infrastructure amongst others; • Visual impacts from many TL projects; • Land acquisition and compensation will be a major concern for the communities; • Impact on the existing infrastructure; • Employment opportunities, enterprise development and skill-based trainings were considered a priority for economic development; and • Migration for foreign employment one of the critical concerns.
NEFIN	• Lack of adequate basic infrastructure including health, education, irrigation and drinking water facilities were the major concerns amongst this group. These concerns were also reflected during the consultations with Adivasi/Janajati groups; • Impacts on cultural heritage, and vulnerable Adivasi/Janajati groups; • Issues related to formal land title documents amongst some communities; • Need for inclusive and culturally appropriate consultations;
FECOFUN	• Concerns raised by FECOFUN includes management of forest fire, promotion of forest-based enterprises, lack of irrigation facilities and a need for vocational trainings; • Impact on community forest and measures to ensure proper mitigation measures; • Dependency of the communities on the community forest; • Increasing interest in promotion of NTFPs and processing plants.
DFO	• Concerns raised by the DFOs echoes with those raised by CFUGs and LFUGs including management of forest fire, promotion of forest-based enterprises, lack of irrigation facilities and a need for training with a focus on forest-based /enterprises; • Impact on biodiversity and forest fragmentation; • Compensatory plantation and afforestation programs; • Decrease in animal poaching across the proposed alignment;

5.4.2 Public Hearing Summary

Table 5.4-2 provides a summary of public hearings and participants. Overall, 1,557 people participated (Male 1278 and Female 279) in the public hearing (refer to Annex J for details). The participants were also given an opportunity to provide additional comments and suggestions on the EIA within seven days through the public information centers located in each district. The public hearings were video recorded and the videos are available from MCA-Nepal.

Table 5.4-2: Summary of Participation from Public Hearing

S.N.	District	Local Level (Rural Municipality (RM)/Municipality)	No of PH	Male	Female	Total
1	Kathmandu	Shankarapur (2019-12-04)	1	22	0	22
2	Sindhupalchowk	Melamchi (2019-12-05)	1	90	6	96
3	Nuwakot	Shivapuri (2019-11-28), Panchakanya (2019-11-27), Likhu (2019-11-26), Belkotgadhi Mun. (2019-11-24), Tarkeshwar RM (2019-11-25)	5	290	60	350
4	Dhading	Galchi RM(2019-11-28), Thakre RM (2019-11-29), Nilkantha (2019-12-01), Siddhalekh RM (2019-11-27), Gajuri RM (2019-11-26), Benighat Rorang RM (2019-11-25)	6	220	54	274
5	Makawanpur	Thaha (2019-12-05), Kailash RM (2019-12-04), Raksirang RM (2019-12-03), Hetuda SMC (2019-12-02)	4	164	40	204
6	Chitwan	Ichchhyakamana RM (2019-11-29)	1	56	10	66
7	Tanahu	Abukhaireni RM (2019-12-01), Bandipur RM (2019-12-02), Vyas (2019-11-25), Rishing RM (2019-11-26), Ghiring RM (2019-11-27)	5	172	60	232
8	Palpa	Rampur (2019-11-28), Nisdi RM (2019-11-29)	2	116	21	137
9	Nawalparashi (Bardaghat Susta East)	Binayeetribeni RM (2019-12-01)	1	43	14	57
10	Nawalparashi (Bardaghat Susta West)	Bardaghat (2019-12-02), Sunwal (2019-12-03), Ramgram (2019-12-04), Palhinandan RM (2019-12-05)	4	105	14	119
		Grand Total	**30**	**1278**	**279**	**1557**

Table 5.4-3 presents major concerns/issues, expectations and proposed responses by the MCA-Nepal. Responses to major concerns/issues, their impacts, and mitigation measures are presented in chapters 7, 8, and 9. Annex C presents recommendation letters and Annex J presents attendance sheets, notice published and details of issues raised by stakeholders during public hearings in all 30 municipalities, including proposed responses by MCA-Nepal.

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Table 5.4-3: Major Issues/Concerns Raised during Public Hearing

SN	Issue	Response
1	**Alignment Change:** Several commenters requested changes in tower locations and transmission line alignment to avoid or minimize impacts on their property. A few requests involved the change of a group of towers, which included IB-NB towers 45 to 51, and 15 to 22; RTE-NH towers 46 to 58 and the alignment near the New Hetauda substation; and RTE-LAP towers 150 to 152. Similarly, there was a strong demand in Lapsiphedi area to reroute transmission line via Shivapuri National Park.	After the public hearing, MCA-Nepal, engineering, environmental and social team visited and evaluated all sites where people had requested for alignment changes. Adjustments in the alignment were done where feasible, and the EIA was updated accordingly. Those areas, where it was not possible to change the alignment for technical, environmental, and social reasons; stakeholders were provided reasons why it could not be done so. Refer to Chapter 6 – Alternatives for more details, especially Table 6.1-4.
2	**Compensation:** People also raised concerns about the compensation for the tower pads and the RoW land. Concerns included: lack of representation of affected people in Compensation Fixation Committee (CFC); undervaluation of land; low easement rate for RoW land; delay in compensation as experienced in past transmission line projects.	MCA-Nepal is obligated to follow GoN regulations while determining the land prices. However, as per MCC Environmental guidelines, MCA-Nepal compensates affected people based on replacement principle. MCA-Nepal has prepared a Resettlement Policy Framework (RPF) which clearly outlines compensation policies and procedures. Refer to Annex I-9 for the RPF.
3	**Electrical and Magnetic Field (EMF) and Health Risk:** People were worried that EMF from transmission lines would cause health problems including cancer, heart diseases, abortion among women, electrocution, etc.	MCA-Nepal added a new mitigation measure, which includes an education and awareness raising program for local communities, and enforcement of proper RoW regulations. Refer to Sections 8.4 and 9.2 for EMF education outreach program.
4	**Pressure on Community Resources:** People also raised concerns that the Project would put undue pressure on community resources in the vicinity of project area, such as roads, drinking water, and health facilities. Based on their past experience, similar projects caused damage to their local roads and left the damaged roads unrepaired. Projects also lead to pollution in the nearby areas.	The EIA has prepared a detail ESHSMP (Chapter 9) to address these issues. ESHSMP will be strictly enforced.
5	**Impact on Community Forests:** Community forest user groups (CFUGs) were concerned that the Project would fell trees in their forests and reforestation would happen in other areas. They were also worried that they would not receive adequate compensation for their loss. They complained that past transmission projects did not consult with them while preparing reforestation and compensation programs.	MCA-Nepal has been closely interacting with the Federation of Community Forestry Users Nepal (FECOFUN). FECOFUN representatives accompanied MCA-Nepal and EIA team in all public hearings. FECOFUN and CFUGs would be involved during the preparation of Forest Clearance and Forest Land Use Permit preparation as well and also during the design of compensatory plantation program. There are mitigation measures included in Chapter 8 specifically committing to making sure the CFUGs receive all appropriate compensation.

SN	Issue	Response
6	**Impact on Households without Land Titles:** Stakeholders also voiced their concerns that the Project would not provide compensation to people living in the land without legal land titles although they may have been living in those lands for a long time. This concern was raised mostly by indigenous people.	RPF (Annex I-9) outlines process and procedure for compensating unregistered land and structures.
7	**Impacts on Birds and Wild Life:** Stakeholders were also concerned that the Project would adversely impact birds and other wildlife in project area.	The Consultant Team has proposed new mitigation measures including programs to offset impacts on bird species.
8	**Employment:** Stakeholders requested skill-based training and employment opportunities for local residents.	MCA-Nepal will encourage the Design and Build Contractor to hire locally and give preference to qualified local residents as well as women, disadvantage, and marginalized groups (see Chapter 9)
9	**Benefit Sharing Programs**: Stakeholders also demanded that the Project should provide them direct and immediate benefits such as support to community infrastructures, subsidized electricity, shares in the project, and electrification, with prioritization of benefits for disadvantaged or marginalized groups (e.g., Chepangs, Dalits)	MCA-Nepal has prepared a MCA Partnership program, which aims to address these concerns. See Section 8.1 – Enhancements.

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CHAPTER SIX
ALTERNATIVES ANALYSIS

An alternatives analysis is a critical component of an Environmental Impact Assessment (EIA) and is essential in identifying a preferred option for achieving the Project purpose. This importance of alternatives analysis is reflected in the Nepal EIA regulations, which require consideration of alternatives. The Hydropower Environmental Impact Assessment Manual (MoFE 2018) recommends considering alternative technologies, modes of operation, locations for ancillary and associated facilities, financing, project phasing, forest cover, location, and structure design. Based on this guidance, the following alternatives were considered in determining the final alignment and design for the proposed ETP:

- Location Alternatives, including ancillary and associated facilities (Section 6.1)
- Design Alternatives, (Section 6.2)
- Construction Alternatives (Section 6.3)
- No Forest/Less Forest Alternative (Section 6.4)
- Technology, Operating Procedures, Phasing/Time Schedule, and Raw Materials Alternatives (Section 6.5)
- Financing Alternatives (Section 6.6)
- Non-Implementation Alternative (Section 6.7)

These various alternatives are described below.

6.1 LOCATION ALTERNATIVES

Location alternatives are especially important because they offer the greatest potential for avoiding environmental and social impacts, the first step in the mitigation hierarchy.

As described in Chapter 2, the Ministry of Energy, Water Resources & Irrigation (MoEWRI) of Nepal has prepared a Transmission System Development Master Plan of Nepal (July 2018). The key element of this Plan is a 400 kV "backbone" transmission line stretching East – West across the hill region of Nepal to evacuate power from planned hydroelectric projects and connect major demand hubs in this region, as well as provide six cross-border connection points for power export to India and two connection points for power export to China. MCA-Nepal ETP forms an important part of this East-West backbone. The proposed ETP part of this backbone was selected by wider consultations between MCC, the Government of Nepal, and other stakeholders in Nepal considering other donors' on-going and proposed programs.

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6.1.1 Substation Selection Process

As indicated above, the agreement between the GoN and the MCC specially indicated that the transmission line would extend from the India Border to the planned New Hetauda and Lapsiphedi substations (Compact 2017). Further, the Detailed Feasibility Study (DFS) conducted by Tetra Tech, Inc., (Tetra Tech 2017), upon which the Compact was based, recommended the Project construct three new substations at New Butwal, New Damauli, and Naubise, in accordance with the Transmission System Development Plan.

As Table 6.1-1 shows, planning and land acquisition for four of the five substations included in this agreement are quite advanced. Nepal Electricity Authority (NEA) and various international development banks have already conducted an environmental and social screening for four of the five substation sites (with the exception of Naubise) and all were found to be acceptable.

Table 6.1-1: Substation Planning and Land Acquisition Status

Substation	Planning Status	Status of Land Acquisition
New Butwal	Agreement with Asian Development Bank	Completed
New Damauli	Agreement with KfW Development Bank	In process
Naubise	To be planned and constructed by MCA-Nepal	Not Started
New Hetauda	Agreement with World Bank	Completed
Lapsiphedi	Agreement with Asian Development Bank	Completed

Field investigations were conducted at the Naubise substation site and it was determined that this site was not well suited for a substation as the terrain was too steep, with an elevation difference across the site of about 60 meters, and site access was difficult, requiring road grades of over 10 percent with a series of sharp turns.

MCA-Nepal (then Office of Millennium Challenge Nepal) identified and evaluated four alternative sites. Figure 6.1-1 shows the locations of these alternatives sites and Table 6.1-2 compares the four alternative sites. Based on this evaluation, MCA-Nepal recommended Alternative II, referred herein as the Ratmate site, because it encompassed less fertile land and was already heavily disturbed by an existing brick factory operation. Alternative III was determined not to have sufficient land available for the substation and Alternatives I and IV encompassed highly fertile and irrigated land.

Subsequently, MCA-Nepal adjusted the final location for the Ratmate Substation to reduce the amount of physical displacement, including avoiding the physical displacement of vulnerable households mostly belonging to the Rai ethnic group, and providing better orientation for the several transmission lines connecting with this substation. Figure 6.1-2 shows the recommended location for the Ratmate substation.

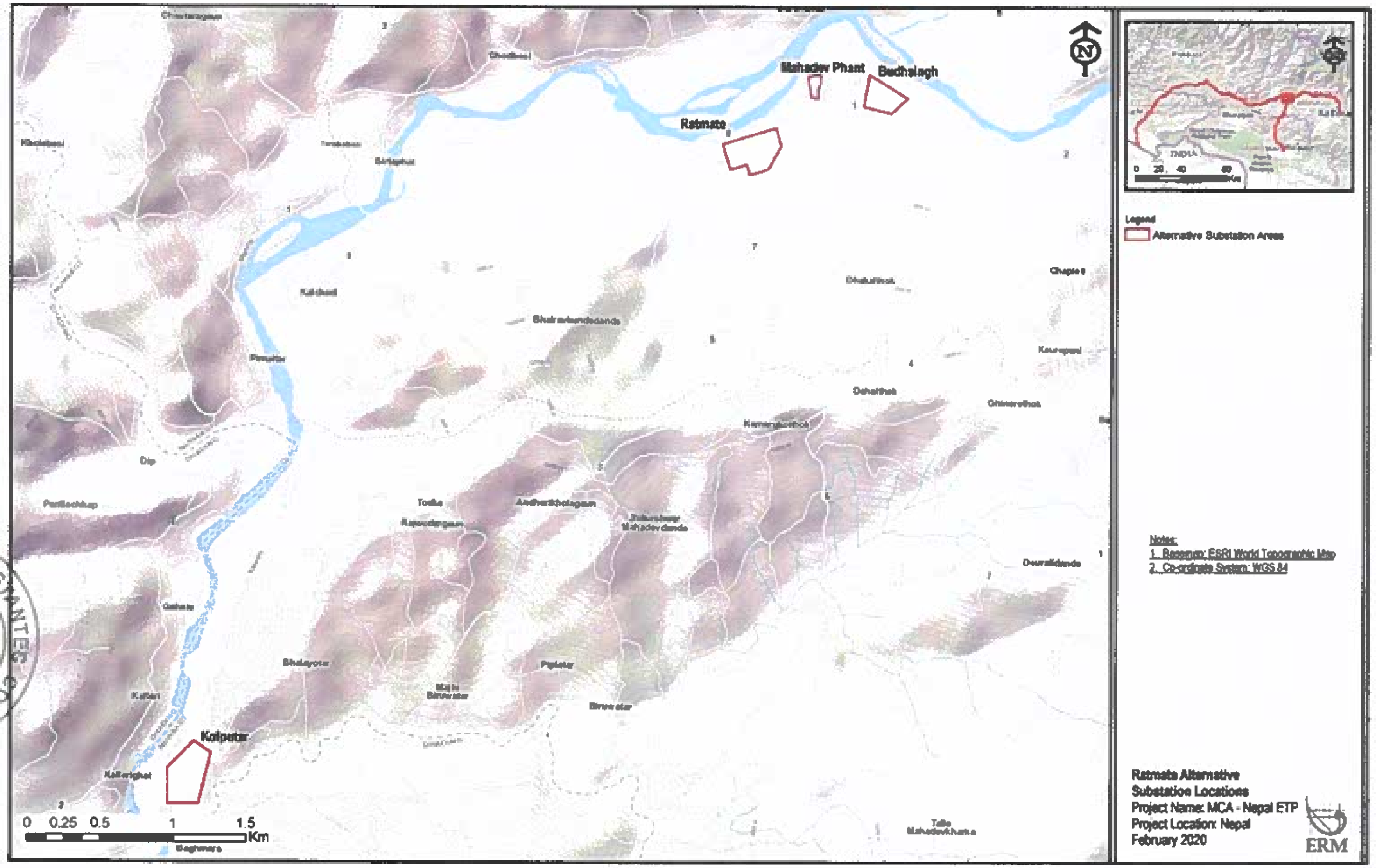


Figure 6.1-1: Naubise Substation Alternative Locations

Table 6.1-2: Naubise Substation Alternatives Analysis

Details/Site Name	Alternative I	Alternative II	Alternative III	Alternative IV
Location	• Kolputar Nuwakot District	• Ratmate Nuwakot District	• Mahadev Phant Nuwakot District	• Budhsingh Nuwakot District
Physical Environment	• 4 kilometers away from Prithvi Highway (Galchhi) • Flat terrain adjacent to Galchhi-Trishuli Highway • East of Trishuli river • Sufficient flat land available for both GIS and AIS substation • Fertile agricultural land with irrigation facility • No problem of soil erosion and slope instability as the site is relatively flat • There is a stream to the east of site, where a tributary of Trishuli river is passing • No problem of drainage, river cutting and water logging	• 10 kilometers away from Prithvi Highway (Galchhi) • Slightly sloped terrain adjacent to Galchhi-Trishuli Highway • Land area is sufficient only for construction of GIS station • Less fertile land without irrigation facility • Land is being used by brick factory at present • Soil erosion and slope instability may occur when additional surcharge occurs due to the substation construction hence a retaining wall will need to be built • An existing stream passes through the selected site. This stream discharges a continuous groundwater flow and seasonal rainwater from about 12 hectares of land in the upstream.	• 11 kilometers away from Prithvi Highway (Galchhi) • Flat terrain adjacent to Galchhi-Trishuli Highway • Land area is not sufficient for construction of new substation • Fertile agricultural land with irrigation facility • No problem of soil erosion and slope instability as the site is relatively flat • No problem of drainage, river cutting and water logging	• 11 kilometers away from Prithvi Highway (Galchhi) • Land area is sufficient only for construction of GIS station • Flat terrain adjacent to West of Trishuli river • Access road construction necessary • Fertile agricultural land with irrigation facility • No problem of soil erosion and slope instability as the site is relatively flat • No problem of drainage, river cutting and water logging
Recommended Site	Alternative II - Ratmate			

AIS = Air Insulated Substations; GIS = Gas Insulated Substations

Figure 6.1-2: Proposed Ratmate Substation Area

6.1.2 Transmission Line Route Selection Process

The agreement between the GoN and MCC, consideration of the Transmission System Development Master Plan (MoEWRI 2018), and the final recommended location for the Ratmate Substation established the five substations to which the transmission line needed to connect. The route selection process described below started from this basis and focused on optimizing the best route for the transmission line to connect between the Indian border and these five substations.

Given the length of the ETP and the need to comply with the International Finance Corporation (IFC) Performance Standards, as a condition of the agreement between the GoN and MCC, MCA-Nepal undertook a comprehensive and collaborative approach for selecting the route for the Project, which engaged stakeholders throughout the route selection process. Route selection involved a three-stage process:

- Stage 1: Detailed Feasibility Study Process – conducted in 2016 to 2017 and resulted in the development of the DFS Alignment (Tetra Tech 2017);
- Stage 2: Scoping Process – conducted in July to November 2018 and resulted in the Scoping Alignment, which was the alignment presented in the Scoping Document and Terms of Reference (ToR) submitted to the Department of Electricity Development (DoED) and the Ministry of Forests and Environment (MoFE) for review;
- Stage 3: EIA Process – conducted from November 2018 to February 2020 and resulted in the development of the recommended alignment presented in this EIA, which is referred to as the EIA Alignment.

Each of these stages is discussed in more detail in the following sections.

This route optimization process involved a set of criteria that were applied throughout the route selection process. These criteria were developed by the Consultant Team to avoid or minimize environmental and social impacts while providing a robust and constructible design for the ETP.

The criteria included the following:

- Physical and Engineering Criteria for tower siting:
  - Avoid extremely steep areas (slopes steeper than 35 degrees);
  - Avoid active or potentially active rock fall and colluvial (talus) zones and debris flow outwash fans;
  - Avoid landslide prone areas;
  - Avoid areas with poor soils;
  - Avoid areas with elevations over 2,000 meters to minimize corona discharge;

- Minimize the number of difficult to access tower sites;
- Minimize the number of river/reservoir crossings;
- Minimize the number of tower sites in floodplains;
- Minimize angle structures for cost reasons; and
- Use the shortest route practicable (other factors being equal).

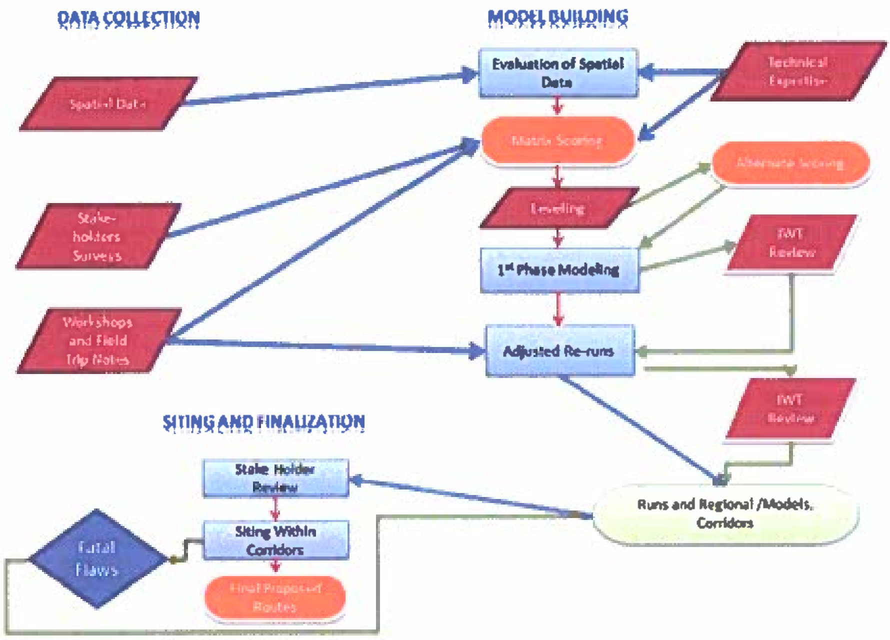
- Environmental Criteria for RoW alignment:
  - Avoid protected areas (e.g., National Parks, Wildlife Reserves, Ramsar wetlands, and their buffers);
  - Avoid or minimize other areas of international or national conservation interest (e.g., Important Bird Areas as identified by Birdlife International and Bird Conservation Nepal; World Wide Fund for Nature [WWF] - Nepal Biodiversity Hotspots; and Kulekhani Watershed);
  - Avoid bat caves;
  - Avoid National Trust for Nature Conservation/WWF Long Term Climate Change Monitoring Plots;
  - Minimize forest clearing;
  - Avoid known vulture, griffon, crane, ibisbill, and eagle nesting and roosting areas; and
  - Minimize crossing of major bird flyways.

- Social Criteria for right-of-way (RoW) alignment:
  - Avoid towns, villages, and settlements;
  - Avoid cultural heritage resources, both tangible and intangible resources;
  - Avoid community facilities (e.g., playgrounds, ritual sites);
  - Avoid impacts on tourism and trekking areas;
  - Minimize the need for physical displacement;
  - Minimize the need for economic displacement;
  - Minimize impacts on highly productive agricultural land;
  - Minimize impacts to indigenous communities;
  - Minimize impacts to planned municipal development areas; and

– Minimize impacts to Community, Leasehold, and Religious Forests.

6.1.2.1 Stage 1: Detailed Feasibility Study Process

The DFS started with an initial route, which was based on a desktop study performed by NEA and primarily considered engineering criteria (Tetra Tech 2017). MCA-Nepal then applied a Multi-Criteria Route Selection Methodology for developing a preliminary TL route (see Figure 6.1-3). The methodology considered all available data and incorporated siting criteria developed by technical experts, in collaboration with key stakeholders. This approach involved the following four steps for establishing the proposed route (Tetra Tech—Volume 2 2017):



Source: Tetra Tech 2017

Figure 6.1-3: Multi-Criteria Route Selection Process

- **Step 1: Gather Data**—Gathered and verified data in the form of geo-referenced GIS layers for the general RoWs suggested by MCA-Nepal and NEA as a starting point for the routing process. The project benefited from receiving extensive GIS information on environmental conditions from WWF-Nepal, and various governmental agencies.
- **Step 2: Implement the Linear Routing Tool (LRT)** — applied the LRT, a proprietary transmission line routing model, which involved providing weights to each of the attribute layers being used in the model. These weights were originally assigned by the multi-disciplinary team, and then modified using stakeholder preferences gathered during an October 2016 workshop and responses to a questionnaire. The weights informed the model about the features that should receive higher importance than others.

- **Step 3: Fine Tune the Routes** — the results of the LRT were then reviewed using multi-criteria analysis by overlaying the LRT-preferred routes on Google Earth imagery and fine-tuning the routes using current data, the local knowledge of the team's national experts, and the concerns of the stakeholders.

- **Step 4: Refine using PLS-CADD**—The LRT routes were then refined using PLS-CADD software program, which is a sophisticated three-dimensional engineering model that enables the integration of terrain, tower structures, and wires to ensure the design complies with international standards (e.g., line sag and clearance criteria). Minor route changes were made where needed by the design constraints.

  As discussed above, planning and land acquisition for four of the five substation sites were well advanced. NEA and the various development banks had already conducted environmental and social screening for four of the sites and all were found to be acceptable. MCA-Nepal did re-evaluate each of these four proposed substation sites to confirm its suitability for use as a substation relative to physical, environmental, and social criteria. MCA-Nepal is responsible for the location, land acquisition, and construction of the fifth substation at Ratmate. The revised route, which was the culmination of the DFS process, is referred to herein as the DFS Alignment.

6.1.2.2 Stage 2: Scoping Process

The Consultant Team initially reviewed and refined the DFS Alignment using:

- Helicopter overflight of the route – to better understand the terrain and land use;

- Worldview Aerial Imagery, 50 centimeter resolution, in four bands (i.e., red, green, blue, and near-infra-red), mostly 2017/2018 imagery data – to more clearly identify buildings, forests, and cultural sites;

- A 9 meter resolution digital terrain model topographic data - to identify potential landslide areas, buildings, and steep slopes;

- A field reconnaissance survey – to validate data on the ground;

- An Initial Alignment Workshop in September 2018 – which provided MCA-Nepal, NEA, DoED, MoFE, and representatives of various civil societies and conservation organizations the opportunity to discuss and provide input on the alignment;

- Public scoping meetings in 31 potentially affected municipalities in September and October 2018 – to better understand stakeholder's issues and concerns; and

- Additional engagement with key stakeholders, such as Bird Conservation Nepal (BCN), WWF Nepal, President Chure Terai Madesh Conservation Development Board (PCTMCDB), International Union for Conservation of Nature (IUCN) Nepal, and others.

This process led to the development of the Scoping Alignment, which served as the basis for the Scoping Document and ToR.

6.1.2.3 Stage 3: EIA Process

The Consultant Team continued to optimize the alignment as additional and higher quality data and additional stakeholder input were obtained, which included:

- Obtaining LiDAR data, which included current (January 2019) high-definition aerial imagery, video of the study area, detailed topography, with structures and trees identified in three dimensions for a 400 meter wide (expanded in some areas) RoW. These data were entered into PLS-CADD to allow three-dimensional RoW optimization and tower spotting. Several figures have been included below to demonstrate the effectiveness of using LiDAR and how it is superior to other forms of photography/data. Figure 6.1-4 compares the original 9 meter Digital Terrain Model (DTM) with the LiDAR imagery for a tower along the New Damauli to Ratmate Substation. Figure 6.1-5 compares Google Earth and more current LiDAR imagery, which clearly shows a new building not appearing on the Google Earth image. Figure 6.1-6 shows how LiDAR can be used to identify unstable slope areas.
- Completing field physical, biological, social, and cultural baseline studies across the study RoW to identify and better understand RoW constraints;
- Conducting geotechnical and soil boring surveys at approximately 58 locations across the study RoW that were representative of geologic and soil conditions along the alignment;
- Gathering cadastral maps and forest information (e.g., government, community, leasehold, religious forests);
- Using MCA-Nepal ESP Community Assistants and the Consultant Team's Community Liaison Officers to collect and field validate local data;
- Meetings with indigenous peoples' representatives, community forestry user groups, and civil society groups;
- Meetings with potentially affected businesses (e.g., Shankarapur Paragliding Pvt. Ltd.); and
- Preparing a Constructability Report of both representative and targeted tower locations for field-truthing and to assess potential access, likely construction methods, and typical construction equipment to be used for tower construction.

As a result of reviewing these additional data and consulting with various stakeholders, the alignment was optimized. Table 6.1-3 summarizes the more substantial modifications that were made to the TL alignment as a result of higher quality data and stakeholder input.

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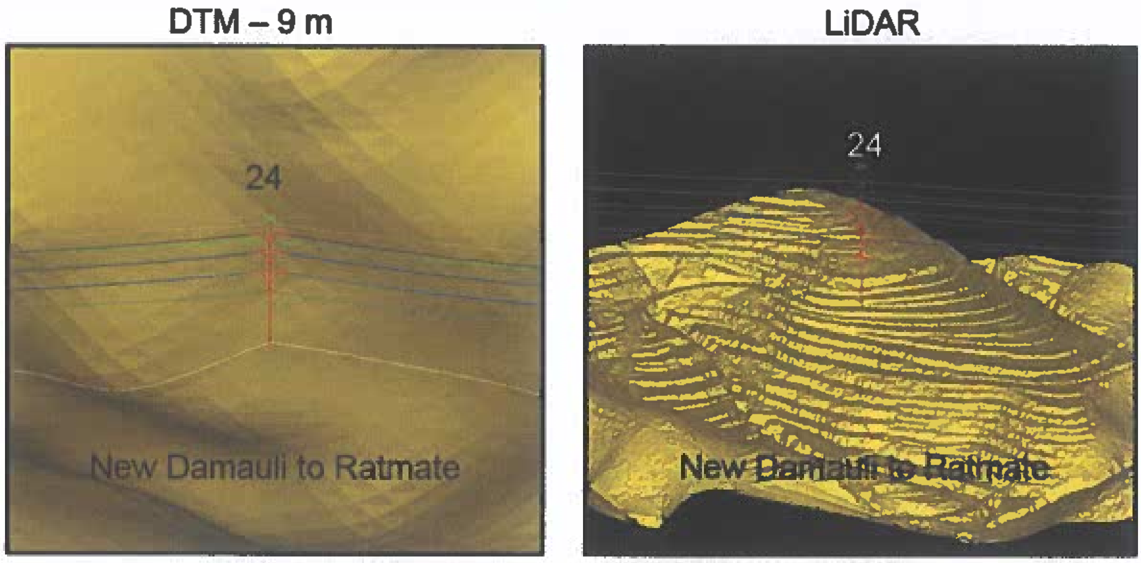

Figure 6.1-4: Comparison of 9 meter DTM and LiDAR

Figure 6.1-5: Comparison of Google Earth and LiDAR Imagery

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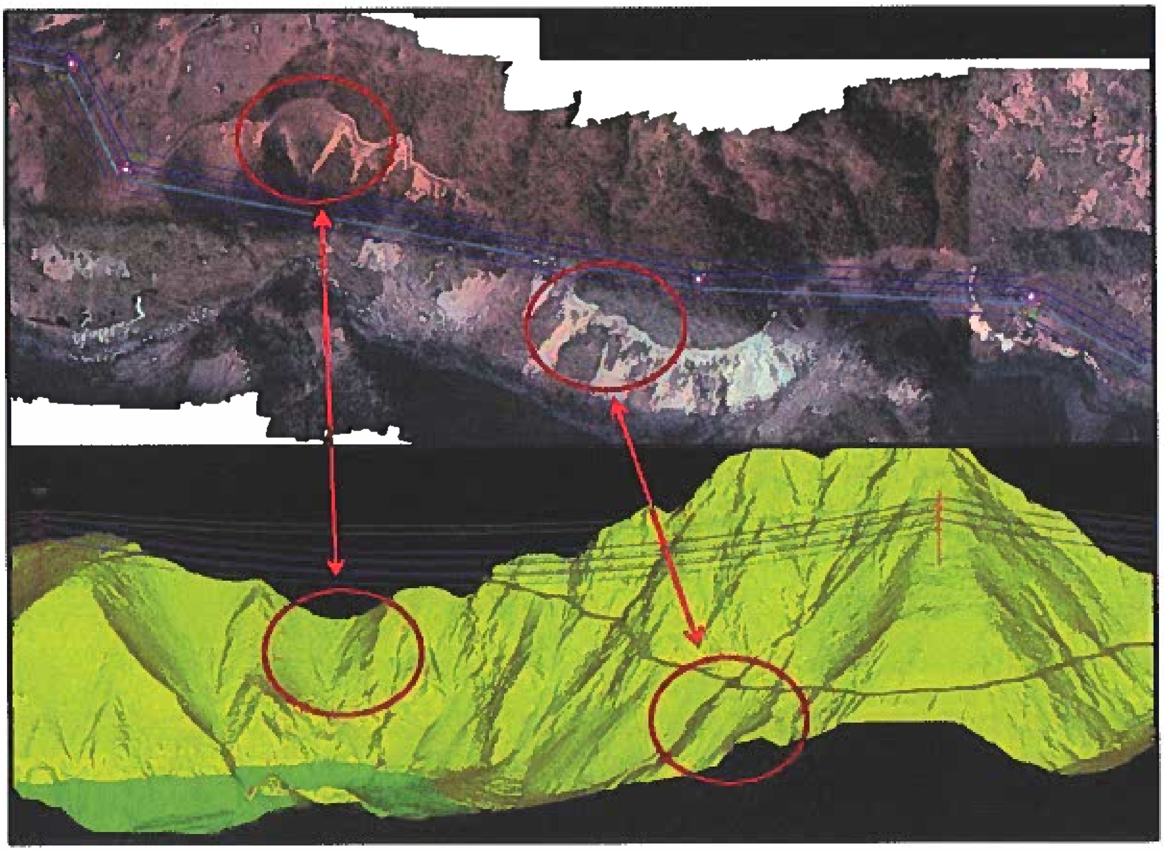

Figure 6.1-6: Example Using LiDAR to Identify Unstable Slopes

Table 6.1-3: Substantial Transmission Line Modifications for the EIA Alignment

Segment/Towers	Modification
India Border to New Butwal Substation	
Towers 30 - 35	Moved towers to increase buffer to a Lesser Adjutant Stork colonial nesting area, an globally threatened Vulnerable species by the IUCN, colonial nesting area from approximately 400 meters to over 900 meters
New Butwal to New Damauli Substation	
Towers 1 - 15	Re-routed alignment to avoid NEA 220 kV line
Towers 19 - 79	Modified alignment to reduce forest clearing and avoid unstable terrain in the Chure Conservation Area
Towers 140 - 153	Modified alignment to avoid Hindu temple/Himalayan Griffon roosting area.
Towers 156 - 246	Modified alignment to avoid the Seti Gorge and double crossing of the Seti River bird flyway
Towers 228 - 246	Modified alignment to avoid the Tanahu Hydroelectric Project and associated transmission lines
New Damauli Substation	Designed substation to avoid three community-identified religious trees
New Damauli to Ratmate Substation	
Towers 60 - 74	Moved towers lower off steep slopes
Tower 175 - 185	Modified alignment to avoid conflicts with road and bridge and to maintain buffer to religious cave
Towers 192 - 196	Moved tower lower off steep slopes
Towers 198 – 205	Modified alignment to avoid impacts on a village
Towers 223 - 236	Moved tower lower off steep slopes
Towers 234 - 244	Modified alignment to avoid an important bird nesting/roosting area along the Trishuli River
Ratmate to New Hetauda Substation	
Towers 1 - 29	Modified alignment to reduce disturbance of steep slopes
Towers 35 – 40	Modified alignment to minimize impacts on Dumsikharka Community Forest
Towers 81 – 91	Modified alignment to avoid steep slopes and Chepang village
Towers 112 - 137	Modified alignment to minimize impacts on town of Hetauda, physical resettlement, provide enhanced bird protection per Bird Conservation Nepal guidance, and to provide more buffer to Parsa National Park
Ratmate to Lapsiphedi Substation	
Towers 4 – 40	Modified alignment to avoid a double crossing of the Trishuli bird flyway
Towers 99 - 108	Modified alignment to minimize physical resettlement and social impacts
Towers 120 - 125	Modified alignment to provide more buffer to the Shivapuri-Nagarjun National Park

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Consultation meetings on the draft final alignment resulting from all of the activities above were held as follows:

- Revised Alignment Workshop (May 2019) - to ensure MCA-Nepal and NEA's support of the revised alignment and substation design;
- Conservation Organizations Consultation (June 2019) - with BCN, WWF Nepal, and PCTMCDB to get their input and to ensure their recommendations received during the route selection process were appropriately incorporated into the revised alignment. Each of these organizations indicated that they supported the revised alignment;
- Affected Municipality Consultation (June 2019) – with affected district, municipal, and ward officials, community forest user group representatives, and other key stakeholders at meetings in each of the 30 affected municipalities, to share with them the revised alignment. MCA-Nepal made the following changes to the alignment based on these municipal consultations (see meeting summaries in Annex J):
  - Melamchi Municipality – adjusted towers to avoid unstable terrain;
  - Galchhi Municipality – adjusted RoW to avoid a temple;
  - Kailash Municipality – adjusted RoW to avoid a limestone mine and provide more buffer to a school and health post;
  - Ichchhyakamana Municipality – adjusted RoW to provide more buffer to a school;
  - Ghiring Municipality – adjusted RoW to increase buffer to some villages;
  - Rampur Municipality – adjusted RoW to avoid Tappudham/Khatang temple and school;
  - Sunwal Municipality – adjusted RoW to avoid a religious area; and
  - Ramgram Municipality – adjusted RoW to reduce impacts on a planned development area
- EIA Public Disclosure Meetings – were held in all 30 affected municipalities in November and early December 2019.

The Consultant Team pegged the corners of the proposed transmission line towers in the field between June and early November 2019 prior to the EIA public disclosure meetings so property owners and other stakeholders could better understand and visualize the location of the proposed towers. This pegging resulted in the filing of a number of grievances as part of MCA-Nepal's Grievance Redressal Mechanism (GRM, see Section 3.4 Stakeholder Consultation), most of which related to tower locations, as well as comments during the EIA public disclosure meetings. MCA-Nepal has been in discussions with those who filed grievances, and has agreed to make several changes to the alignment to minimize environmental and social impacts and to address community concerns (Table 6.14).

Table 6.1-4: Substantial Transmission Line Modifications in Response to Grievances and Public Disclosure Meeting Comments

Segment/Towers	Modification
India Border to New Butwal Substation	
Towers 15 - 22	Moved towers to reduce impacts on high value cropland, proposed gas facility, and property owners
Towers 45 - 51	Moved towers to reduce impacts on high value cropland and property owners and obtain better alignment with the New Butwal substation bays
New Butwal to New Damauli Substation	
Towers 1 - 16	Coordinated with NEA to agree upon use of quad-circuit towers for this section of the transmission line to serve both the MCA-Nepal 400 kV double-circuit transmission line as well as the NEA Lamahi 400 kV double-circuit transmission line. The use of quad-circuit towers in this section significantly reduces social and economic impacts in this relatively densely developed area. See Section 2.6.2.1 (Transmission Towers) for additional details.
Tower 198	Moved tower to avoid impacts on land given to provide access to a school
New Damauli to Ratmate Substation	
Towers 177 - 180	Moved towers to reduce impacts on high value agricultural and
Towers 184 - 187	Modified alignment to avoid a proposed substation and to reduce social impacts.
Towers 241 - 248	Modified alignment to reduce impacts on a municipal planned industrial park and social impacts
Ratmate to New Hetauda Substation	
Towers 1 - 2	Modified alignment to create two quad-circuit towers for the ETP New Damauli to Ratmate and Ratmate to New Hetauda segments to reduce social impacts and provide better orientation with the Ratmate Substation bays
Tower 4	Moved this tower to avoid a Tamang cremation site
Towers 46 - 58	Modified alignment to avoid impacts to a residential area, avoid a damaged monastery, and provide a more direct route with fewer towers
Towers 133 - New Hetauda Substation	Modified alignment in close coordination with municipal officials to reduce community impacts.
Ratmate to Lapsiphedi Substation	
No changes	

Some tower optimization, primarily in terms of tower siting within a parcel, may still occur as part of the RAP process,

6.1.3 Comparison of Major Alternative Alignments

This section compares the three major alternative alignments considered (see Figure 6.1-7):

- DFS Alignment – the alignment recommended in the DFS Final Report (green line);
- Scoping Alignment – the alignment presented in the ETP Scoping Document and ToR (blue line); and
- EIA Alignment – the alignment proposed in this EIA (red line).

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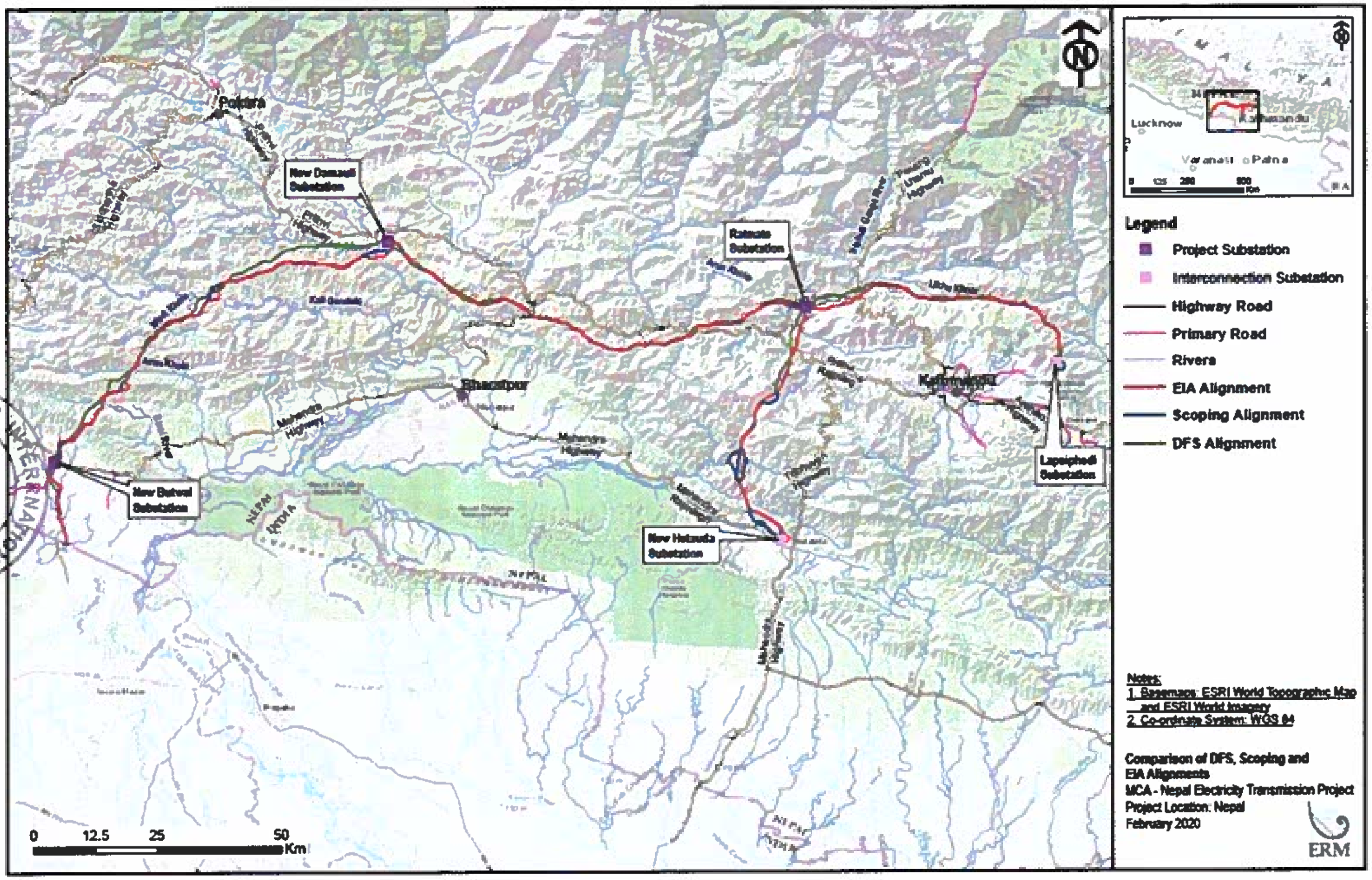

Figure 6.1-7: Comparison of DFS, Scoping, and EIA Alignments

Table 6.1-5 compares each of these alternatives against a variety of physical, environmental, and social metrics. Relative to the original DFS alignment, the EIA alignment is shorter, has fewer towers, crosses fewer important bird flyways and municipalities, covers less forest, and affects fewer buildings.

Table 6.1-5: Comparison of Alternative Alignments

Metrics/Alignments	DFS Alignment	Scoping Alignment	EIA Alignment
Engineering/Physical Metrics			
Length (kilometers)	325	308	314
Towers (#)	1,069	1056	856
Large River Crossing (#)	9	7	5
Hydropower Reservoir Crossings (#)	1	1	0
Highway Crossings (#)	14	15	9
Transmission Line Crossings (#)	Existing—8 Proposed—11	Existing—8 Proposed—12	Existing—8 Proposed—15
Biological Metrics			
Areas of Conservation Interest Crossed	3	3	2
Important Bird Flyways Crossed (#)	8	7	3
Forest Land in RoW (hectares)	772	565	697[1]
Social Metrics			
Municipalities Crossed (#)	36	31	30
Land in RoW (hectares)	1495	1417	1,438
Residences in RoW (#)	546	491	187
Agricultural Land in RoW (hectares)	606	645	585

The EIA Alignment is the preferred alignment when compared to the two initial alignments for the following reasons:

- Comparison with the DFS Alignment – the EIA Alignment is 11 kilometers shorter (i.e. affects less land); has 213 fewer towers (i.e. affects fewer land owners); crosses fewer large rivers, hydropower projects, and major roads; avoids the Shivapuri-Nagarjun National Park buffer (which the DFS alignment encroaches into); crosses five fewer important bird flyways; crosses less forest land; affects 66 percent fewer residences (i.e. will result in substantially less physical resettlement); and affects 3 percent less

[1] Excludes shrub/scrub habitat in order to allow direct comparison with other alignments.

agricultural land. For these reasons, the EIA Alignment is preferred over the DFS Alignment.

- Comparison with the Scoping Alignment – the EIA Alignment is approximately the same length (i.e. about 2 percent longer); has 200 fewer towers (i.e. affects fewer land owners); crosses fewer large rivers and hydropower projects; avoids the Shivapuri-Nagarjun National Park buffer (which the Scoping Alignment encroaches into); crosses four fewer important bird flyways; affects 62 percent fewer buildings (i.e. will result in substantially less physical resettlement) and 9 percent less agricultural land.

  The EIA Alignment has about 27 percent more forest land within the RoW, but simply comparing the amount of forest within the alternative RoWs is not the best metric for assessing forest impacts. For example, MCA-Nepal will be using some large towers to allow longer spans (up to 1500 meters) for use especially in spanning large river valleys (e.g., Seti River) and areas with difficult terrain. In addition, many of the towers are tall (i.e. the average tower height is 61 m) with conductors that can span over much forest and still meet the required clearance over the tree canopy (see Table 2.6-1). This combination of fewer towers, special long span towers, and taller towers greatly reduces the need to clear the underlying forest. Therefore, overall, the EIA Alignment is preferred from a technical, environmental, and social perspective over the Scoping Alignment.

6.2 DESIGN ALTERNATIVES

MCA-Nepal is committed to meeting international good practice standards for the design and construction of the ETP, and has considered several alternatives relating to the specific design of the substations and transmission lines. It has developed a project-specific Design Manual, which includes, in addition to engineering criteria, environmental and social standards that will be integrated into the overall project design (PEI 2018). These environmental and social design standards include the following:

- IFC Performance Standards (IFC 2012);
- World Bank Group Environmental, Health and Safety General Guidelines (World Bank Group 2007);
- World Bank Group Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (World Bank Group 2007); and
- *Avian Power Line Interaction Committee Reducing Avian Collisions with Power Lines – The State of the Art in 2012*, including the installation of visibility enhancement objects such as marker balls, bird deterrents, bird flight diverters, suspended devices, solar powered reflectors, and/or aerial marker spheres on static lines to increase line visibility to birds and reduce bird-line collisions, especially where lines cross known flyways.

Design alternatives not specifically addressed in the Design Manual, such as the capacity of the system and underground vs aboveground transmission lines, are also discussed below.

6.2.1 Capacity Alternatives

The Project was envisioned from the start to be a 400 kV transmission line system and to serve as a significant portion of the backbone 400 kV transmission line network proposed in the Transmission System Development Plan of Nepal (MoEWRI 2018). Nevertheless, as part of a cost-benefit optimization study, a 220 kV system was evaluated as an option to the 400 kV system solution (Tetra Tech 2017). This analysis found that the 220 kV scenario was less desirable than the 400 kV scenario for the following reasons (See Table 6.2-1):

- Places a greater burden on other 220 kV lines in the region;
- Limits annual electricity consumption by almost 5 percent;
- Reduces annual electricity exports slightly because of capacity constraints at the New Butwal substation;
- Increases environmental and social impacts because of the need to construct additional transmission lines to meet electricity demand.

For these reasons, a 400 kV capacity line was determined to be most appropriate.

Table 6.2-1: Comparison of 400 kV and 220 kV Capacity Alternatives

Scenarios	Annual GWh Consumption	Annual GWh Loss	Annual GWh Load Shedding	Annual GWh Export	Annual GWh Unused Generation
2023 @ 400 kV	15,211	342	1,701	2,895	-
2023 @ 220 kV	15,195	349	1,717	2,899	-
2030 @ 400 kV	25,007	1,081	3,082	8,572	38
2030 @ 220 kV	23,873	1,008	4,216	8,273	356

Source: Tetra Tech 2017

6.2.2 Transmission Line Right-of-Way Width

The standard RoW width for a 400 kV transmission line in Nepal is 46 meters. Reducing this RoW width would increase the potential for incompatible development occurring adjacent to the transmission line and would increase the risk of exceeding international standards for exposure to electric and magnetic fields. As discussed in Section 7.2, a 46 meter wide RoW will meet the International Commission on Non-Ionizing Radiation Protection standard for chronic exposure to electric and magnetic fields at the edge of the RoW – so there are no health risks for anyone living outside of the proposed 46 meter wide RoW. A narrower RoW would provide less protection to electric and magnetic fields.

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Increasing the RoW width would result in increased land acquisition and costs, and potential for additional environmental impact, with no identified benefits. Therefore, there are no compelling reasons to adjust the proposed RoW width.

6.2.3 Tower Types and Heights

All line segments will utilize double circuit lattice type galvanized steel frame structures. The towers shall typically be of the following standard types, as stated in the Design Criteria (see Table 6.2-2).

Table 6.2-2: 400 kV Double Circuit Towers

Tower Type	Angle	Tower Designation	Number of Towers
Suspension	0-2⁰	DA	126
Tension	2-15⁰	DB	255
Tension	15-30⁰	DC	164
Dead End	30-60⁰	DD	25
Dead End	0-30⁰	DE	148
Dead End	30-90⁰	DF	129
Station Gantry			9
Total			856

Source: Design Report 2019

Alternative tower types and heights were considered to minimize the number of towers required (i.e. reduce the need for land acquisition) and to minimize forest clearing.

For example, MCA-Nepal developed special dead end tower types (Types DD, DE, and DF) to support long conductor spans along the alignment to minimize the number of difficult to access tower locations, minimize the need for land acquisition, and reduce forest clearing.

The height of towers is determined based on the conductor's maximum sag, environmental conditions, and specified ground clearance. Taller towers allow the conductors to span forest and still meet the clearance requirements. The average tower height is 61 meters. Alternative tower heights are used where crossing other transmission lines and to allow longer spans while still meeting clearance requirements to roads, rivers, buildings, or trees. Towers range as high as 92.5 meters.

6.2.4 Underground vs Aboveground Transmission Lines

Some transmission lines can be buried, which can reduce bird and visual impacts, but burial of high-voltage transmission lines (i.e., 400 kV and higher) has rarely been done anywhere in the world other than near airports or in major cities. Burial would require special insulated lines, more forest clearing, complete disturbance of the RoW for transmission line burial, and in the case of a line fault, are more difficult to locate and repair problems. In Nepal, where depth to rock is often quite shallow, construction of underground lines would require more blasting and associated environmental and social impacts. While underground transmission lines are more tolerant to weather conditions compared with overhead transmission lines, they are more vulnerable to landslides, seismic activity, and accidental excavation, all of which can result in extensive, expensive, and time-consuming repairs. Underground transmission lines are estimated to be 10 to 20 times more expensive than overhead lines (USFS 2006).

While underground transmission lines have fewer forced outages than overhead lines, damage to the cable or components often results in longer outage durations. When a failure does occur, overhead lines can be quickly visually inspected and repaired. In contrast, underground line cable failures cannot be visually diagnosed. The cable or fluid system must be tested with specialized equipment to locate the damaged sections of the cable. Upon locating the faulty component or cable or determining whether there is a leak that is potentially causing contamination, specially trained workers must be mobilized to repair or replace the failed components or cable resulting in potential outages of weeks or months depending on the type of failure to be repaired, the failure location, and the availability of replacement materials. A catastrophic failure of any portion of the system—underground cable, splices, terminations, or fluid systems—could result in the system being inoperable and out of service.

Given these reasons, locating the proposed transmission lines underground was not considered the preferred option.

6.2.5 Substation Type

There are many design elements associated with substations, but relatively few that result in any meaningful differences in environmental or social impacts. This section describes the two main types of substations – air insulated substations (AIS) and gas insulated substations (GIS). Table 6.2-3 compares these two types of substations against a variety of technical, environmental, and social criteria. See Annex F for more details on the relative benefits of GIS versus AIS substations.

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Table 6.2-3: Comparison of AIS and GIS Substation Types

Considerations	AIS	GIS
Insulation media	Air	Sulfur hexafluoride
Land Requirements	Larger	Smaller (40–60% smaller)
Weight	More	Less
Procurement Time	More	Less
Construction Time	More	Less
Installation	Slower	Faster (30% faster)
O&M Cost	More	Less
Capital Cost	Less	More (10–40% more)

Source: Power Engineers, Inc. ETP Project Design Report, August 2019

In summary, GIS substations are better suited where the area available for the substation is limited or where there are environmental or social constraints. All three of the new substations are located in areas with residential development, so the smaller footprint required for the GIS substations will avoid additional social impacts (e.g., land acquisition and physical displacement).

The disadvantage of using GIS technology is that the insulation material, sulfur hexafluoride, is a potent greenhouse gas. The sulfur hexafluoride will be in a sealed container and with continuous monitoring system to detect any leaks. MCA-Nepal and NEA have decided to use GIS for the three new substations (Table 6.2-4). Chapter 8 identifies proposed mitigation measures to reduce the risk of the release of any sulfur hexafluoride.

Table 6.2-4: Proposed Substation Type and Rationale

Substation	Proposed Substation Type	Rationale
New Butwal	GIS	Minimize social impacts
New Damauli	GIS	Minimize social impacts
Ratmate	GIS	Minimize social impacts and lighter switchgear equipment is preferred given current road condition

Source: Power Engineers, Inc. ETP Project Design Report, August 2019

6.3 CONSTRUCTION ALTERNATIVES

This section describes construction alternatives considered to minimize Project environmental and social impacts. There are relatively few construction alternatives for the substations, as these sites need to be cleared and graded.

6.3.1 Right-of-Way Clearing

It is common practice in many parts of the world to clear the entire RoW of all trees. While there is a need for safety reasons to maintain clearance between the conductors and the ultimate canopy height of underlying trees, this does not necessitate the clearing of all trees or other vegetation within the RoW.

MCA-Nepal has carefully spotted towers, adjusted tower heights, and even developed special dead end tower types (see Section 2.6.2.2 and 6.2.3) to maximize opportunities for the transmission line to span over underlying trees while still maintaining required clearances, rather than clearing the trees. This approach will reduce the required forest clearing associated with the Project, with only approximately 45.6 percent of the forest within the RoW needing to be cleared.

The Design and Build (D&B) Contractors will be restricted to only clear trees that have the potential to encroach into the minimum required clearance between the transmission lines, as approved by the Division Forest Offices as part of the Forest Clearance Permit.

6.3.2 Transmission Tower Construction Access

As indicated in Section 2.4.2, MCA-Nepal will be constructing vehicular access to the New Damauli and Ratmate substations; the other three substations will already have access provided by others.

As many of the proposed transmission towers are located some distance from existing roads, several alternatives were evaluated for transporting construction materials to the tower sites:

- Construction of access roads – this is not the preferred alternative as it involves additional land acquisition, forest clearing, and disturbance. Therefore, construction of access roads is not proposed and is not further discussed in this EIA.
- Use of helicopters – this alternative can avoid the additional land acquisition, clearing, and disturbance associated with the construction of access roads, but could be expensive, is weather dependent, and may not be safe in all locations. However, use of helicopters may be required in difficult to access tower sites, or to transport heavy materials to the three new substations.
- Use of pack animals, porters, and small portable mechanized equipment – this alternative would use existing, or create new, paths to access the tower sites without clearing any trees. This method can avoid most of the additional land acquisition, clearing, and disturbance associated with the construction of access roads, and is less expensive than

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using helicopters, but may not be a viable alternative in especially remote areas or on exceptionally steep slopes. This option also creates additional local employment opportunities.

MCA-Nepal intends to use pack animals, porters, and small portable mechanized equipment wherever possible to reduce forest clearing associated with tower access. Recognizing that some tower sites will be difficult to transport construction materials to using draft animals, porters, and small portable mechanized equipment, the D&B Contractors may use helicopters, which will still avoid the need to clear forest. Similarly, the D&B Contractors may also decide to transport heavy equipment to one or more of the substation sites using helicopters, especially if road or bridge weight limits may restrict vehicular transport. The D&B Contractors will not construct any new access roads for towers (they will to access the New Damauli and Ratmate substations), but may make minor improvements to existing roads that will not require tree clearing, physical displacement, or land acquisition in coordination with local ward officials. Section 2.4.2 and Annex E (Transmission Tower Details) describe in more detail how the D&B Contractors will access tower construction sites.

6.3.3 Foundation Excavation and Tower Erection Methods

The alternatives for foundation excavation and tower erection methods are manual and mechanized construction.

Mechanical excavation and tower erection typically involve the use of backhoes, cranes, and other heavy equipment. Along most of the ETP alignment, however, use of this mechanized equipment would require construction of new access roads for this equipment to reach the tower sites. Construction of these access roads and use of this heavy equipment would result in increased forest clearing, noise, and air quality impacts.

Manual excavation and tower erection would involve the use of skilled and unskilled labor, and the use of small portable equipment, such as a concrete mixer and vibrator, in lieu of heavy equipment. This would result in less land disturbance, less forest clearance, less noise and air emissions, and increased local employment opportunities than mechanical processes.

MCA-Nepal primarily intends to use manual excavation and tower erection methods. The D&B may use helicopters to provide construction access to a few remote tower sites, or even decide to fabricate portions of some towers at the tower laydown areas and transport them to some of the tower pads by helicopter.

6.3.4 Stringing

There are several alternative construction technologies available for conductor stringing. One alternative is the use of a stringing machine, but this generally requires vehicular access, which is only available for approximately half of the ETP towers, and would require clearing of trees within at least a 40 meter by 32 meter area at each tower located within a forested area. Hand stringing is the traditional method in Nepal, but also requires clearing of trees and can expose the conductors to dust, which can increase the corona discharge and associated noise levels along the transmission line. A third alternative that MCA-Nepal is discuss with the D&B Contractors is the use of drones for stringing. This is an emerging technique, which would avoid increases in the corona discharge and reduce forest clearing, although it would still require some tree trimming and forest clearing. A fourth alternative is to use helicopters to string the conductors, which would further reduce the need for forest clearing, but would be prohibitively expensive to use at all towers.

MCA-Nepal anticipates use of all four stringing alternatives depending on site-specific tower conditions (e.g., use of stringing machines where vehicular access to tower is available; use of hand stringing in areas without vehicular access and with more open forest; and use of drones or helicopters in more dense forest or more remote areas so as to minimize forest clearing in high value forested areas.

6.4 NO FOREST OR LESS FOREST ALTERNATIVES

For a transmission line project of this length (314 kilometers) and this RoW width (46 meters), it is simply impossible to avoid forest clearing completely (i.e., the No Forest Alternative). Figure 6.4-1 illustrates an attempt at a No Forest Alternative, which would result in a transmission line length of approximately 479 kilometers, or about 53 percent longer than the proposed route, and would still result in 76 ha of forest clearing. By trying to avoid forests completely, the No Forest Alternative would need to traverse more developed areas, which would result in substantially greater social impacts than the current alignment (e.g., more land acquisition due to the need for more towers, more physical resettlement, increased loss of agricultural land, more land within the RoW incurring land use restrictions). There would also be greater indirect environmental impacts associated with the manufacture of the additional conductors and the steel needed for the towers, the removal of more aggregate from Nepal's rivers and streams, and other similar impacts.

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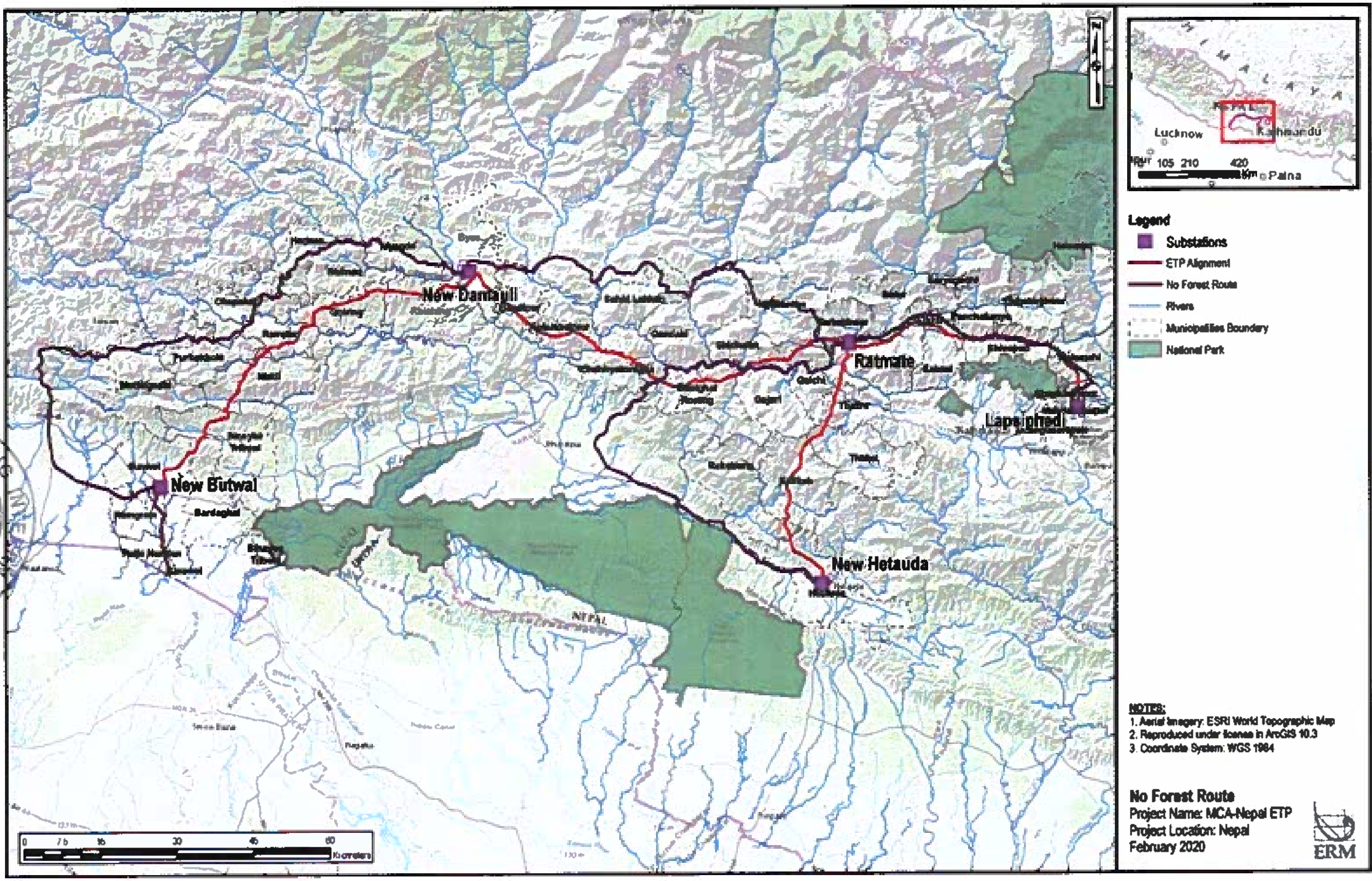

Figure 6.4-1: No Forest Alternative Route

In terms of the Less Forest Alternative, the proposed alignment has been developed to reduce forest clearing to the extent possible, while also taking into consideration important features like cultural sites and reducing other physical and social impacts. MCA-Nepal used high towers and special dead end towers to allow spanning of forest, and carefully spotted towers to minimize forest clearing, as reflected in Table 6.1-3. Figure 6.4-2 illustrates one example where over 10 kilometers of the EIA Alignment (green) was modified from the original DFS alignment (purple) to generally follow a road and open forest/agricultural/residential area versus traversing a less disturbed and higher value forest (New Butwal to Ratmate Substation—Towers 189–216).

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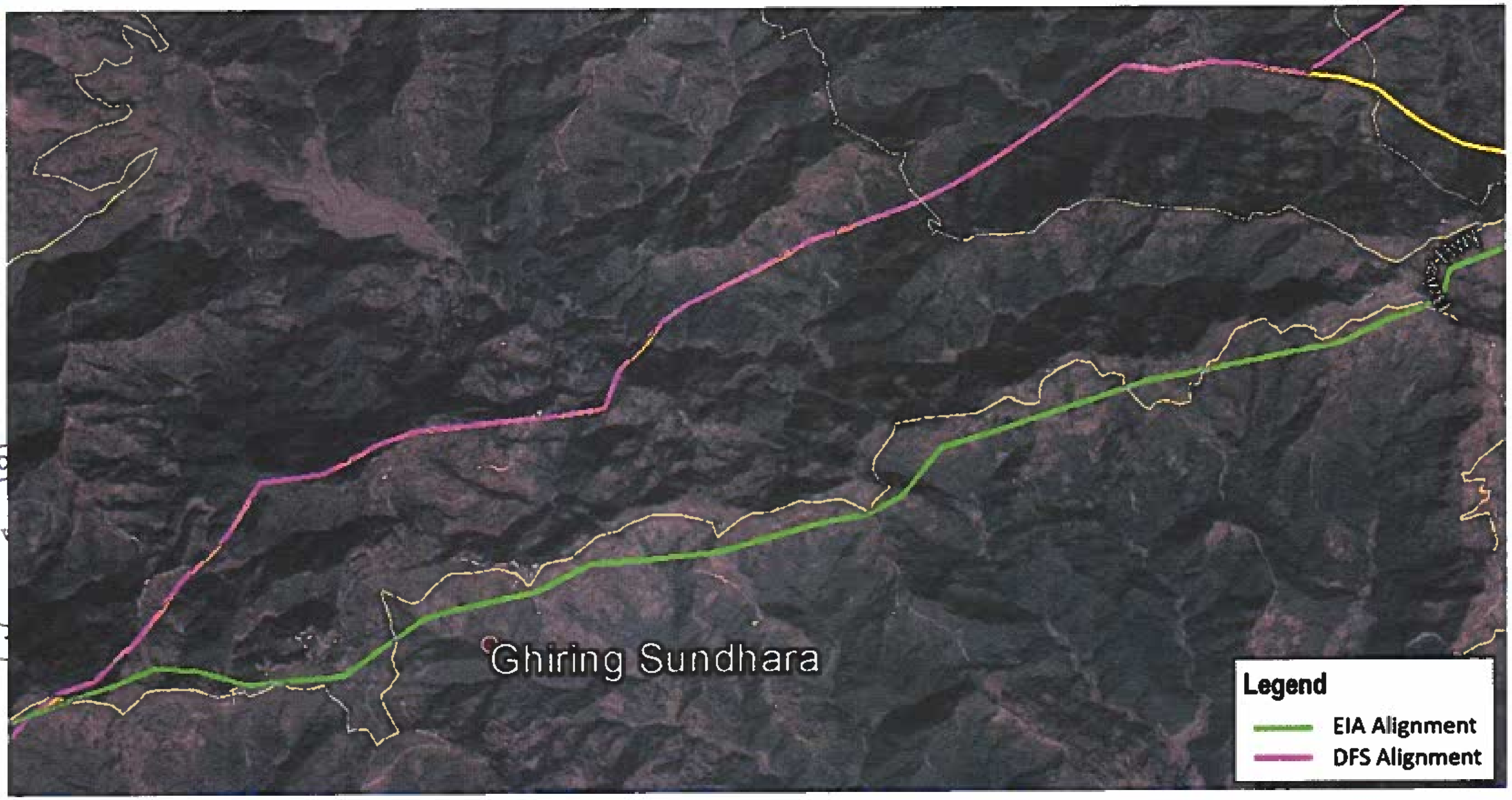

Figure 6.4-2: Illustrative Alignments Modification to Minimize Forest Clearing

In addition, simply comparing the amount of forest within the alternative RoWs is not the best metric for assessing forest impacts. For example, MCA-Nepal has developed special large dead end towers to allow longer spans (up to 1500 meters) for use especially in spanning large river valleys (e.g., Seti River) and areas with difficult terrain. Many of these towers are tall (i.e., average tower height is 61 meters high) enabling spanning of the valleys. This reduces the number of required towers and will greatly increase the number of areas where the conductors will meet the minimum clearance from forest canopy, thereby avoiding the need to clear the underlying forest (see Figure 6.4-3).

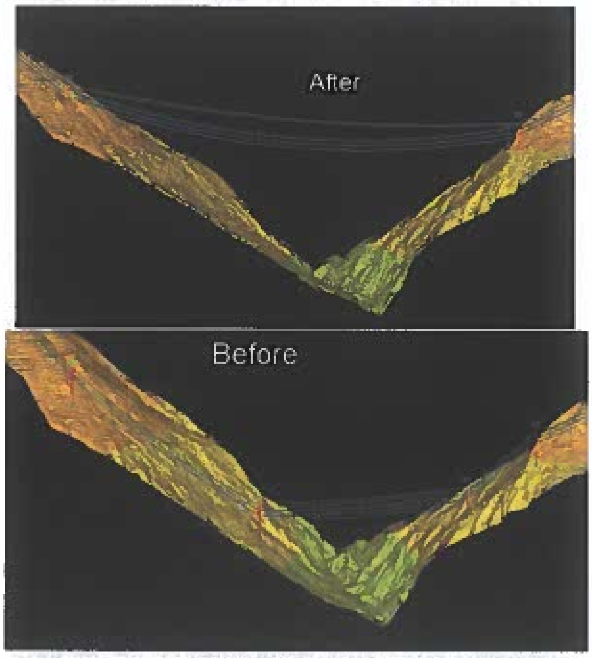

Figure 6.4-3: Illustration of Dead End Tower (Type DF)

6.5 ALTERNATIVE TECHNOLOGY, PROCEDURES OF OPERATION, TIME SCHEDULES, AND RAW MATERIALS USED

MCA-Nepal also took into consideration alternative technologies, operational procedures, schedules, and raw materials, as described below:

- Alternative Technologies – MCA-Nepal considered a variety of alternative technologies for construction of the ETP, most of which are described above under Construction Alternatives (Section 6.3). These included a decision not to build new access roads or make extensive use of heavy equipment (e.g., cranes, backhoes, concrete mixing transport trucks) for tower construction, and tensioning machines for stringing operations, but instead to use porters, pack animals, and small mechanized equipment to access most tower sites. Hand labor will be used to lay the foundations and erect the towers, to minimize forest clearing and to increase opportunities for local employment. For some difficult to reach sites, helicopters are likely to be used to deliver construction materials or to help with tower erection. Helicopters and possible drones will be used to help with stringing the conductors.

- Alternative Schedules – although the ETP will need to be constructed on an expedited basis, to meet the MCC's funding requirement that all construction be completed within five years, the Project anticipates minimizing land disturbing activities (e.g., foundation excavation) during the monsoon season.
- Alternative Raw Materials – construction of the transmission towers and lines requires relatively few raw materials (i.e., cement, coarse and fine aggregate, water, and steel. There are really no alternatives to the use of these raw materials, other than the sourcing of these materials. These materials, other than the steel, will be sourced locally in Nepal. The aggregate will be obtained from sand and gravel miners and quarries with appropriate environmental authorization, from foundation excavation spoils, or perhaps in limited situations from nearby local sources such as streams.
- Mode of Operation: The transmission line infrastructure will be owned by the Government of Nepal through the Ministry of Energy, Water Resources and Irrigation. It will be handed over to NEA or any other functional transmission entity at the time of completion as per Government of Nepal decision, and that entity will operate and manage it. ETP also has a technical assistance component to strengthen the transmission line management capacity of NEA and the Nepal Electricity Regulatory Commission.

No alternative operational procedures were identified.

6.6 NON-IMPLEMENTATION ALTERNATIVE

The "Non-Implementation" Alternative will have the effect of eliminating the benefits (i.e., national, regional, and local) that are expected from the ETP, including enhanced transmission system reliability, reduced load-shedding, and the revenue from increased power exports to India, increased employment, and anticipated indirect benefits to the Nepal economy (see Section 2.3). This alternative would also have the effect of eliminating the impacts that are expected from the ETP, including clearing of approximately 354.4 ha of forest (see Section 7.3, Biological Impacts); 98.9 hectares of land acquisition (i.e. about 78.5 hectares for transmission towers and 20.4 hectares for the Ratmate Substation and New Damauli Substation access road) and the physical resettlement of approximately 187 households (see Section 7.4).

To the extent the proposed substations and transmission lines are part of the Transmission System Development Plan of Nepal, it is expected that these lines, or other very similar ones, will be constructed at some point in the future, although perhaps on a more piecemeal basis and perhaps not in full accordance with good international industry practice, such as the IFC's Performance Standard, as required by MCC as part of the funding agreement with the Government of Nepal. Therefore, any potential negative impacts would likely only be postponed to a later date. Nepal is growing and developed areas are expanding, so social and

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resettlement impacts associated with large-scale transmission line projects like the ETP will only be expected to increase in magnitude in the future.

6.7 ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

The ETP will result in some environmental and social impacts, despite the efforts made to avoid and minimize impacts. MCA-Nepal has prepared an Environmental, Social, Health, and Safety Management Plan (ESHSMP), which identifies the management and mitigation measures it has committed to implementing in order to reduce environmental and social impacts.

MCA-Nepal is developing an Environmental and Social Management System (ESMS) to ensure that project risks and impacts are managed in accordance with the ESHSMP, as approved by DoED and MoFE. Although ESMS's can take a variety of forms, MCA-Nepal will develop an ESMS consistent with the IFC's ESMS Implementation Handbook (IFC 2015). The general content of the ESMS will include the following elements:

- MCA-Nepal Environmental and Social Policy and commitment to implementing the ESMS;
- Identification of Risks and Impacts;
- Management Program;
- Organizational Capacity and Competency;
- Stakeholder Engagement;
- External Communications and Grievance Mechanisms;
- Ongoing Reporting to Affected Communities and other stakeholders; and
- Monitoring and Review, potentially leading to ESMS updates.

6.8 WHETHER OR NOT THE RISKS RESULTING FROM THE IMPLEMENTATION OF THE PROPOSAL CAN BE ACCEPTED

The EIA process involved the selection of the optimal alternatives, using a detailed review of the existing environmental baseline, an in-depth impact assessment methodology, the identification of appropriate mitigation measures, and the development of a comprehensive ESHSMP. As indicated in Chapter 7 (Environmental Impacts), the recommended EIA Alignment results in a Project that avoids and minimizes many physical, biological, and social impacts. The remaining residual impacts can be mitigated or managed such that all residual impacts are minor or negligible (see Chapter 8). Therefore, the risks resulting from implementation of the ETP are considered acceptable and the EIA Alignment is considered the preferred option.

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CHAPTER SEVEN
ENVIRONMENTAL IMPACTS

7.1 BENEFICIAL IMPACTS

The ETP will generate beneficial impacts during both its construction and operation phases as is described below.

7.1.1 Construction Phase Benefits

During the construction phase, the following benefits will occur:

7.1.1.1 Increased Local Employment Opportunities

The project will generate a range of employment opportunities. During the construction phase it is expected that the ETP will require more than 7,300 full-time equivalent workers over the 3.5-year construction duration (see Section 2.8.2.1 Contractor Workforce). It is anticipated that about 14 percent of the labor hours will be for skilled workers, about 20 percent will be for semi-skilled workers, and about 66 percent will be for unskilled workers, with about 60 percent of the overall positions filled by Nepali workers, representing nearly 4,400 new jobs. The contractor's will target meeting a goal of women representing 33 percent of total employment and will strictly implement the principle of "equal pay for equal work." MCA-Nepal will also encourage the construction contractors to hire individuals from marginalized and traditionally excluded groups to the extent they are qualified.

7.1.1.2 Increased Local Business Opportunities

The project will require the purchase of goods (e.g., cement, aggregate, food) and services (e.g., equipment rental, cooking, cleaning) throughout its lifecycle. There are many opportunities for local businesses to provide these goods and services. Construction materials such as fine and coarse aggregates, cement and, in some locations, water for construction is planned to be sourced locally to create business opportunities for local suppliers, transporters, and contractors. Other opportunities during the construction phase of the project will include rental income from locally or domestically sourced construction equipment, vehicles, helicopters, and generators.

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At least 11 Tower Laydown Areas will be established along the ETP for the construction phase, each occupying 0.2 to 3.0 hectares in area. Several of these may be on private land based on a long lease/rental agreement with a willing lessor. Such arrangements will also generate lease/rental income for the local parties willing to provide their land for these activities.

As a result, existing local businesses may expand or new businesses may be established to meet these demands—providing indirect employment opportunities, particularly during the construction phase.

7.1.1.3 Enhanced Skill Development

Over the longer term, some locally employed project workers are likely to obtain improved or new skills acquired from their experience of working to higher standards of performance or from receiving skills training by contractors. This is likely to have a positive impact on the skill base of the local labor force, potentially making them more competitive for employment opportunities on other similar projects.

7.1.1.4 Local Biodiversity Capacity Building

Although the project will result in the clearing of a large number of trees, the Ministry of Forests and Environment requires re-planting cleared trees on a 1:10 basis (i.e., plant 10 saplings for each tree cleared), so the overall net effect will be an increase in the number of trees. Although final afforestation sites will be determined in consultation with Ministry of Forests and Environment, MCA-Nepal would like the compensatory afforestation to occur in degraded areas adjacent to biodiversity habitat, consistent with the IFC Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) to achieve no net loss of biodiversity values (IFC 2012).

While achieving no net loss in biodiversity values is mitigation, the process of doing so and monitoring the achievement of no net loss could facilitate capacity building among community members and local non-governmental organizations involved in the process in implementing such conservation action.

7.1.1.5 MCA Partnership Program

The ETP will also include the MCA Partnership program, which is a benefit sharing component of the project. The project will set aside a certain percentage of funds to support projects, identified through extensive consultations with the affected communities, within the scope of the MCA Partnership program.

The objective of the MCA Partnership program is to:

- Foster direct project related benefit accrual by the project communities through increasing access to energy and maximizing use of energy for productive use; and
- Help build relationships with the project communities for timely completion of projects.

MCA Partnership program is still under development and is intended to focus on:

- Increasing access to electricity through grid extension or off-grid solutions for households and public institutions;
- Enhancing reliability of electricity within the ETP footprint;
- Increasing access to clean drinking water; and
- Increasing capacity of the local government through training and development of municipal energy plans or capacity building trainings

7.1.2 Operation Phase Benefits

During the operation phase, the following benefits will occur.

7.1.2.1 Improved National Electricity System Reliability

The Government of Nepal has realized that the economic growth of the country can be accelerated with the optimum development of its large hydropower potential, but recognizes that a secure and reliable transmission network is needed to meet domestic demand and for cross border energy trade. The Ministry of Energy, Water Resources & Irrigation has prepared a Transmission System Development Plan of Nepal (July 2018). A key element of this Plan is a 400 kV "backbone" transmission line stretching east to west across the hill region of Nepal to evacuate power from planned hydroelectric projects and connect major demand hubs. The ETP represents a large segment of the Ministry of Energy, Water Resources & Irrigation 400 kV east-west electricity transmission network (RPGCL 2018).These network improvements will improve the grid's ability to transmit domestically generated electricity to the demand centers. The interconnection with India is designed to be two-way, so electricity could be imported from India if needed to meet Nepal's electricity demand and provide more reliability to the Nepal grid.

7.1.2.2 Increased Economic Investment

As a result of improved reliability of the electricity system and reduced load shedding, it is anticipated that the ETP will result in increased economic investment both foreign direct investment and domestic investment. This would be observed in industrial manufacturing, construction, tourism, and infrastructure as a more reliable electricity supply makes Nepal a more attractive country to invest in, all of which would indirectly strengthen Nepal's service sector as spending would increase.

7.1.2.3 Increased National Government Revenues

Financial and economic modeling conducted during the Detailed Feasibility Study (Tetra Tech 2017, Volume 8) indicated that the ETP, primarily due to the interconnection with India, would achieve an annual increase of 48 percent (4080 gigawatt hours) in electricity export to India.

7.1.2.4 Increased Local Employment Opportunities

In the operation phase, inspection and maintenance activities are expected to require about 50 personnel per line segment or about 250 personnel total for the ETP. Such personnel would be comprised of about 5 percent skilled, 10 percent semi-skilled, and 85 percent unskilled workers. The operations at each substation will involve approximately 50 personnel including about 40 percent skilled and 60 percent semi-skilled. There would be a few additional support staff for general administration, maintenance, and cleaning. Most of these positions are expected to be filled by Nepali workers.

7.1.2.5 Reduction in Greenhouse Gases

The ETP will provide climate change benefits from a life cycle perspective through the provision of a more reliable and renewable energy source—hydropower. This provision will reduce emissions from diesel back-up generators in Nepal. There is also expected to be some reduction in the emissions from fossil fuel fired power plants in India once Nepalese renewable electricity is exported there.

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7.2 ADVERSE IMPACTS TO THE PHYSICAL ENVIRONMENT

7.2.1 Overview

This Physical Environment chapter discusses Project impacts on the following physical resources:

- Topography, Geography and Soils
- Land Use and Land Cover
- Climate and Air Quality
- Water Resources
- Acoustic Environment
- Landscape Values and Visual Amenity

MCA-Nepal has carefully applied the mitigation hierarchy (i.e., in sequence, avoid, then minimize, and finally mitigate impacts) in developing the ETP route to avoid and minimize impacts to the extent possible (see Chapter 6 – Alternatives Analysis). In terms of the Physical Environment, this includes the following avoidance and minimization measures:

- Topography, Geology, and Soils
  - Elevations above 2,000 meters – elevations over 2,000 meters have a higher potential for corona effect. The ETP alignment has been adjusted to avoid these areas, and now the highest elevation along the alignment is 1,918 meters;
  - Extremely steep slopes –tower locations were adjusted to avoid extremely steep slopes (e.g., Ratmate to New Hetauda Substation Segment – Towers 130 to 152 and 163 to 190 and New Butwal to New Damauli Substation Segment from Tower 167 to 177);
  - Landslide prone areas – where landslide prone areas were identified based on either LiDAR imagery or field verification, one of the following actions was taken:
    - Changed the alignment to avoid the area (e.g., New Damauli to Ratmate Substation Segment from Tower 94 to 116, and Ratmate to New Hetauda Substation Segment from Tower 137);
    - Adjusted tower locations so as to span over the landslide prone area (e.g., New Damauli to Ratmate Substation Segment Tower Nos 78 to 84); and
    - Adjusted the route to go upslope of the hazard (e.g., Ratmate to New Hetauda Substation Segment from Tower 130 to 132).

- Land stability and erosion - ensure land stability of the ETP tower locations through the following actions:
  - o The tower pad locations have avoided natural drainage channels, and minimized impacts to flood plains, and the edge lines of major slope breaks;
  - o Tower pads are located on flat /convex part of the slope with minimum potential of disturbance on the natural drainage system;
  - o Tower pad locations avoided the regional and local fault line /lineaments identified by the geological investigations;
  - o The tower foundation and framework have been designed to withstand the probable ground acceleration on the event of the earthquake.
- Mining and Mineral Resources
  - o The RoW alignment was modified to avoid a limestone mining license concession (Ratmate to New Hetauda Substation Segment Towers 86 – 91) and will not impact any known mining activities.

- Land Use and Land Cover
  - The substations have adopted gas insulated switchgear systems in lieu of air insulated system, which requires less land area, thereby reducing impacts to land use; however, this has required a trade-off, since the insulating gas, if allowed to leak, will add to atmospheric greenhouse gases;
  - Settlements - the ETP alignment was adjusted to avoid settlements and buildings to the extent possible;
  - Agriculture land - The ETP alignment, wherever possible, was routed through marginal and low productivity agricultural land;
  - Forest land - the towers were spotted near ridges so the transmission lines can span the stream valleys without requiring forest clearance. MCA-Nepal has also decided to construct the ETP without constructing new tower access roads, which minimizes forest clearance and land use change.
- Climate and Air Quality
  - The ETP alignment was routed to stay below 2000 m to minimize the potential corona effect and related ozone and nitrogen oxide emissions as corona effect decreases in lower elevation compared to higher elevation;
  - Aluminum conductor steel-reinforced (ACSR) conductors will be installed to minimize ionization of air surrounding the conductor that contributes to corona effect and related generation of ozone and nitrogen oxides.

- Water Resources
  - The project has avoided impacts to rivers, streams, lakes, and springs by spanning these waterbodies in all cases;
  - Tower locations in floodplains have been minimized;
  - The project has minimized crossings of proposed hydropower projects – the ETP alignment was shifted to the south to avoid crossing the Tanahu Hydroelectric Project and associated transmission lines (New Butwal to New Damauli Substation Segment – Towers 232 to 245).
- Acoustic Environment
  - ACSR conductors will be installed to minimize ionization of air surrounding the conductor that results in a corona effect and related audible hissing or cracking noise;
  - The ETP alignment has been routed to avoid elevations over 2,000 meters to minimize the potential corona effect and related audible hissing or cracking noise as the corona effect is less at lower elevations.
- Landscape Values and Visual Amenity
  - Bandipur – provided a 5-kilometer aerial buffer to the historic town of Bandipur and located the towers such that they were screened by intervening hills located south of the township. The northern view overlooking the Himalayan ranges are not obstructed by the TL route;
  - Nuwakot – provided a 3-kilometer buffer to the historic town of Nuwakot. The TL route passes south of the township. The northern view overlooking the Himalayan ranges are not obstructed by the TL route.

The remainder of this section describes Project impacts on each of these physical environment aspects, first discussing Project-wide impacts, which are common to most if not all of the transmission line segments, followed by Segment-specific impacts, which are somewhat unique to a specific transmission line segment. Section 3.1 defines the spatial scale of this impact assessment by defining the Project's direct and indirect impact areas. The direct impact area includes the Project RoW, substations, and ancillary facilities. The indirect impact area includes physical resources within approximately 1 kilometer of the transmission line RoW.

7.2.2 Project-Wide Adverse Physical Impacts

As described above, this section first evaluates Project-wide impacts, and then discusses site-specific impacts on a segment by segment basis for each of the five segments. The Project-wide impacts are further categorized into potential Construction Phase and Operational Phase impacts that could occur along the alignment. The discussion of Segment-specific impacts focuses on those impacts that are specific to that segment.

7.2.2.1 Change in Topography, Geology, and Soils

Construction Phase
Erosion and Landslides

Project topography, geology, and soils impacts are primarily related to erosion and the potential for the Project to increase the risk of slope failures and landslides. Project construction activities like forest clearing and tower foundation excavation, particularly areas with steep slopes and especially during the monsoon season, can substantially increase the risk of erosion and lead to landslides. Once destabilized, these landslide areas are very difficult to re-stabilize, and the erosion and mass wasting could go on for an extended period.

However, given the gentler slopes found at the three new substation sites, grading and foundation excavation activities are not likely to impact the land stability of the surrounding areas.

In summary, the Project's potential impact on topography, geology and soils from excavation, ground leveling, and vegetation clearing during construction phase will be direct, adverse, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Moderate.

Operation Phase
Erosion and Landslides

The forest clearing of portions of the RoW during transmission line construction and ongoing vegetation management as part of Project operations will increase soil exposure to precipitation, increasing the risk of surface erosion, again especially in the hilly and mountainous terrain of the ETP. This has the potential to promote land degradation (landslides/debris flows), particularly during the monsoon season. Over the medium-term, disturbed areas will revegetate by a combination of Contractor-required plantings and natural growth.

In summary, the Project's potential impact on topography, geology, and soils during operation phase will be direct, adverse, high in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of Moderate.

Construction and Operation Phases
Tower Collapse

There is the potential for a transmission tower to collapse because of a natural disaster (e.g., earthquake, landslide) or an accident due to design or construction issues (e.g., during stringing). In terms of natural disasters, the towers are fairly tolerant of seismic activity since they are relatively flexible, are made up of relatively small mass, and seismic forces are dampened by the conductors. The towers are really more susceptible to landslides triggered by seismic events. The towers were located to avoid areas with slope stability issues, but the potential for a natural disaster exceeding the tower design cannot be completely eliminated.

In terms of accidents, the towers have been designed by qualified firms and will be constructed by an experienced construction contractor, and the design has been reviewed and the construction will be monitored by an independent engineer. Further, the towers will be inspected on a regular schedule during operations to ensure appropriate maintenance and necessary repair. So while the risk of an accident cannot be completely eliminated, the measures taken by MCA-Nepal are consistent with international good practice.

In the unlikely event of a tower collapse, there is the potential for damage to structures, property, and crops and the risk of injuries or even fatalities, in the area immediately around the tower (about 100 m as the largest tower is 92.5 m high).

There is no potential for a conductor breakdown or the presence of "live" wires on the ground that could harm people or animals. Phase failure (conductor discontinuity) are sensed by protection relays and tripped in milli-seconds, eliminating the risk of electrocution.

In summary, the Project's potential impacts in the event of a natural disaster or accident will be direct, adverse, high in magnitude, site-specific in extent, and medium-term in duration, with an overall pre-mitigation significance of Moderate.

7.2.2.2 Change in Land Use and Land Cover

The Project will affect various land uses and land covers, which primarily includes clearance of forest and disturbance of agricultural land for various construction activities such as establishing laydown areas; constructing the substations and towers; and clearing portions of the RoW. Overall, the Project will result in the loss of 354.4 hectares of forest and 72.4 hectares of agricultural land (Table 7.2-1). Forest that is cleared in the RoW will be converted to maintained RoW while the remaining land will be converted to Built Up land for use as the substations and tower pads.

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Table 7.2-1: Project Changes to Land Use/Land Cover

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations (ha)			Laydown Areas		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	727.7	-304.0	423.7	49.8	-49.8	0.0	0.0	0.0	0.0	0.7	-0.7	0.0
Cultivated	542.7	0.0	542.7	53.8	-53.8	0.0	14.3	-14.3	0.0	12.5	-4.3	8.2
Barren	0.0	0.0	0.0	0.0	0.0	0.0	3.2	-3.2	0.0	0.0	0.0	0.0
River & Floodplain	17.5	0.0	17.5	0.0	0.0	0.0	0.0	-0.0	0.0	0.0	0.0	0.0
Built Up	59.2	0.0	59.2	0.0	103.6	103.6	2.0	17.5	19.5	0.0	0.0	0.0
Maintained RoW	0.0	304.0	423.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,347.1		1,47.1	103.6		0.0	19.5		0.0	13.2		8.2

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The impacts associated with changes in land use/land cover are primarily related to impacts to forest and agricultural land, which are discussed in Sections 7.3 and 7.4, respectively. A separate significance rating is not provided for these Land Use and Land Cover impacts.

7.2.2.3 Change in Climate

This section evaluates Project contributions to climate change (i.e., production of greenhouse gases). Since climate change impacts are always long-term, they are presented here as combined construction and operation phases.

Greenhouse Gas (GHG) Emissions

Materials used in the construction of transmission lines (aluminum, concrete, other metals, other building materials) have embodied emissions as a result of the energy used to produce them (Madrigal et al. 2010). In addition to the embodied emissions, transmission line construction can also contribute emissions from construction equipment, energy in land clearing, sulfur hexafluoride (SF_6, used in insulation and current interruption applications), and nitrous oxide (N_2O) corona effects created by very high-voltage transmission lines. SF_6, and N_2O are GHGs having 22,800 and 298 global warming potential (IPCC 2007). Given the size of the ETP program, calculation of embodied and direct GHG emissions are computed to determine the full climate change impacts of the program.

In addition to the direct and embodied GHG emissions from construction of the TL, the Project may have impacts associated with the clearance of the RoW under the TL in forested areas. It has been estimated that the average annual carbon dioxide equivalent (CO_2e) sequestration in the CHAL amounts to about 13 tons (t) CO_2e/hectare (Subedi et al. 2015). The same source estimated average biomass residing in different types of forests as ranging from 145 to 342 t/ha. If the cleared vegetation is burned, it would release substantial amounts of carbon into the atmosphere.

As of 2010, Nepal's GHG emissions make up less than 0.1 percent of global emissions[1]. With its current policies, Nepal's GHG emissions are expected to increase to between 50 to 53 metric tons (Mt) CO2e by 2030 (an increase of 55 to 66 percent compared to 2010 levels). Even with this increase, the country's per capita emissions would only grow from 1.2 tCO_2e/cap as of 2010 to 1.5 to 1.6 tCO_2e/cap by 2030, still far below the 2012 world average of 7.6 tCO_2e/cap (Climate Action Tracker Undated).

Up to 25 percent of global carbon emissions is due to deforestation (IPCC 2001). Although deforestation occurs rampantly in the national forest of Nepal, the community forests have successfully managed a reforestation in those areas they control, particularly in the hills. A

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[1]Nepal contributes 37.37 $MtCO_2e$ per year compared to world emissions of 42,669.72 $MtCO_2e$ per year (not including land use change and forestry). https://en.wikipedia.org/wiki/List_of_countries_by_green house_gas_emissions Accessed 16 November 2016.

managed with positive economic, social, and environmental outcomes". The routing process included an effort to avoid going through forests since the right-of-way areas under the lines will require removal of the existing trees, thereby potentially reducing the carbon-capture capability of the community forests.

The ETP will have overall positive climate change effects from a life cycle perspective by meeting increased power demand with renewable hydropower generation and by reducing emissions from diesel back-up generators in Nepal due to the provision of more reliable electrical power. Some reduction in the emissions from coal-fired power plants in India is also expected once Nepalese hydropower electricity is exported to India. Refer to Tables 7.2-3 and 7.2-4 for details on the parameters considered to calculate the overall GHG emissions from the Project.

Table 7.2-2: Assumptions for Greenhouse Gas Calculations

Parameters Considered for Greenhouse Gas Calculations	
Project life (years)	50
Estimated forest area potentially impacted (ha.)	354.4
CO_2e capture per ha.	13.0
Reduction in number of back-up generators: estimate of how many large diesel generators in Nepal in areas where the NR1 Project would provide more reliable power. For the DFS, the team surveyed 52 entities in Nepal.	200
Assumed load-shedding interruption of service (hours per day) in areas affected by the Project	6
Total length of Construction Period (years)	3.5
Number of towers	856
Number of substations	3
Total length of project (km)	314
Estimated amount of steel required per tower (kg in thousands)	40
Estimated typical amount of concrete required per tower (m^3)	140
Estimated typical time of operation of heavy equipment per tower (hours)	72
Estimated typical distance traveled by steel delivery trucks per tower (km). Assume steel comes from Jharkhand, India.	600
Typical steel load per truck (tons)	20
Estimated typical distance traveled by concrete delivery trucks per tower (km)	5
Typical concrete load per truck (tons)	15
Estimated amount of steel required per substation (tons)	2,600
Estimated amount of concrete required per substation (m^3)	4,600
Estimated typical time of operation of heavy construction equipment per substation (hours). Assume 10 hrs. /construction day; 3 months construction.	900
Estimated typical distance traveled by steel delivery trucks per substation (km)	600

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Parameters Considered for Greenhouse Gas Calculations	
Estimated typical distance traveled by concrete delivery trucks per substation (km). Assume concrete is locally produced.	10
Typical annual power exported to India after project completion in 2023(GWh). Power sold from Feasibility Study (Volume 1, Table 3.23)	2,896

Table 7.2-3: Greenhouse Gas Emissions from the Project

Source	Total Project Life CO_2e Emissions (tons)
Construction	
Construction Vehicle Emission for Towers	1,334
Construction Equipment Emissions for Towers	4,622
Construction Vehicle Emissions for Substations	304
Construction Equipment Emissions for Substations	405
Embodied CO_2e in Steel for Towers	94,502
Embodied CO_2e in Steel for Substations	21,528
Embodied CO_2e in Concrete for Towers	29,624
Embodied CO_2e in Concrete for Substations	3,411
Embodied CO_2e in Steel and Aluminum for conductor (ACSR Moose)	190,405
CO_2e Capture lost from cleared forests	14,251
Total CO_2e emissions from construction:	**360,387**
Operation	
Reduction in CO_2e from less use of diesel generators	-3,285,000
CO_2e capture lost from cleared forests	203,580
Reduction in CO_2e in India	-102,373,600
Total CO_2e from operations:	**-105,455,020**
Net Project total CO_2e emissions:	**-210,549,653**

The Project's potential impact on climate, measured as release of GHG emissions, during the combined construction and operation phases will be indirect, beneficial, positive in magnitude, regional in extent, and long term in duration, with an overall pre-mitigation significance of Positive.

7.2.2.4 Change in Air Quality

The ETP Project will release a variety of air quality emissions, such as fugitive dust, nitrogen oxide (NOx), carbon monoxide (CO), particulate matter (PM), and sulfur dioxide (SO_2), which are evaluated below.

Construction Phase

Construction Phase Project impacts include fugitive dust and diesel generator emissions. As indicated in Section 2.4, MCA-Nepal is not planning on constructing any new access roads to the tower sites, so transport of construction materials to the tower sites and erection of the towers will be primarily manual, with very limited use of heavy equipment and helicopters. Emissions associated with transport vehicles (e.g., trucks and helicopters) for tower construction will be negligible and highly dispersed across the 314-kilometer-long RoW, and would not result in any measureable change in air quality, and are not further assessed in this EIA.

Transmission Line Construction Emissions

Project construction will involve disturbing approximately 611.7 hectares of land as a result of forest clearing along the RoW (312.9 hectares), tower construction (78.5 hectares), substation construction (37.7 hectares), and ancillary facilities (182.6 hectares). This disturbed land will generate fugitive dust, especially during the dry season when there is little precipitation to moisten the soil.

The magnitude of this impact is limited, however, because little heavy equipment will be used, which typically is the source of fugitive dust dispersal. As well, the disturbed areas are not concentrated, but rather limited to a long narrow 46-meter-wide RoW, and construction will be phased so only portions of the RoW will be disturbed at any one point in time. The impacts will be local, as some of the fugitive dust will likely be blown by the wind outside of the RoW, but is not expected to be carried long distances so as to cause a more regional impact.

The construction of transmission lines will be performed mainly using the manual labor with support from a portable 10 kilowatt (kW) diesel generator. The emissions associated with diesel generator were based on the U.S. EPA AP-42 emission factors (USEPA 2010). Table 7.2-4 presents detailed calculation of diesel generator emissions based on these emission factors. These emissions are low and will not result in any violation of air quality standards.

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Table 7.2-4: Pollutant Emission Rates for the Portable 10 kW Diesel Generator

Air Pollutant	Power (hp)[a]	Emission Factor (lb/hp-hr)	Annual Hours of Operation[b] (Hours/Year)	Maximum Hourly Emissions (g/s)	Annual Emissions (TPY)	Annualized Hourly Emissions (g/s)
NOx	14	0.011	1440	0.019	0.111	0.003
CO	14	0.00696	1440	0.012	0.070	0.002
SO_2	14	0.000591	1440	0.001	0.006	0.000
$PM_{10}/PM_{2.5}$	14	0.000721	1440	0.001	0.007	0.000
CO_2	14	1.08	1440	1.905	10.886	0.313

g/s = grams per second; hp = horsepower; lb/hp-hour = pounds per horsepower per hour; TPY = tons per year

[a] Actual generator specifications were not available; emission estimates based on specification for a Kohler Model PA-PRO90E-3001-PC Industrial Diesel Generator (400-500 kW/500-625 kVA, 1800 rpm)

[b] Based on a conservative assumption of 90 days of operation with 16 hours per day. Tower construction is anticipated to occur in three stages each of about two weeks in duration.

In summary, the Project's potential impact on air quality from transmission line construction will be direct, adverse, medium in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Minor.

Substation Construction Emissions

Most of the equipment involved during the construction will be powered by connection to the local electric distribution system, therefore, there will be no fuel combustion emissions from these equipment. However, there will be fugitive emissions associated with these equipment when operated at the construction site and significant portion of the fugitive emission will be from the concrete mixer involved as part of concrete batch process.

The detailed calculation of fugitive emissions from the concrete mixer are shown in Table 7.2-5. Emissions were calculated based on the maximum operating capacity, hours of operation, and the emission factors. These emissions are low and will not result in any violation of air quality standards. There will be vehicular and diesel-powered equipment emissions at the construction site, but these emissions will be negligible, and would not result in any measurable change in air quality.

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Table 7.2-5: Fugitive Emissions from Concrete Mixer

Air Pollutant	Maximum Operating Capacity (yd³/hr)	Emission Factor (lb/yd³)[a]	Annual Hours of Operation [b] (Hours/Year)	Maximum Hourly Emissions (g/s)	Annual Emissions (TPY)	Annualized Hourly Emissions (g/s)
PM_{10}	32.8	0.0440	1440	0.182	0.001	0.182
$PM_{2.5}$	32.8	0.0066	1440	0.00002	0.0001	0.00002

g/s = grams per second; yd = yard; lb/yd = pounds per yard; TPY = tons per year

a Emissions factors obtained for USEPA AP-42, 11.12 Concrete Batching; Table 11.12-6 Plant wide emission factors per yard of central mix concrete

b Based on a conservative assumption of 90 days of operation with 16 hours per day.

In summary, the Project's potential impact on air quality from substation construction emissions during construction phase will be direct, adverse, low in magnitude, site-specific in extent, and short-term in duration, with an overall pre-mitigation significance of Negligible.

Operation Phase

There will be no operation phase air quality impacts associated with the transmission line. Disturbed areas will be stabilized at the completion of construction so no measurable amount fugitive dust will be generated. There is no need for any power generation (e.g., diesel generators) for RoW maintenance as the only activities will be periodic inspections, maintenance, and repair.

Substation Operation Emissions

The three new substations will be connected to the local electrical distribution system for their power needs. Each of the new substations, however, will also have a 400 kW backup diesel generator in case of a power failure. The emissions from each of these generators are summarized in Table 7.2-6. The emissions associated with diesel generators were based on the U.S. EPA AP-42 emission factors (USEPA 2010).

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Table 7.2-6: Emission Rates for 400 kW Backup Diesel Generator—Criteria Pollutants

Air Pollutant	Power (hp)[a]	Emission Factor (lb/hp-hr)	Annual Hours of Operation (Hours/Year)	Maximum Hourly Emissions (g/s)	Annual Emissions (TPY)	Annualized Hourly Emissions (g/s)
NOx	536	0.011	480	0.743	1.415	0.041
CO	536	0.00696	480	0.470	0.895	0.026
SO_2	536	0.000591	480	0.040	0.076	0.002
$PM_{10}/PM_{2.5}$	536	0.000721	480	0.049	0.093	0.003
CO_2	536	1.08	480	72.939	138.931	3.997

g/s = grams per second; hp = horsepower; lb/hp-hour = pounds per horsepower per hour; TPY = tons per year

[a] Actual generator specifications were not available; emission estimates based on specification for a Kohler Model 500REOZJ Industrial Diesel Generator (400-500 kW/500-625 kVA, 1800 rpm)

The modeled concentrations for all criteria pollutants are below 35 percent of the World Health Organization (WHO) guideline concentrations for all averaging period at the closest property boundary. Table 7.2-7 summarizes the maximum modeled impacts at 75 meters downwind (closest property boundary) as well as the percentage of the WHO Guidelines. This analysis indicates that emissions from the proposed backup generator will have a minimal air quality impact in the neighborhood of the substation.

Table 7.2-7: Modeled Impacts Compared to Ambient Air Quality Guidelines (micrograms per cubic meter [μg/m³]) at the Closest Property Boundary

Pollutant	Averaging Period	WHO Guidelines (μg/m³)	Modeled Concentrations at Closest Boundary (μg/m³) a,b,c	Percent of Relevant Guideline
NO_2	1-hour	200	69.26	35%
	Annual	40	6.93	17%
SO_2	10-minute	500	6.03	1%
	24-hour	20	2.53	13%
PM_{10}	24-hour	50	3.08	6%
	Annual	20	0.51	3%
$PM_{2.5}$	24-hour	25	3.08	12%
	Annual	10	0.51	5%
CO	1-hour	30,000	49.59	0%
	8-hour	10,000	44.63	0%

PM10 =Particulate Matter – 10 micrograms; PM 2.5 = Particulate Matter – 2.5 micrograms

a 10-minute is calculated using the 1/5th power law.

b 8-hour, 24-hour and annual are calculated using scaling ratios of 0.90, 0.60 and 0.10, respectively.

c PVMRM approach has been applied for the conversion of NOx to NO2 and an in-stack ratio of 0.2 has been applied.

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In summary, the Project's potential impact on air quality from the three new substation operations during operation phase will be direct, adverse, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

7.2.2.5 Change in Water Resources

In terms of impacts on water resources, the Project will have negligible effects on groundwater resources, considering the small volumes of hazardous materials such as oils, lubricants, and fuel to be used (see Chapter 2 – Project Introduction). Further, the Project has spotted towers so as to avoid all known groundwater seeps/springs. Therefore, the following evaluation focuses on potential impacts to surface waters.

Construction Phase

Potential Project impacts on surface waters during the construction phase includes water sourcing, aggregate sourcing, river crossing and floodplain impacts, erosion and sedimentation, wastewater discharges, hazardous materials spills, and improper solid waste disposal.

Water Sourcing

Tower construction will require on average 27,000 liters of water for producing the approximately 270 cubic meters (m^3) of concrete needed for each tower foundation (see Section 2.8.3). Given that no new tower access roads are proposed, this water will need to be transported to the tower sites by porters or pack animals, so there is a strong incentive to source this water from local springs, streams, or rivers. The 27,000 liters of water equates to about 0.3 liters/second for one day, so a relatively small withdrawal, although it could be more substantial during the dry season for springs and small streams that may have relatively little flow. These water withdrawals could affect nearby villages if they are dependent on the same water source. This water withdrawal would be temporary and a single small water source would likely only be used to provide water support one or two towers, given the average tower spacing of 363 meters. Water for domestic uses (e.g., drinking, cooking, bathing) will not be more than about 10 liters per person per day, and with a maximum of about 40 non-local workers at any single tower at any point in time, this only totals to about 400 liters per day. The D&B Contractor will be responsible for providing safe water for its workers either via transporting water to the tower sites or treating local water sources. Domestic water needs are minor relative to water needs for concrete production and will not result in any measureable impacts above those associated with concrete production

Domestic water for the three new substation sites (i.e., New Butwal, New Damauli, and Ratmate) will be sourced from on-site wells, while water needed for concrete production will be sourced from the streams/rivers that drain adjacent to the New Butwal and New Damauli sites and pumped from the Trishuli River for the Ratmate site.

Therefore, the Project's potential impact from local sourcing of water during construction phase will be direct, adverse, medium in magnitude, local in extent (as it could result in some *offsite downstream impacts), and short-term in duration, with an overall pre-mitigation significance of Minor.*

Aggregate Sourcing

The Project will require large quantities of aggregate for concrete production needed for constructing foundations and other structures at tower pads and substation sites. The amount of coarse and fine aggregate required per tower varies by tower type, but ranges from 26 to 220 m^3 of coarse aggregate and 13 to 110 m^3 for fine aggregate (Section 2.8.3). As indicated in Chapter 2 (Project Introduction), aggregate will be obtained from two sources: district permitted sand miners and appropriately permitted quarries. The sand miners and quarries are already approved and permitted sources and are not discussed further in this EIA.

The Project's potential impact to water resources from sourcing of aggregate during construction phase is direct, adverse, medium in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Minor.

River Crossings and Floodplain Impacts

As discussed in Chapter 6 (Alternative Analysis), one of the criteria used in developing the transmission line alignment was to avoid placement of transmission towers within rivers/streams and minimize the placement of transmission towers within a floodplain. This was generally accomplished as there are no proposed towers located within any river/stream channels and 22 out of 856 towers are located within a potential flood prone areas. In all other river/stream crossings, the transmission towers are located outside of flood prone areas and the transmission line spans the waterbody and associated floodplain.

These tower locations within potential flood prone areas were selected in order to reduce social impacts in consultation with municipal officials. The following towers are located within potential flood prone areas (also see Annex D - Alignment Maps):

- India Border to New Butwal Segment (Towers 16, 17, 17/1, 18, 19, 20, 21, 22, 45, 45/1, 46, 47, 48, 48A, and 49) – the Jharai River;
- New Butwal to New Damauli Segment (Towers 9, 11, 12, and 13) – the Jharai River; and
- Ratmate to New Hetauda Segment (Towers T5, T6, and T7) - the East Rapti River.

These transmission towers could potentially collect debris and slightly interfere with river flow during flooding events.

The Project's potential impact to floodplains during construction phase is direct, adverse, low in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Negligible.

Erosion and Sedimentation

The Project will disturb approximately 611.7 hectares of land as a result of required forest clearing and other construction activities. These construction activities, as discussed in Section 7.2.2, can expose soils to rainfall, destabilize slopes, and result in erosion. The Project will also require the excavation of 856 tower foundations, generating on average approximately 22 cubic meters of spoil per tower (estimated range of 15–30 m^3 per tower), which are susceptible to erosion if not properly managed. This spoil, if eroded, could ultimately be transported by storm water runoff to nearby streams, resulting in elevated turbidity levels in the water column and sediment deposition within the stream channel (Tamang et al. 2015).

Erosion and sedimentation is an issue for the ETP because of both the steep slopes found along the alignment and the heavy rains that occur during the monsoon season. The International Centre for Integrated Mountain Development identified poorly developed infrastructure as a principal source of intensified sediment flow to Nepal rivers, especially in the Middle Hills area, through which much of the ETP traverses (ICIMOD 2018). This high sediment load, as it is transported downstream by stream flow, can worsen flooding and increase river bank erosion. These eroded soils, particularly if from agricultural lands, can also carry nutrients and pesticides, which can further degrade water quality for downstream communities and aquatic life.

In summary, the Project's potential impact to water quality from sedimentation during construction phase is direct, adverse, high in magnitude, local in extent (as some of the sediment could move offsite), and short-term in duration, with an overall pre-mitigation significance of Moderate.

Wastewater Discharges

Wastewater discharges can have impacts on water quality depending on the characteristics of the wastewater. In this case, the only wastewater generated by the Project will be domestic wastewater from construction workers and worker camps.

As described in Section 2.7, tower construction will occur in multiple phases. Each of these phases will involve a maximum of 40 workers camping at each tower (excluding local workers) for up to a four-week period. The workers will camp in close proximity to the towers. Construction of the three new substations will require approximately 80 workers for approximately 2.5 years. Construction of the new bays at the two existing substations (i.e., New Hetauda and Lapsiphedi) will require about 25 workers for about three months. All of these workers will generate domestic wastewater that will require appropriate treatment and disposal. If these wastes are not properly managed, they could create public health risks in the immediate project area or water users downstream. The Design and Build (D&B) Contractor will provide a septic system at each of the three new substations and latrines at each tower work camp for wastewater disposal.

In summary, the Project's potential impact to water quality from wastewater discharges during construction phase is direct, adverse, medium in magnitude, local in extent (as some of *the domestic wastewater contamination could move offsite), and short-term in duration, with an overall pre-mitigation significance of Minor.*

Hazardous Material Spills

Construction of the ETP will not require much use of hazardous materials. At the tower sites, there will be diesel fuel for the generator sets and likely some lubricants, but all in small, portable containers. Chemical additives (hazardous/non-hazardous) are likely to be used for specific purpose (e.g., concrete mixing or metal frame protection) at the foundation sites.

The substation construction sites will obtain power from the local distribution system so will not use diesel generator sets for power, but will likely have a diesel storage tank (maximum 3,000-liter) for vehicle and other equipment refueling. There will also be use of some oils, lubricants, solvents, and cleaners. The risk to water quality is associated with a spill or leaks of these materials that reaches either a stream.

Therefore, the Project's potential impact to water quality from hazardous material spills during construction phase is direct, adverse, medium in magnitude (taking into consideration the risks associated with the 3,000 liter diesel storage tank), local in extent (as the spill could travel offsite), and short-term in duration, with an overall pre-mitigation significance of Minor.

Improper Solid Waste Disposal

The general construction solid waste at the tower and substation construction sites may include packaging materials (e.g., plastic, cardboard, and/or jute packaging), iron wires and scraps, used wooden frames, left over concrete, broken or punctured containers, and food wastes. Littering and haphazard disposal of these solid wastes in the surrounding environment and/or in nearby waterbodies will impact the visual appearance of the area, create environmental nuisances potentially attract pests, and degrade the water quality of the receiving water bodies.

The potential impact from improper solid waste disposal is medium in magnitude, taking into consideration the 847 tower work camps (excluding the nine gantry towers located within the substation sites), site-specific as most of this waste would likely remain at the tower work camps, and medium-term in duration as some of these wastes are slow to degrade and would remain in place after completion of construction, unless removed by others.

Therefore, the Project's potential impact from improper waste disposal during construction phase is direct, adverse, medium in magnitude (taking into consideration the 847 tower work camps), local in extent (as some of the waste may blow off site), and medium-term in duration, with an overall pre-mitigation significance of Minor.

Operation Phase

During the operations phase, the Project will not require any water or aggregate, so sourcing of these materials is not an operational issue. The other potential operational phase water resource impacts are evaluated below.

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Floodplain Impacts

As indicated above, the Project will have 22 transmission towers located within potential flood prone areas in order to reduce social and economic impacts because of constraints that limited flexibility in spotting the towers (e.g., residential development, municipal planned development area, and several other transmission lines).

The Project's potential impact to floodplains during operations phase is direct, adverse, low in magnitude, local in extent, and long term in duration, with an overall pre-mitigation significance of Minor.

Sedimentation

As described in Section 2.7, Project operations along the transmission line will not require any further land disturbance, only periodic operations and maintenance (O&M) activities to safeguard the infrastructure and ensure operational safety of the TL and substations (e.g., tree trimming). These O&M activities pose little risk of increasing sediment delivery to rivers and streams along the RoW.

The Project will require a total of 354.4 hectares of permanent forest clearing at the 856 tower sites, substations, and other locations along the RoW in order to maintain the required clearance between the conductors and the forest canopy. This removal of forest cover during transmission line construction will make these lands more susceptible to erosion and sedimentation during project operations, as the soil will be more exposed to direct precipitation, especially during the monsoon season. Unless properly stabilized and re-vegetated, this could result in high sedimentation rates.

Therefore, the Project's potential impact to water quality from sedimentation during the operations phase is adverse, direct, high in magnitude, local in extent, and medium-term in duration, with an overall pre-mitigation significance of Moderate.

Wastewater Discharges

As described in Section 2.7, Project operations along the transmission line will not require any permanent field-based staff and no meaningful wastewater disposal concerns. Project operations at the three new substations will require a permanent workforce of approximately 50 workers at each substation. These workers will generate domestic wastewater for the duration of Project operations. The substation workers will use the septic system constructed at each of the substations to provide wastewater treatment and disposal for worker-generated domestic wastewater.

Therefore, the Project's water quality impact from wastewater discharges during the operational phase will be direct, adverse, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

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Hazardous Material Spills

During the operation phase, O&M activities along the transmission line RoW are limited and do not involve the use of hazardous materials. Although used in some parts of the world, current RoW maintenance practices in Nepal do not routinely involve the use of pesticides or herbicides to manage vegetative growth. Each of the three new substations will have a backup diesel generator in case of emergencies, with a 1000 liter storage tank, and a vehicle refueling area with a 3000 liter storage tank. Substation O&M activities will also require small volumes of various oils, lubricants, solvents, and cleaners.

Therefore, the Project's water quality impact from hazardous material spills during the operational phase will be direct, adverse, medium in magnitude (taking into consideration the risks associated with the diesel storage tank), site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Minor.

Improper Solid Waste Disposal

As indicated above, there will not be any permanent field-based staff along the TL during Project operations, so there are no meaningful solid waste disposal concerns. The permanent workforce of approximately 50 workers at each of the three new substations will generate a variety of solid wastes. These wastes will be managed in accordance with local practices.

Therefore, the Project's potential impact from improper waste disposal during the operation phase is adverse, direct, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

7.2.2.6 Change in Acoustic Environment

This section assesses the Project's impacts on the acoustic environment. Descriptions of primary noise sources, receptor types, and Project-wide impacts during the construction and operation phases are discussed. The results of the existing noise levels measured near each of the substations as well as the regulatory requirements for noise are discussed in Section 5.1.6.

Construction Phase

Noise Impacts from Transmission Line Construction

The primary source of noise during construction of the transmission line will be portable diesel generator sets and concrete mixers. There will be little to no vehicular access to the tower sites and most construction activities will be done by hand. Table 7.2-8 shows that noise contribution from construction activities along the transmission line route will be reduced to 44 A-weighted decibels (dBA) at 400 meters, which is below Nepal's daytime noise standard (45 dBA) for rural residential areas. Construction of the transmission lines will increase noise in the immediate vicinity of the Project; however, and the noise increases will be temporary (i.e., up to about a month duration for a work crew mobilization).

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Table 7.2-8: Predicted Noise Levels during Transmission Line Construction

Equipment Description (Representative)	Reference Sound Pressure Level at 10 meters (dBA)	Predicted Sound Pressure Level (dBA) at Multiple Distances from Construction Site		
		100 meters	200 meters	400 meters
Portable diesel generator (15 kW)	65	45	39	33
Concrete mixer (167 kW)	76	56	50	44
Total Noise Contribution	76	56	50	44

Source: BSI 2014

Based on the information above and predicted results in Table 7.2-9, the Project's potential impact from noise during transmission line construction is expected to be adverse, direct, medium in magnitude, local in extent (impacts extend only about 400 meters from the tower locations), and short-term in duration (only about four weeks maximum duration for each work crew mobilization), with an overall pre-mitigation significance of Minor.

Noise Impacts from New Substation Construction

The primary sources of noise during construction of the three new substations (New Butwal, New Damauli, and Ratmate) are expected to be dozers, front-end loaders, cranes, dump trucks, portable diesel generators, and batch plants/concrete mixers. The construction equipment will be used for activities such as site preparation, foundation laying, and building construction. The construction of each new substation will be short-term (approximately 2.5 years) and will occur during the day when noise increases are more tolerable. Table 7.2-9 shows that total noise contribution from construction activities at the new substation sites will be reduced to 44 dBA at 800 meters, which is below Nepal's daytime noise standard (45 dBA) for rural residential areas. In addition, existing daytime noise levels at the substation areas range from 54 to 62 dBA (see Section 5.1.6). This indicates construction noise levels from the new substation sites will be attenuated to ambient daytime levels in less than 200 meters.

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Table 7.2-9: New Substation Construction Noise Sources and Levels

Equipment Description (Representative)	Reference Sound Pressure Level at 10 meters (dBA)	Predicted Sound Pressure Level (dBA) at Multiple Distances from Construction Site			
		100 meters	200 meters	400 meters	800 meters
Dozer (104 kW)	74	54	48	42	36
Front-end Loader (184 kW)	76	56	50	44	38
Wheeled Mobile Crane (275 kW)	70	50	44	38	32
Articulated Dump Truck (250 kW)	76	56	50	44	38
Portable diesel generator (15 kW)	65	45	39	33	27
Concrete mixer (167 kW)	76	56	50	44	38
Batch Plant	61	41	35	29	23
Total Noise Contribution	82	62	56	50	44

Source: BSI 2014

Based on the information above and predicted results in Table 7.2-9, the Project's potential impact from noise during substation construction is expected to be adverse, direct, medium in magnitude, local in extent (noise levels will attenuate to ambient levels within about 200 meters of the substation boundary), and short-term in duration (about 2.5 years), with an overall pre-mitigation significance of Minor.

Noise Impacts from Existing Substation Construction

Construction activities associated with transmission line connections to the existing substations (New Hetauda and Lapsiphedi) will be minimal and shorter in duration (approximately 6 months) in comparison to activities at the new substation sites. The only equipment required will be wheeled crane and a concrete mixer with their typical noise levels indicated in Table 7.2-10.

Table 7.2-10: Existing Substation Construction Noise Sources and Levels

Equipment Description (Representative)	Reference Sound Pressure Level at 10 meters (dBA)	Predicted Sound Pressure Level (dBA) at Multiple Distances from Construction Site			
		100 meters	200 meters	400 meters	800 meters
Wheeled Mobile Crane (275 kW)	70	50	44	38	32
Concrete mixer (167 kW)	76	56	50	44	38
Total Noise Contribution	77	57	51	45	39

Source: BSI 2014

The Project's potential impact from noise associated with transmission line connection to existing substations is expected to be adverse, direct, low in magnitude, local in extent, and short-term in duration (about six months), with an overall pre-mitigation significance of Negligible.

Noise Impacts from Use of Helicopters

Helicopters may be used to transport construction materials to difficult areas to access tower locations and to transport heavy equipment, which may exceed local road and bridge weight restrictions, to the new substation locations. For tower construction, the helicopters could land at proposed laydown areas, take on construction materials (e.g., cement, rebar, steel for tower erection), and deliver it to the tower locations where it will land to offload or hover and lower the materials to the ground. Noise impacts will likely be most acute in the areas surrounding the laydown areas as these areas will incur the heaviest and most prolonged use of helicopters.

Helicopters can generate noise up to approximately 90 dBA at approximately 150 m from the aircraft (Malcolm Hunt Associates 2017), although this varies with the size of the helicopter. The use of helicopters is currently proposed at only two remote tower locations (see Section 2.6), but will ultimately be determined by the D&B Contractor. The use of helicopters would only occur a few times at any given tower.

The Project's potential impact from noise associated with the use of helicopters during the construction phase is expected to be adverse, direct, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Moderate.

Noise/Vibration Impacts from Use of Explosives/Implosives

Explosives are planned to be used at 24 tower sites (see Chapter 2, Table 2.7-1) to level tower sites if hard rock is encountered that cannot be loosened or removed by other means. Noise from blasting is instantaneous and could reach up to 140 dBA at the blast location or over 90 dBA for noise sensitive receptors within approximately 150 m. Use of explosives could also cause vibrations that can damage structures. Though noise generated during blasting can cause concern among nearby noise sensitive receptors, blasting is a relatively short duration event compared to other rock removal methods such as using track rig drills, rock breakers, jack hammers, rotary percussion drills, core barrels, and/or rotary rock drills, which can also generate loud noise.

Implosive devices may also be used to make connections between conductors, which is the current industry-preferred method in contrast to conventional hydraulic compression techniques. Implosive charges can generate noise levels of about 120 dBA at a distance of approximately 60 m.

Use of explosives and implosives will generate noise, which may startle or disturb nearby people, livestock, and wildlife, and vibration that may damage structures.

The Project's potential impact from noise/vibration associated with the use of explosives and implosives during the construction phase is expected to be adverse, direct, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Moderate.

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Operation Phase

This section discusses Project-related noise impacts from transmission line and substation operations. It is expected that helicopters would only be used for emergency purposes during Project operations, and not for routine operations and maintenance activities, and therefore is not evaluated.

Noise Impacts from Transmission Line Operation

Transmission line operations do not generate any noise, other than potentially corona noise. Corona noise is the most common noise associated with transmission lines and is heard as a sporadic crackling or buzzing sound. Corona is the breakdown of air into charged particles caused by electrical field at the surface of conductors and is heard as a sporadic crackling or hissing sound. Corona noise levels are not consistent from location to location because conductor surface defects, damage, dust, and other inconsistencies can influence the corona effect. The corona effect is typically worse at higher elevations (e.g., above 2,000 meters) because the air pressure is less (He et al. 2017). Elevation was a criteria used in selecting the ETP alignment (see Chapter 6 – Alternatives Analysis) and the maximum elevation along the proposed route is just above 1,900 meters. Corona noise typically results in noise levels up to about 40 to 50 dBA in close proximity to the transmission line, such as at the edge of the right-of-way (Aspen Environmental Group 2019).

Based on the information above, the corona noise impact during transmission line operation is expected to be adverse, direct, low in magnitude, local in extent, and long term in duration, with an overall significance of Minor.

Noise Impacts from Substation Operation

Transformers, reactors, and backup generators are the primary sources of operational noise at three new substations. The transmission line connections included as part of this Project to the existing New Hetauda and Lapsiphedi substations will not increase ambient noise levels from operation of these substations.

The primary sources of noise during operation of the three new substations are as follows:

- New Butwal Substation—two units of 315 mega volt ampere (MVA), 400/220 kilovolt (kV) three phase transformers (92 dBA each), three reactor units (80 dBA each);
- New Damauli Substation—six units of 160 MVA, 400/220 kV single-phase auto transformers (87 dBA each), and three reactor units (80 dBA each); and
- Ratmate Substation—six units of 160 MVA, 400/220 kV single-phase auto transformers (87 dBA each).

All three new substation will each have a backup diesel generator. The backup generators will only be operated/tested for a few hours every quarter, and are represented as such in the noise evaluation analysis.

The predicted noise contribution at the nearest noise sensitive receptors (e.g., residences, schools, hospitals) due to continuous operation of the New Butwal, New Damauli, and Ratmate substations are summarized in Table 7.2-11. The result tables include a comparison of the predicted noise levels to the Nepal noise standards for rural residential areas and silence zones such as hospitals, educational institutions, and places of worship. The predicted results at nearest receptors were also assessed to ensure noise increases above baseline levels were below 3 decibels (dB).

Table 7.2-11: Summary of Predicted Noise Levels at Nearest Noise Sensitive Receptors

NSR and Distance from Substation Centroid	Existing Ambient Sound Level (dBA)	Predicted Noise Level from the Substation (dBA)	Total Noise Contribution (dBA)	Increase Above Ambient (dBA)	Comply with Nepal Noise Standard	Comply with <3 dB Above Baseline Criterion
Daytime (6.00 a.m.–10.00 p.m.)						
New Butwal House – 335 meters	62	35.5	62	0	Yes	Yes
New Damauli House – 290 meters	54	32.9	54	0	Yes	Yes
Ratmate House – 120 meters	56	42.1	56	0	Yes	Yes
Ratmate School – 540 meters	56	22.7	56	0	Yes	Yes
Night time (10.00 p.m.–6.00 a.m.)						
New Butwal House – 335 meters	47	35.5	47	0	Yes	Yes
New Damauli House – 290 meters	54	35.9	54	0	Yes	Yes
Ratmate House – 120 meters	56	42.1	56	0	Yes	Yes
Ratmate School – 540 meters	56	22.7	56	0	Yes	Yes

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Based on the information above and predicted results in Table 7.2-12, the substations will not result in any increase in ambient noise levels at the nearest noise sensitive receptors.

Therefore, the Project's noise impact during substation operation is expected to be adverse, direct, low in magnitude, local in extent (extending a short distance off site), and long term in duration, with an overall pre-mitigation significance of Minor.

7.2.2.7 Change in Landscape Values and Visual Amenities

In terms of transmission towers, which will be a permanent change in the landscape values and visual amenities, the distinction between construction and operational phases is not meaningful so an integrated evaluation of both phases is presented below.

Construction and Operation Phases
Degradation of Scenic Viewsheds

The ETP will introduce artificial structures (i.e., the transmission towers) within a predominantly natural setting, and will impact to some extent the views of all people living along the route. The transmission line is traversing forest for 53 percent of the alignment, which will screen views of the towers to some extent. There are portions of the alignment where the towers are located at or near ridge lines and may be visible for some distance. However, the ETP will cross 23 other existing or proposed transmission lines along the route, so transmission towers are a common, although artificial, visual element along much of the route.

In Chapter 5 (Existing Environmental Conditions), five visually sensitive viewpoints were identified. Table 7.2-12 summarizes Project effects on these scenic viewpoints.

Table 7.2-12: Scenic Viewpoint Impacts

Scenic Viewpoints	Distance from TL	Project Impacts
Village of Bandipur	4.1 km from nearest point of transmission line (New Damauli to Ratmate Substation Segment - Tower 36)	There are intervening hills that obscure visibility of transmission line from Village of Bandipur.
Village of Nuwakot	3.6 km from nearest point of transmission line (Ratmate to Lapsiphedi Substation Segment - Tower 35)	Nuwakot durbar sits at high point with views over a large area. Approximately 3 km of the transmission line will be visible as a mid-range view from Nuwakot.
Trishuli River	The transmission line crosses the Trishuli River in three locations (New Damauli to Ratmate Substation Segment between Towers 93 to 94, 183 to 184, and 240 and 241)	There are several other and proposed existing transmission lines that cross the Trishuli River, so these crossings will not introduce a new physical element inconsistent with the existing landscape.

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Scenic Viewpoints	Distance from TL	Project Impacts
Seti River	The transmission line crosses the Seti River gorge (New Butwal to New Damauli Substation Segment – between Towers 233 and 234 of NB to ND	The transmission line will span the Seti River well over 400 meters above the river elevation so would not be within normal line of vision for recreation users in the gorge. The transmission line is over 2 km downstream of the Tanahu HEP and over 3 km downstream from the Town of Vyas and will not be visible from either location because of bends in the river.
Shivapuri-Nagarjun National Park and Buffer	0.1 km from nearest point of National Park buffer (Ratmate to Lapsiphedi Substation Segment—Tower 120) 1.7 km from nearest point of National Park core (Ratmate to Lapsiphedi Substation Segment—Tower 150)	The transmission line will be about 1.7 km from the Shivapuri-Nagarjun National Park and will be located in the valley and over 1,200 m below Shivapuri Peak [elevation 2,732 m], so will not interfere with views of the Himalayan range.

km = kilometer

Similarly, the alignment generally keeps to the south of the Prithvi Highway, which is the main highway linking Kathmandu with Pokhara, with just a single crossing (Ratmate to New Hetauda Substation Segment – Towers 24 to 25), so as to provide unobstructed view of the northern landscape facing the snow clad Himalayan ranges.

Therefore, the Project's potential impact on significant landscape values and visual amenities during the construction and operation phases will be direct, adverse, low in magnitude, local in extent, and long term in duration, with an overall pre-mitigation significance of Minor.

7.2.3 Segment-Specific Impacts

This section provides segment specific physical impacts for the Project, with a focus on construction phase and operation phase impacts (where applicable). No significance rating has been provided at a segment-level, as the highest significance rating for each impact has been taken into consideration at the project-wide impacts level, discussed earlier, and summarized in Section 7.2.2.

7.2.3.1 India Border to New Butwal Substation Segment

The India Border to New Butwal Substation Segment is entirely within the Terai physiographic province where slopes are very gentle, most land is in agricultural use, and the little forest that exists will be spanned by the transmission lines such that no clearing will be required. Table 7.2-13 summarizes Project impacts on the Physical Environment as applicable to the India Border to New Butwal Substation Segment.

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Table 7.2-13: Summary of Project Impacts Applicability to India Border to New Butwal Substation Segment

Aspect	Impact	Phase	Applicability to India Border to New Butwal Substation Segment
Topography/Geology/Soils	Erosion and Landslides	C & O	Little risk given relatively flat topography.
Land Use/Land Cover	Changes in LULC	C & O	10.2 ha of agricultural land will be permanently converted to Built Up land (4.0 ha for the towers and 6.3 ha for the New Butwal Substation). 10.5 ha of forest clearing will be required (8.8 ha for the TL and 1.6 ha for the New Butwal Substation). See more detailed discussion below in Section 7.2.3.1.
Climate Change	Greenhouse Gas Emissions	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Climate Change	Effects of Climate Change on ETP	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Air Quality	Fugitive Dust	C	Little clearing of trees, although most soil is already exposed. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.4.
Air Quality	New Substation Emissions	C & O	Impacts limited to vehicle and backup generator emissions are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Water Resources	River Crossings and Floodplains	C & O	TL alignment spans the Jharai River or its tributaries 10 times. 15 towers are located within the Jharai River floodplain. Otherwise, impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above. See more detailed discussion below in Section 7.2.3.2.
Water Resources	Water Sourcing	C	This segment has good construction access and water can be sourced where available and transported to within close proximity of tower pads by vehicles.
Water Resources	Aggregate Sourcing	C	District approved river mining suppliers (see Table 2.8-10).
Water Resources	Sedimentation	C & O	Little risk given relatively flat topography.
Water Resources	Wastewater Discharges	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Hazardous Materials Spills	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Improper Solid Waste Disposal	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.

Aspect	Impact	Phase	Applicability to India Border to New Butwal Substation Segment
Noise	Transmission Line Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above, although higher population density and fewer trees to function as buffers can make noise impact incrementally more significant.
Noise	New Substation Construction Noise	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Helicopter Noise	C	This TL segment has generally good construction accessibility, so helicopters will likely be used less often.
Noise	New Substation Operation Noise	O	Noise modeling indicates the New Butwal Substation will comply with applicable noise regulations. See more detailed discussion below in Section 7.2.3.3.
Landscape Values and Visual Amenities	Degradation of Scenic Viewpoints	C & O	There are no scenic viewpoints identified in this TL segment.

C = construction; LULC = Land Use/Land Cover; O = operations

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Change in Land Use and Land Cover

As Table 7.2-14 indicates, the ETP will result in a net increase of 7.3 hectares of Built Up land as a result of the construction of the 55 transmission towers and 8.3 hectares of maintained RoW as a result of forest clearing for the RoW. There will be a corresponding net decrease of 10.5 hectares of forest and 6.6 hectares of agricultural land.

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Table 7.2-14: Land Use/Land Cover Change within the India Border to New Butwal Substation Segment

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations and Laydown Areas (ha)		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	9.8	-9.8	0.0	0.7	-0.7	0.0	0.0	0.0	0.0
Cultivated	61.9	0.0	61.9	6.1	-6.1	0.0	0.5	-0.5	0.0
Barren	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
River & Floodplain	2.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0
Built Up	3.9	0.0	3.9	0.0	6.8	6.8	0.0	0.5	0.5
Maintained RoW	0.0	8.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0
Total	78.0		76.5	6.8		0.0	0.5		0.0

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River Crossing and Floodplain Impacts

The India Border to New Butwal Substation Segment will involve 10 river or stream crossings, as listed in Table 7.2-15. All of these rivers and streams will be spanned by the transmission line, but 15 of the transmission towers (i.e., Towers 16, 17, 17/1, 18, 19, 20, 21, 22, 45, 45/1, 46, 47, 48, 48A, and 49) would be located within the floodplain, so the Project may have a small effect on surface water hydrology in this segment.

Table 7.2-15: Waterbody Crossings along the India Border to New Butwal Substation Segment

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width	Waterbody Type	Municipality
Jharai River	9-10	85	36	River	Palhi Nandan
Jharai River	14-15	90	34	River	Ramgram
Jharai River (double crossing)	18 - 19	50	34	River	Ramgram
Jharai River	19 - 20	30	36	River	Ramgram
Jharai River	20 - 21	14	25	River	Ramgram
Tributary of Jharai River	28-29	36	34	River	Ramgram
Tributary of Jharai River	41-42	61	44	River	Ramgram
Tributary of Jharai River	43-44	54	45	River	Ramgram
Tributary of Jharai River	44-45	66	42	River	Sunwal

Change in Acoustic Environment

The primary operational noise source along this transmission line segment is the New Butwal Substation (e.g., transformers and reactors). Table 7.2-16 presents receptor types and approximate distance to Butwal Substation boundary centroid. The receptor locations near New Butwal Substation are shown in Figure 7.2-1. All receptors surrounding the substations were identified as rural residential areas consistent with the Government of Nepal's land use classification for noise evaluation.

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Table 7.2-16: New Butwal Substation Receptor Locations

Receptor ID	Receptor Type	Distance to New Butwal Substation Boundary Centroid (meters)
R1	Rural residential area	350
R2	Rural residential area	355
R3	Rural residential area	540
R4	Rural residential area	745
R5	Rural residential area	400
R6	Rural residential area	335
R7	Rural residential area	525

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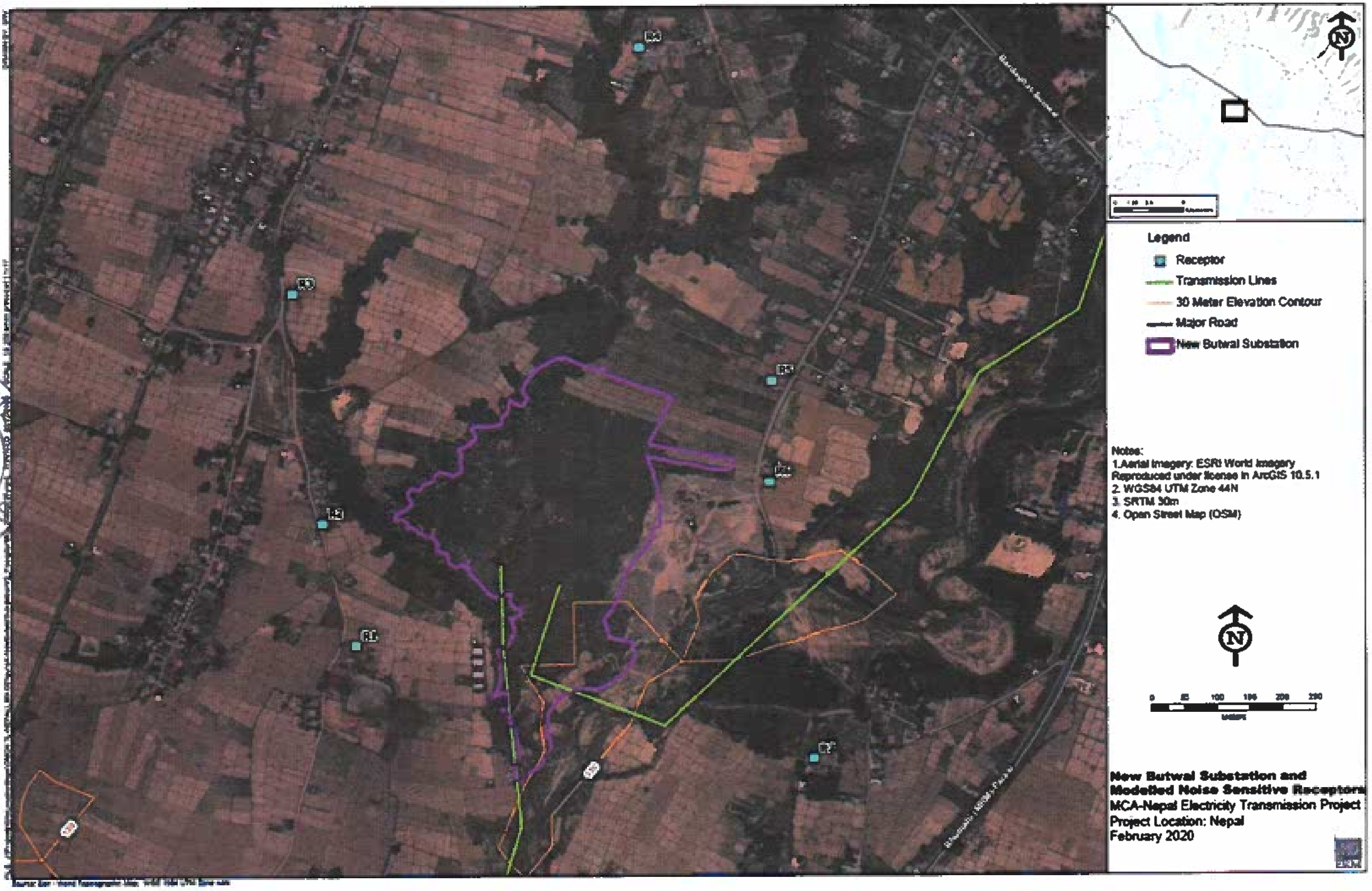

Figure 7.2-1: New Butwal Substation and Modelled Noise Sensitive Receptors

The predicted operation noise levels for the New Butwal Substation complies with Nepal noise standards (Table 7.2-17), and are shown in Figure 7.2-2.

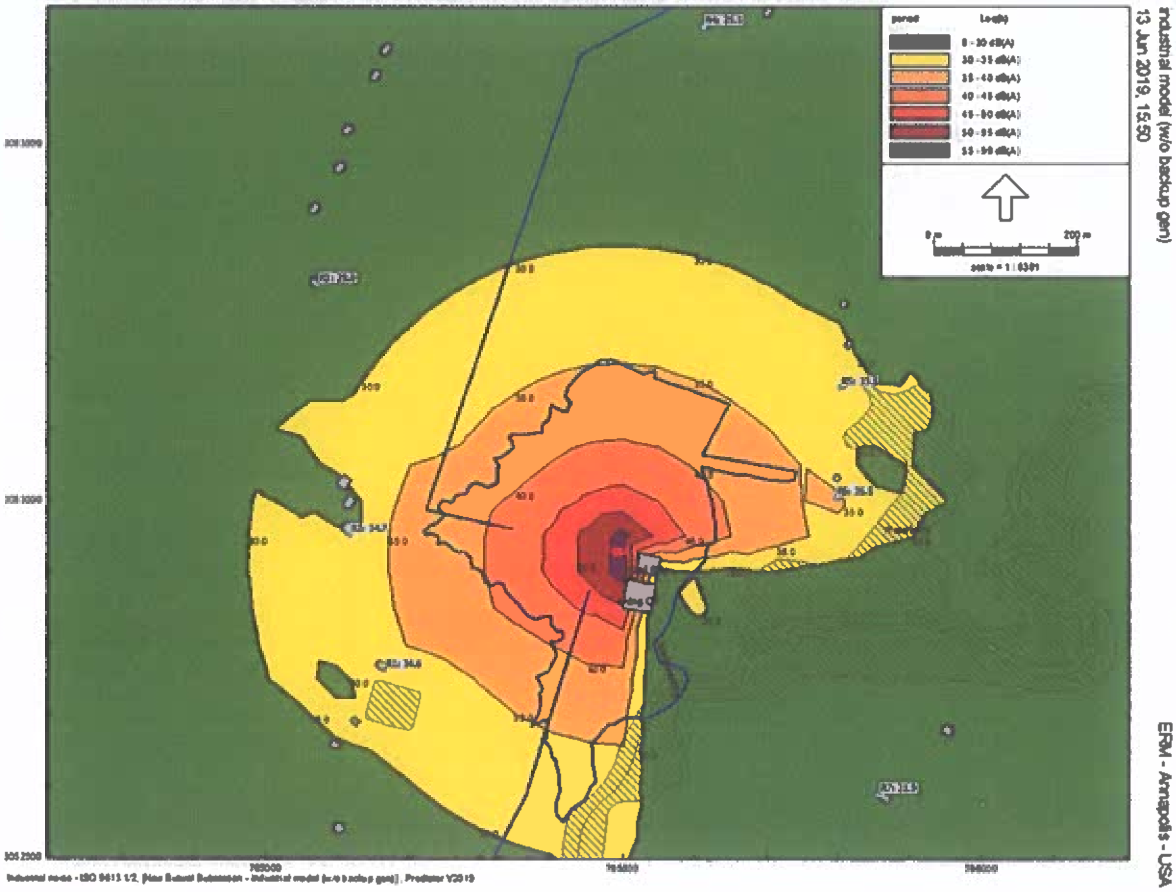

Figure 7.2-2: Noise Contours for New Butwal Substation

Table 7.2-17: Predicted Noise Levels for New Butwal Substation and Comparison with Nepal Noise Standard

NSR Description and Approximate Distance from Substation Boundary Centroid	Existing Ambient Sound Level (dBA)	Predicted Noise Level from the Substation (dBA)	Total Noise Contribution (Substation + Ambient)(dBA)	Potential Increase Above Ambient (dBA)	Comply with Nepal Noise Standard for RRA (45 dBA Day, 40 dBA Night)	Comply with <3 dB Above Baseline Criterion
Daytime (6.00 a.m.–10.00 p.m.)						
R1 – RRA, 350 meters away	62	34.6	62	0	Yes	Yes
R2 – RRA, 355 meters away	62	34.7	62	0	Yes	Yes
R3 – RRA, 540 meters away	62	29.0	62	0	Yes	Yes
R4 – RRA, 745 meters away	62	25.5	62	0	Yes	Yes
R5 – RRA, 400 meters away	62	33.5	62	0	Yes	Yes
R6 – RRA, 335 meters away	62	35.5	62	0	Yes	Yes
R7 – RRA, 525 meters away	62	21.9	62	0	Yes	Yes
Night-time (10.00 p.m.–6.00 a.m.)						
R1 – RRA, 350 meters away	47	34.6	47	0	Yes	Yes
R2 – RRA, 355 meters away	47	34.7	47	0	Yes	Yes
R3 – RRA, 540 meters away	47	29.0	47	0	Yes	Yes
R4 – RRA, 745 meters away	47	25.5	47	0	Yes	Yes
R5 – RRA, 400 meters away	47	33.5	47	0	Yes	Yes
R6 – RRA, 335 meters away	47	35.5	47	0	Yes	Yes
R7 – RRA, 525 meters away	47	21.9	47	0	Yes	Yes

NSR = noise sensitive receptor; RRA = rural residential area

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7.2.3.2 New Butwal to New Damauli Substation

The New Butwal to New Damauli Substation Segment traverses through the Terai, Siwalik, and Middle Mountain physiographic provinces where slopes range from relatively level, to moderate, to steep. Table 7.2-18 summarizes Project impacts on the Physical Environment as applicable to the New Butwal to New Damauli Substation Segment.

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Table 7.2-18: Summary of Project Impacts Applicability to New Butwal to New Damauli Substation Segment

Aspect	Impact	Phase	Applicability to New Butwal to New Damauli Substation Segment
Topography/Geology/Soils	Erosion and Landslides	C & O	Prone to erosion and landslides given the nature of topography (hills and mountain), especially within the Siwalik (Chure) physiographic province. See more detailed discussion below in Section 7.2.4.1.
Land Use / Land Cover	Changes in LULC	C & O	16.6 ha of agricultural land will be permanently converted to Built Up land. 115.0 ha of forest clearing will be required. See more detailed discussion below in Section 7.2.4.
Climate Change	Greenhouse Gas Emissions	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Climate Change	Effects of Climate Change on ETP	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Air Quality	Fugitive Dust	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Air Quality	Substation Emissions	C & O	Impacts limited to vehicle and backup generator emissions are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Water Resources	River Crossings and Floodplains	C & O	TL alignment spans the Nisdi Khola, Kali Gandaki River, Seti Gandaki or other streams 23 times. Four transmission towers are located within the Jharai River floodplain. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above. See more detailed discussion below in Section 7.2.4.3.
Water Resources	Water Sourcing	C	Most of the tower locations within this segment are not vehicle accessible, so water will be sourced locally and carried to the tower sites to meet concrete production and other construction water needs. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Aggregate Sourcing	C	District approved river mining suppliers (see Table 2.8-10).
Water Resources	Sedimentation	C & O	This segment is prone to sedimentation given the high risk of erosion. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Wastewater Discharges	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Hazardous Materials Spills	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.

Aspect	Impact	Phase	Applicability to New Butwal to New Damauli Substation Segment
Water Resources	Improper Solid Waste Disposal	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Noise	Transmission Line Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	New Substation Construction Noise	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Helicopter Noise	C	Helicopter access proposed for some towers within this TL segment. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	New Substation Operation Noise	O	Noise modeling indicates the New Damauli Substation will comply with applicable noise regulations. See more detailed discussion below in Section 7.2.4.5.
Landscape Values and Visual Amenities	Degradation of Scenic Viewpoints	C & O	This segment crosses the Seti River Gorge. As indicated in Section 7.2.2.7, the transmission line will span the gorge well over 400 m above the river elevation so would not be within normal line of sight for recreation users in the gorge. The transmission line is over 2 km downstream of the Tanahu HEP and over 3 km downstream from the Town of Vyas and will not be visible from either location because of bends in the river. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.7 above.

C = construction; LULC = Land Use/Land Cover; O = operations

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Change in Topography, Geology, and Soils

The Chure area of Nepal is especially susceptible to erosion and landslides because of its relatively steep slopes and underlying geology and soil characteristics. Clearing of forest has been identified as a key contributor to destabilizing these slopes. Construction of the ETP, and the associated clearing of forest, poses a special risk within this area.

The ETP will cross 85.6 hectares of the Chure Conservation Area. MCA-Nepal carefully selected the ETP alignment through the Chure to avoid unstable slopes and to minimize forest clearing within the RoW. In recognition of the erosion and slope stability risks, MCA-Nepal also proposes some special mitigation measures for the Chure region in Chapter 8.

Change in Land Use and Land Cover

As Table 7.2-19 indicates, the ETP will result in a net increase of 31.9 hectares of Built Up land, as a result of the construction of the New Damauli Substation and 248 transmission towers, and 102.4 hectares of maintained RoW as a result of forest clearing for the RoW. There will be a corresponding net decrease of 117.3 hectares of forest and 17.0 hectares of agricultural land.

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Table 7.2-19: Permanent Land Use/Land Cover Change within the New Butwal to New Damauli Substation Segment

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations and Laydown Areas (ha)		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	219.3	-102.4	116.9	14.9	-14.9	0	0.0	0.0	0
Cultivated	139.5	0	139.5	15.1	-15.1	0	1.9	-1.9	0
Barren land	0	0	0	0	0	0	0	0	0
River & Floodplain	8.6	0	8.6	0	0	0	0	0	0
Built Up	15.4	0	15.4	0	30.0	30.0	0.0	1.9	1.9
Maintained RoW	0	102.4	102.4	0	0	0	0	0	0
Total	382.8		382.8	30		0	1.9		0.0

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River Crossing and Floodplain Impacts

The New Butwal to New Damauli Substation Segment will involve 23 river or stream crossings, as identified in Table 7.2-20. All of these rivers and streams will be spanned by the transmission line, but four of the transmission towers (i.e., Towers 9, 11, 12, 13) would be located within the floodplain, so the Project may have a small effect on surface water hydrology in this segment.

Table 7.2-20: Water Body Crossings at New Butwal to New Damauli Substation Segment

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width	Waterbody Type	Municipality
Tributary of Jharai	1-2	115	27	Stream	Sunwal
Tributary of Jharai	3-4	67	18	Stream	Sunwal
Tributary of Jharai	7-8	32	21	Stream	Sunwal
Tributary of Jharai	8-9	10	26	Stream	Sunwal
Tributary of Jharai	9-10	85	30	Stream	Sunwal
Tributary of Jharai	10-11	365	21	Stream	Sunwal
Tributary of Jharai	11-12	24	37	Stream	Sunwal
Tributary of Jharai	AP 14 81 – AP 80/5-15	25	39	Stream	Sunwal
Tributary of Jharai	W18-17	115	27	Stream	Sunwal
Tributary of Jharai	17-18	450	27	Stream	Sunwal
Tributary of Jharai	24-25	60	24	Stream	Sunwal
Tributary of Jharai	44-45	132	30	Stream	Bardaghat
Tributary of Narayani	47-48	140	48	Stream	Binayee Tribeni
Tributary of Narayani	49-50	36	99	Small River	Binayee Tribeni
Tributary of Narayani	50-51	120	90	Small River	Binayee Tribeni

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width	Waterbody Type	Municipality
Tributary of Narayani	64-65	225	30	Stream	Binayee Tribeni
Tributary of Narayani	77-78	180	80	Small River	Nisdi
Tributary of Nisdi Khola	100-101	180	30	Stream	Nisdi
Nisdi Khola	108-109	164	40	Stream	Nisdi
Nisdi Khola	126-127	160	49	Stream	Rampur
Kali Gandaki River	143-144	134	140	Large River	Rampur
Tributary of Seti Gandaki	220-221	127	23	Stream	Rhising
Seti River	233-234	140	75	Large River	Rhising

Source: LiDAR & Satellite Imagery ERM 2019

Aggregate Sourcing

The Chure area of Nepal is especially susceptible to flash flooding relatively steep slopes and underlying geology and soil characteristics. Disturbance of stream channels and removal of rock from the riverbed, which helps to protect the channel from erosion, have been identified as a key contributor to erosion and downstream flooding.

Change in Acoustic Environment

The primary noise source along this transmission line segment is the New Damauli Substation (transformers and reactors) and corona noise from the transmission lines. Table 7.2-21 presents receptor types and approximate distance to Damauli Substation boundary centroid. The receptor locations near Damauli Substation are shown in Figure 7.2-3. All receptors surrounding the substations were identified as rural residential areas.

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Table 7.2-21: New Damauli Substation Receptor Locations

Receptor ID	Receptor Type	Approximate Distance to New Substation Boundary Centroid (meters)
R1	Rural residential area	210
R2	Rural residential area	294
R3	Rural residential area	215
R4	Rural residential area	320
R5	Rural residential area	365
R6	Rural residential area	300
R7	Rural residential area	325
R8	Rural residential area	290

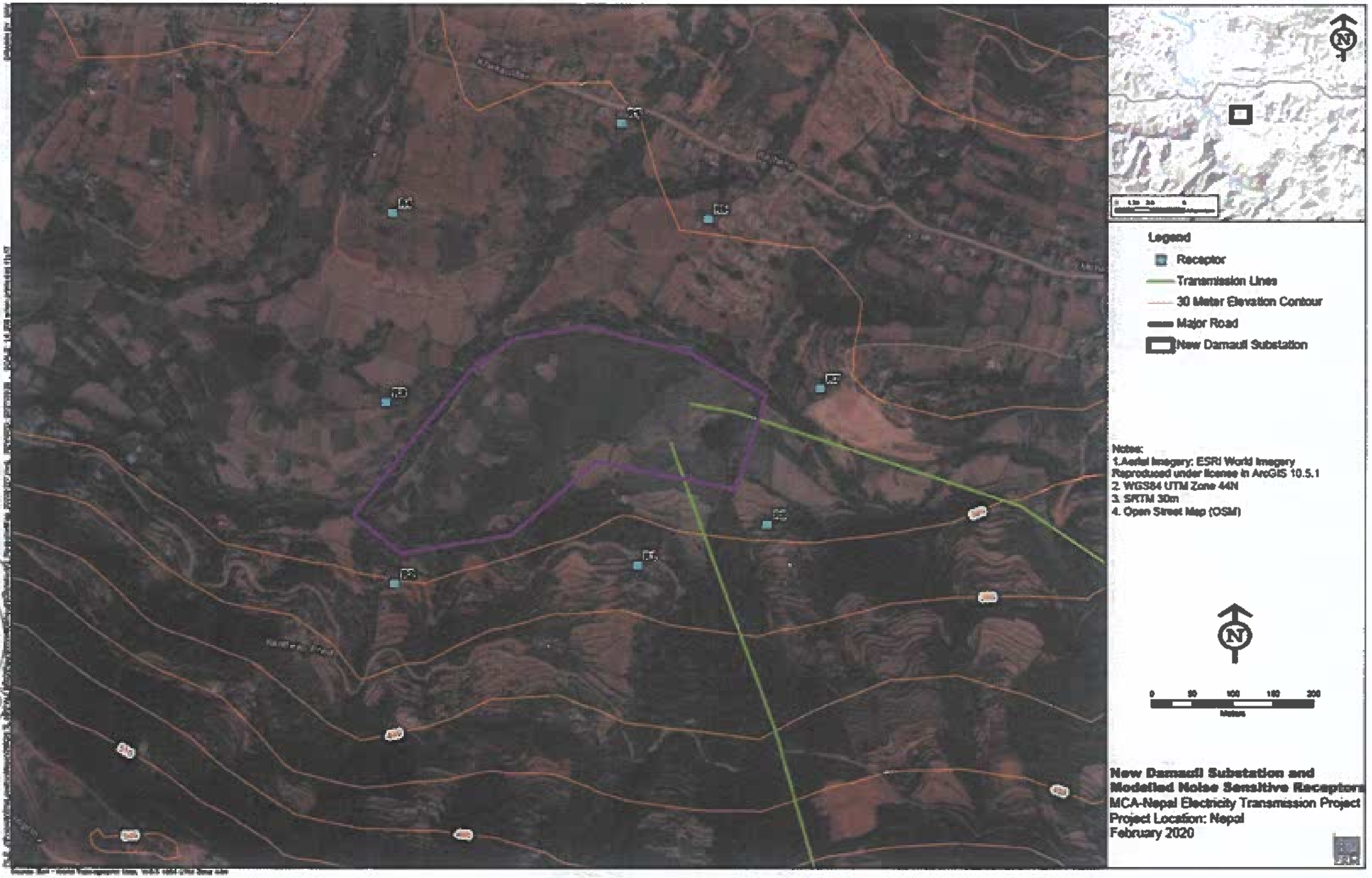

Figure 7.2-3: New Damauli Substation and Modelled Noise Sensitive Receptors

The predicted operation noise levels for the New Damauli Substation complies with Nepal noise standards (Table 7.2-22), and are shown in Figure 7.2-4.

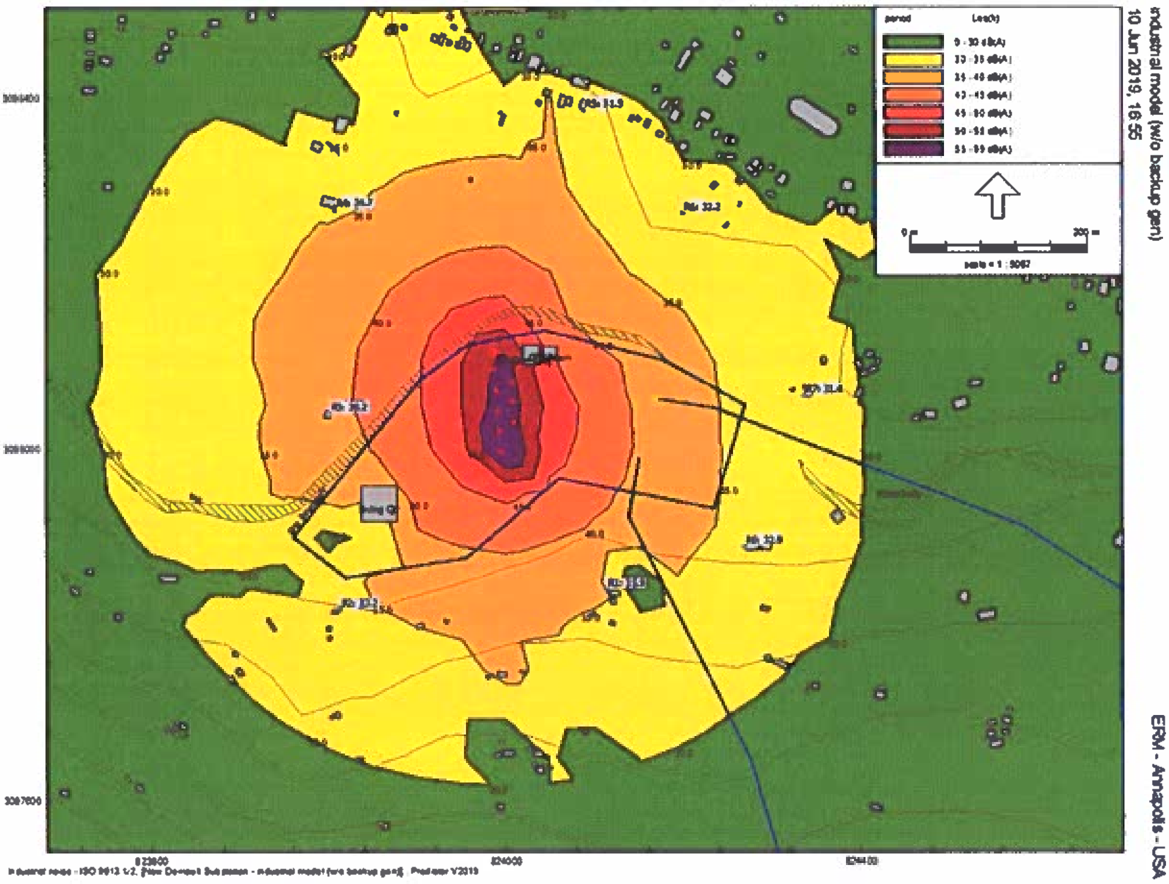

Figure 7.2-4: Noise Contours for New Damauli Substation

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Table 7.2-22: Predicted Noise Levels for New Damauli Substation and Comparison with Nepal Noise Standard

NSR Description and Approximate Distance from Substation Boundary Centroid	Existing Ambient Sound Level (dBA)	Predicted Noise Level from the Substation (dBA)	Total Noise Contribution (Substation + Ambient) (dBA)	Potential Increase Above Ambient (dBA)	Comply with Nepal Noise Standard for RRA (45 dBA Day, 40 dBA Night)	Comply with <3 dB Above Baseline Criterion
Daytime (6.00 a.m. – 10.00 p.m.)						
R1 – RRA 350 meters away	54	35.9	54	0	Yes	Yes
R2 – RRA 355 meters away	54	33.2	54	0	Yes	Yes
R3 – RRA 540 meters away	54	38.2	54	0	Yes	Yes
R4 – RRA 745 meters away	54	34.7	54	0	Yes	Yes
R5 – RRA 400 meters away	54	31.9	54	0	Yes	Yes
R6 – RRA 335 meters away	54	32.2	54	0	Yes	Yes
R7 – RRA 525 meters away	54	31.4	54	0	Yes	Yes
R8 – RRA 290 meters away	54	32.9	54	0	Yes	Yes
Night-time (10.00 p.m.–6.00 a.m.)						
R1 – RRA 350 meters away	54	35.9	54	0	Yes	Yes
R2 – RRA 355 meters away	54	33.2	54	0	Yes	Yes
R3 – RRA 540 meters away	54	38.2	54	0	Yes	Yes
R4 – RRA 745 meters away	54	34.7	54	0	Yes	Yes
R5 – RRA 400 meters away	54	31.9	54	0	Yes	Yes
R6 – RRA 335 meters away	54	32.2	54	0	Yes	Yes
R7 – RRA 525 meters away	54	31.4	54	0	Yes	Yes

NSR Description and Approximate Distance from Substation Boundary Centroid	Existing Ambient Sound Level (dBA)	Predicted Noise Level from the Substation (dBA)	Total Noise Contribution (Substation + Ambient) (dBA)	Potential Increase Above Ambient (dBA)	Comply with Nepal Noise Standard for RRA (45 dBA Day, 40 dBA Night)	Comply with <3 dB Above Baseline Criterion
R8 – RRA 290 meters away	54	35.9	54	0	Yes	Yes

NSR = noise sensitive receptor; RRA = rural residential area

7.2.3.3 New Damauli to Ratmate Substation

The New Damauli to Ratmate Substation Segment is entirely within the Middle Mountain Physiographic province where slopes are mostly moderate to steep. Table 7.2-23 summarizes Project impacts on the Physical Environment as applicable to the New Damauli to Ratmate Substation Segment.

Table 7.2-23: Summary of Project Impacts Applicability to New Damauli to Ratmate Substation Segment

Aspect	Impact	Phase	Applicability to New Damauli to Ratmate Substation Segment
Topography/Geology/ Soils	Erosion and Landslides	C & O	Prone to erosion and landslides given the nature of topography (hills and mountain). Impacts are consistent with Project-wide impact discussion in Section 7.2.2.1 above.
Land Use / Land Cover	Changes in LULC	C & O	26.7 ha of agricultural land will be permanently converted to Built Up land and 84.1 ha of forest clearing will be required. See more detailed discussion below in Section 7.2.5.
Climate Change	Greenhouse Gas Emissions	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Climate Change	Effects of Climate Change on ETP	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Air Quality	Fugitive Dust	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Air Quality	Substation Emissions	C & O	Impacts limited to vehicle and backup generator emissions are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Water Resources	River Crossings and Floodplains	C & O	TL alignment spans the Seti Gandaki and Trishuli River or its tributaries 10 times. There are no transmission towers located within the floodplain in this segment. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above. See more detailed discussion below in Section 7.2.5.2.
Water Resources	Water Sourcing	C	Most of the tower locations within this segment are not vehicle accessible, so water will be sourced locally and carried to the tower sites to meet concrete production and other construction water needs. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Aggregate Sourcing	C	District approved river mining suppliers (see Table 2.8-10).
Water Resources	Sedimentation	C & O	This segment is prone to sedimentation given the high risk of erosion. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Wastewater Discharges	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Hazardous Materials Spills	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Improper Solid Waste Disposal	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.

Aspect	Impact	Phase	Applicability to New Damauli to Ratmate Substation Segment
Noise	Transmission Line Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	New Substation Construction Noise	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Helicopter Noise	C	Helicopter access proposed for some towers within this TL segment. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	New Substation Operation Noise	O	Noise modeling indicates the Ratmate Substation will comply with applicable noise regulations. See more detailed discussion below in Section 7.2.5.3.
Landscape Values and Visual Amenities	Degradation of Scenic Viewpoints	C & O	This segment includes the scenic viewpoints of the Village of Bandipur and one of the Trishuli River crossings. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.7 above.

C = Construction; LULC = Land Use/Land Cover; O = Operations

Change in Land Use and Land

As Table 7.2-24 indicates, the ETP will result in a net increase of 49.0 hectares of Built Up land, as a result of the construction of the Ratmate Substation and 250 transmission towers, and 70.9 hectares of maintained RoW as a of forest clearing in the RoW. There will be a corresponding net decrease of 85.9 hectares of forest and 30.5 hectares of agricultural land.

Table 7.2-24: Permanent Land Use/Land Cover Change within the New Damauli to Ratmate Substation Segment

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations and Lay down areas (ha)		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	198.4	-70.9	127.5	14.8	-14.8	0.0	0.2	-0.2	0.0
Cultivated	170.4	0.0	170.4	15.6	-15.6	0.0	18.0	-14.9	3.1
Barren	0.0	0.0	0.0	0.0	0.0	0.0	3.5	-3.5	0.0
River & Floodplain	2.2	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Built Up	15.5	0.0	15.5	0.0	30.4	30.4	2.0	18.6	20.6
Maintained RoW	0.0	70.9	70.9	0.0	0.0	0.0	0.0	0.0	0.0
Total	386.5		386.5	30.4		0.0	23.7		3.1

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River Crossings and Floodplain Impacts

The New Damauli to Ratmate Substation Segment will involve 10 river or stream crossings, as identified in Table 7.2-25. All of these rivers and streams will be spanned by the transmission line and none of the transmission towers would be located within the floodplain, so the Project will have no measurable effect on surface water hydrology in this segment.

Table 7.2-25: Water Body Crossings at New Damauli to Ratmate Substation Segment

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
Tributary of Seti Gandaki	38-39	80	40	Stream	Bandipur
Tributary of Seti Gandaki	46-47	465	30	Stream	Anbukhaireni
Tributary of Seti Gandaki	49-50	280	20	Stream	Anbukhaireni
Tributary of Seti Gandaki	59-60	220	30	Stream	Anbukhaireni
Trishuli River	94-95	70	105	Large River	Anbukhaireni
Tributary of Trishuli	138-139	440	39	Stream	Benighat Rorang
Tributary of Trishuli	155-156	270	30	Stream	Benighat Rorang
Tributary of Trishuli	174-175	65	46	Stream	Benighat Rorang
Trishuli River	183-184	144	105	Large River	Gajuri
Trishuli River	240-241	105	110	Large River	Tarkeshwar

Source: LiDAR & Satellite Imagery ERM 2019

Change in Acoustic Environment

The primary noise source along this transmission line segment is the Ratmate Substation (transformers). However, the impact magnitude of these noise sources on the nearest rural residential areas and silent zones (school) will be low. MCA-Nepal is acquiring an approximately 20 hectares tract of land, within which the Ratmate Substation will be located. This larger tract of land will increase the buffer between the substation and the nearest residential area. Table 7.2-26 presents receptor types and approximate distance to Ratmate Substation boundary centroid. The receptor locations near Ratmate Substation are shown in Figure 7.2-5. All receptors surrounding the substation were identified as rural residential areas, except for a school (silence zone) west of the Ratmate compressor station.

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Table 7.2-26: Ratmate Substation Receptor Locations

Receptor ID	Receptor Type	Approximate Distance to New Substation Boundary Centroid (meters)
R1	Rural residential area	120
R2	Rural residential area	307
R3	Rural residential area	355
R4	Rural residential area	280
R5	Rural residential area	365
R6	Rural residential area	295
R7	Rural residential area	270
R8	Silence zone (school)	540

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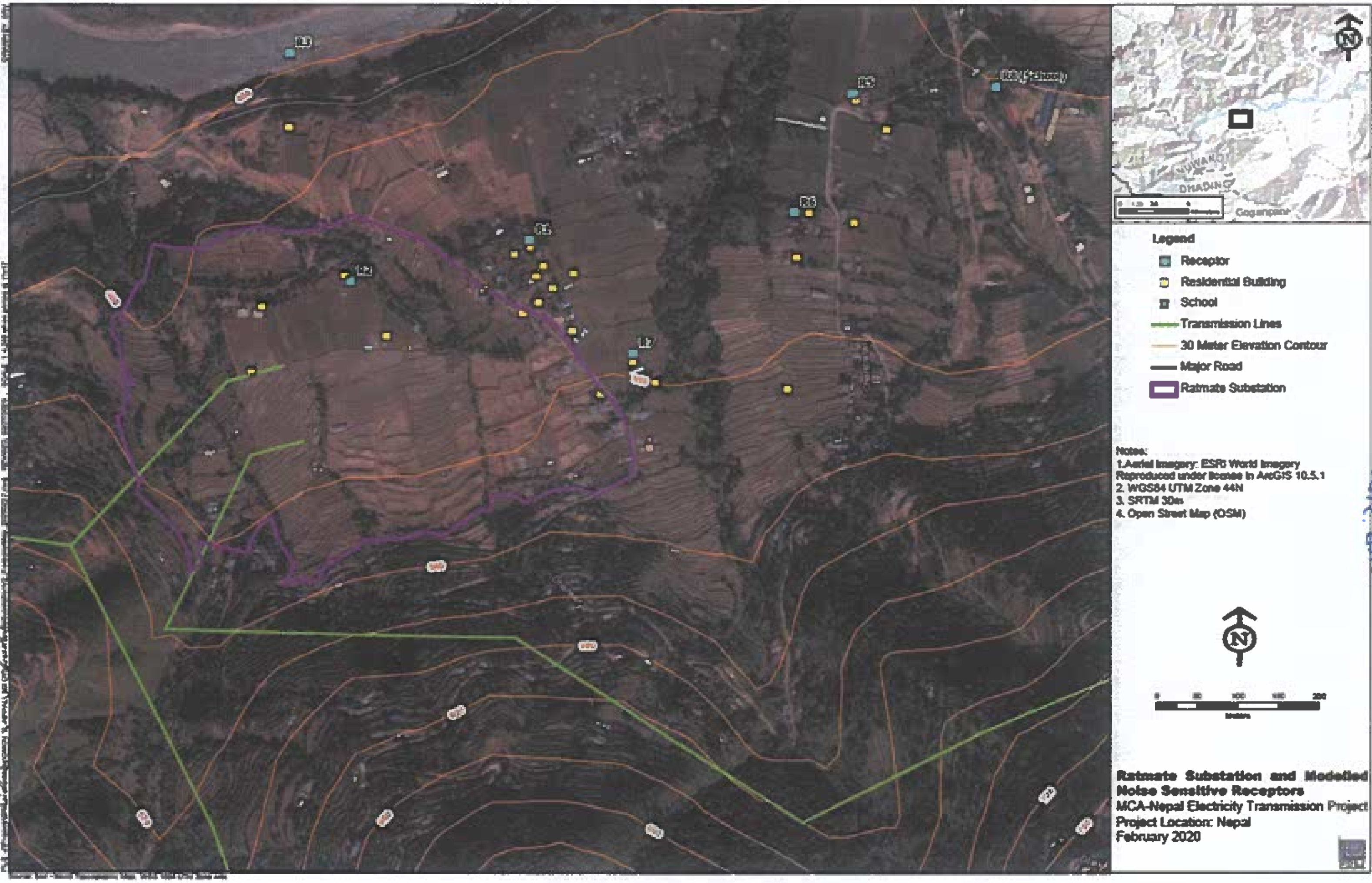

Figure 7.2-5: Ratmate Substation and Modelled Noise Sensitive Receptors

The predicted operation noise levels for the Ratmate Substation complies with Nepal noise standards (Table 7.2-27) and are shown in Figure 7.2-6.

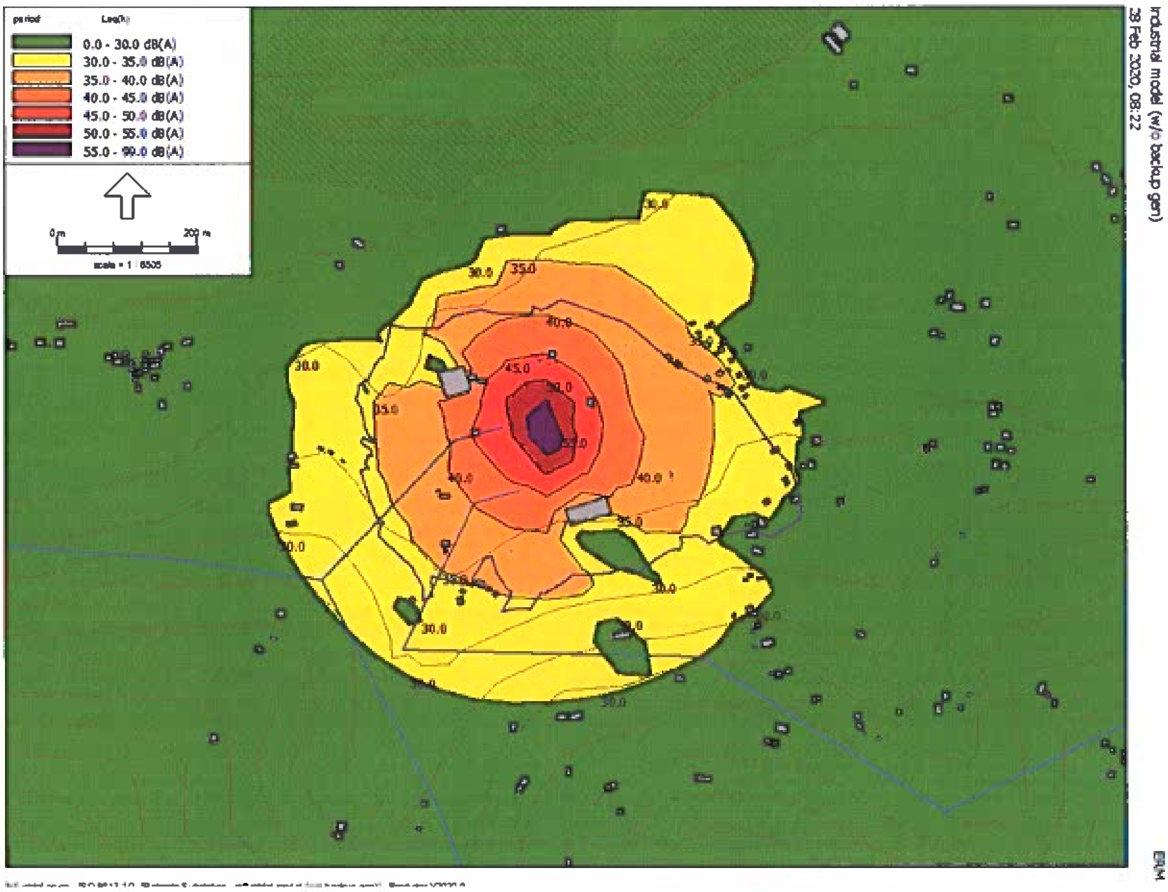

Figure 7.2-6: Noise Contours for Ratmate Substation

Table 7.2-27: Predicted Noise Levels for Ratmate Substation and Comparison with Nepal Noise Standard

NSR Description and Approximate Distance from Substation Boundary Centroid	Existing Ambient Sound Level (dBA)	Predicted Noise Level from the Sub-station (dBA)	Total Noise Contribution (Substation + Ambient) (dBA)	Potential Increase Above Ambient (dBA)	Comply with Nepal Noise Standard for RRA (45 dBA Day, 40 dBA Night) and SZ (50 dBA Day, 40 dBA Night)	Comply with <3 dB Above Baseline Criterion
Daytime (6.00 a.m.–10.00 p.m.)						
R1 – RRA 120 meters away	56	42.1	56	0	Yes	Yes
R2 – RRA 305 meters away	56	33.5	56	0	Yes	Yes
R3 – RRA 355 meters away	56	30.4	56	0	Yes	Yes
R4 – RRA 280 meters away	56	24.6	56	0	Yes	Yes
R5 – RRA 365 meters away	56	25.1	56	0	Yes	Yes
R6 – RRA 295 meters away	56	29.0	56	0	Yes	Yes
R7 – RRA 270 meters away	56	23.3	56	0	Yes	Yes
R8 (SZ) 540 meters away	56	22.7	56	0	Yes	Yes
Night-time (10.00 p.m. – 6.00 a.m.)						
R1 – RRA 120 meters away	56	42.1	56	0	Yes	Yes
R2 – RRA 305 meters away	56	33.5	56	0	Yes	Yes
R3 – RRA 355 meters away	56	30.4	56	0	Yes	Yes
R4 – RRA 280 meters away	56	24.6	56	0	Yes	Yes
R5 – RRA 365 meters away	56	25.1	56	0	Yes	Yes
R6 – RRA 295 meters away	56	29.0	56	0	Yes	Yes
R7 – RRA 270 meters away	56	23.3	56	0	Yes	Yes
R8 (SZ) 540 meters away	56	22.7	56	0	Yes	Yes

NA = not applicable; NSR = noise sensitive receptor; RRA = rural residential area; SZ = silence zone

7.2.3.4 Ratmate to New Hetauda Substation

The Ratmate to New Hetauda Substation Segment traverses across the Siwalik and Middle Mountain physiographic provinces where slopes are mostly moderate to steep. Table 7.2-28 summarizes Project impacts on the Physical Environment as applicable to the Ratmate to New Hetauda Substation Segment.

Table 7.2-28: Summary of Project Impacts Applicability to Ratmate to New Hetauda Substation Segment

Aspect	Impact	Phase	Applicability to Ratmate to New Hetauda Substation Segment
Topography/Geology/ Soils	Erosion and Landslides	C & O	Prone to erosion and landslides given the nature of topography (hills and mountain). Impacts are consistent with Project-wide impact discussion in Section 7.2.2.1 above.
Land Use / Land Cover	Changes in LULC	C & O	3.7 ha of agricultural land and 94.8 ha of forest will be converted to either Built Up land or maintained RoW. See more detailed discussion below in Section 7.2.6.1.
Climate Change	Greenhouse Gas Emissions	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Climate Change	Effects of Climate Change on ETP	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Air Quality	Fugitive Dust	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Air Quality	Substation Emissions	C & O	Impacts limited to vehicle and backup generator emissions are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Water Resources	River Crossings and Floodplains	C & O	TL alignment spans the Trishuli River, Agra Khola, East Rapti or its tributaries 6 times. There are 3 transmission towers located within the floodplain in this segment. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above. See more detailed discussion below in Section 7.2.6.2.
Water Resources	Water Sourcing	C	Most of the tower locations within this segment are not vehicle accessible, so water will be sourced locally and carried to the tower sites to meet concrete production and other construction water needs. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Aggregate Sourcing	C	District approved river mining suppliers (see Table 2.8-10).
Water Resources	Sedimentation	C & O	This segment is prone to sedimentation given the high risk of erosion. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Wastewater Discharges	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Hazardous Materials Spills	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Improper Solid Waste Disposal	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.

Aspect	Impact	Phase	Applicability to Ratmate to New Hetauda Substation Segment
Noise	Transmission Line Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Existing Substation Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Helicopter Noise	C	Helicopter access proposed for some towers within this TL segment. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Existing Substation Operation Noise	O	No increase in ambient noise. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Landscape Values and Visual Amenities	Degradation of Scenic Viewpoints	C & O	No scenic viewpoints were identified in this segment.

C = Construction; LULC = Land Use/Land Cover; O = Operations

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Change in Land Use and Land Cover

As Table 7.2-29 indicates, the ETP will result in a net increase of 16.9 hectares of Built Up land, as a result of the construction of the 140 transmission towers, and 87.0 hectares of maintained RoW as a result of forest clearing in the RoW. There will be a corresponding net decrease of 99.2 hectares of forest and 4.7 hectares of agricultural land.

Table 7.2-29: Permanent Land Use/Land Cover Change within the Ratmate to New Hetauda Substation Segment

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations and Laydown Areas (ha)		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	171.6	-87.0	84.6	12.2	-12.2	0.0	0.5	0.0	0.5
Cultivated	60.8	0.0	60.8	4.7	-4.7	0.0	3.6	0.0	3.6
Barren	0.0	0.0	0.0	0.0	-0.0	0.0	0.0	0.0	0.0
River & Floodplain	2.7	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
Built Up	12.1	0.0	12.1	0.0	16.9	16.9	0.0	0.0	0.0
Maintained RoW	0.0	87.0	87.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	247.2		247.2	16.9		0.0	4.1		4.1

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River Crossing and Floodplain Impacts

The Ratmate to New Hetauda Substation Segment will involve six river or stream crossings, as identified in Table 7.2-30. All of these rivers and streams will be spanned by the transmission line, but three of the transmission towers (i.e., Towers T5, T6, and T7) would be located within the floodplain, so the Project may have a small effect on surface water hydrology in this segment.

Table 7.2-30: Water Body Crossings at Ratmate to New Hetauda Substation Segment

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width	Waterbody Type	Municipality
Tributary of Trishuli	12-13	26	46	Stream	Belkotgadhi
Tributary of Trishuli	24-25	130	46	Stream	Thakre
Tributary of Aagra Khola	49-50	43	20	Stream	Thaha
Tributary of East Rapti	68-69	52	32	Stream	Kailash
East Rapti River	86-87	106	98	Small River	Kailash
Tributary of East Rapti	108-109	25	12	Stream	Hetauda

Source: LiDAR & Satellite Imagery ERM 2019

7.2.3.5 Ratmate to Lapsiphedi Substation

The Ratmate to Lapsiphedi Substation Segment lies entirely on the Middle Mountain Physiographic provinces where slopes are mostly moderate to steep. Table 7.2-31 summarizes Project impacts on the Physical Environment as applicable to Ratmate to Lapsiphedi Substation Segment.

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Table 7.2-31: Summary of Project Impacts Applicability to Ratmate to Lapsiphedi Substation Segment

Aspect	Impact	Phase	Applicability to Ratmate to Lapsiphedi Substation Segment
Topography/Geology/Soils	Erosion and Landslides	C & O	Prone to erosion and landslides given the nature of topography (hills and mountain). Impacts are consistent with Project-wide impact discussion in Section 7.2.2.1 above.
Land Use / Land Cover	Changes in LULC	C & O	8.2 ha of agricultural land and 50.1 ha of forest will be converted to built up land or maintained RoW. See more detailed discussion below in Section 7.2.7.1.
Climate Change	Greenhouse Gas Emissions	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Climate Change	Effects of Climate Change on ETP	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.3 above.
Air Quality	Fugitive Dust	C	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Air Quality	Substation Emissions	C & O	Impacts limited to vehicle and backup generator emissions are consistent with Project-wide impact discussion in Section 7.2.2.4 above.
Water Resources	River Crossings and Floodplains	C & O	TL alignment spans the Tadi and Likhu rivers or their tributaries five times. There are no transmission towers located within the floodplain in this segment. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above. See more detailed discussion below in Section 7.2.7.2.
Water Resources	Water Sourcing	C	Most of the tower locations within this segment are not vehicle accessible, so water will be sourced locally and carried to the tower sites to meet concrete production and other construction water needs. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Aggregate Sourcing	C	District approved river mining suppliers (see Table 2.8-10).
Water Resources	Sedimentation	C & O	This segment is prone to sedimentation given the high risk of erosion. Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Wastewater Discharges	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Hazardous Materials Spills	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.
Water Resources	Improper Solid Waste Disposal	C & O	Impacts are consistent with Project-wide impact discussion in Section 7.2.2.5 above.

Aspect	Impact	Phase	Applicability to Ratmate to Lapsiphedi Substation Segment
Noise	Transmission Line Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Existing Substation Construction Noise	C	Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Helicopter Noise	C	This TL segment has generally good construction accessibility, so helicopters will likely be used less often. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Noise	Existing Substation Operation Noise	O	No increase in ambient noise. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.6 above.
Landscape Values and Visual Amenities	Degradation of Scenic Viewpoints	C & O	Village of Nuwakot identified in this segment which is 1.5 km from Tower 35. Shivapuri-Nagarjun National Park is 1.7 km from Tower 150 of this segment. Impacts are generally consistent with Project-wide impact discussion in Section 7.2.2.7 above.

C = Construction; LULC = Land Use/Land Cover; O = Operations

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Change in Land Use and Land Cover

As Table 7.2-32 indicates, the ETP will result in a net increase of 19.6 hectares of built up land, as a result of the construction of the 163 transmission towers, and 44.4 hectares of maintained RoW as a result of forest clearing in the RoW. There will be a corresponding net decrease of 51.5 hectares of forest and 12.4 hectares of agricultural land.

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Table 7.2-32: Permanent Land Use/Land Cover Change within the Ratmate to Lapsiphedi Substation Segment

Land Cover	Transmission RoW (excluding towers) (ha)			Transmission Towers (ha)			Substations and Laydown Areas (ha)		
	Existing	Change	Future	Existing	Change	Future	Existing	Change	Future
Forest	128.6	-44.3	84.3	7.2	-7.2	0.0	0.0	0.0	0.0
Cultivated	110.0	0.0	110.0	12.4	-12.4	0.0	3.4	0.0	3.4
Barren	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
River & Floodplain	1.6	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
Built Up	12.3	0.0	12.3	0.0	19.6	19.6	0.0	0.0	0.0
Maintained RoW	0.0	44.3	44.3	0.0	0.0	0.0	0.0	0.0	0.0
Total	252.5	0.0	252.5	19.6	0.0	0.0	3.4	0.0	0.0

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River Crossing and Floodplain Impacts

The Ratmate to Lapsiphedi Substation Segment will involve five river or stream crossings, as identified in Table 7.2-33. All of these rivers and streams will be spanned by the transmission line and none of the transmission towers would be located within the floodplain, so the Project will have no measurable effect on surface water hydrology in this segment.

Table 7.2-33: Water body Crossings at Ratmate to Lapsiphedi Substation Segment

River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width (m)	Waterbody Type	Municipality
Tributary of Tadi	30-31	65	26	Stream	Belkotgadhi
Tributary of Tadi	39-40	85	30	Stream	Belkotgadhi
Likhu River	82-83	140	44	Stream	Shivapuri
Likhu River	116-117	262	24	River	Shivapuri
Likhu River	122-123	55	25	River	Shivapuri

Source: LiDAR & Satellite Imagery ERM 2019

7.2.4 Pre-mitigation Significance Rating for Physical Environment

The table below provides the significance for the various impacts assessed prior to the implementation of mitigation measures. There are likely to be some variances across the significance categories in keeping with the segments and Project lifecycle phases. Significance ratings are provided for the construction phase, separately from the operations phase.

Table 7.2-34: Pre-mitigation Significance Rating for Construction and Operation Phases

Impacts	Magnitude (Score)	Extent (Score)	Duration (Score)	Significance (Score)
Construction Phase				
Erosion and Landslides	High (60)	Local (20)	Short-term (5)	Moderate (85)
Greenhouse Gas Emissions	Low (10)	Regional (60)	Long-term (20)	Moderate (90)
Fugitive Dust	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Tower Site Diesel Generator Construction Emissions	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)

Impacts	Magnitude (Score)	Extent (Score)	Duration (Score)	Significance (Score)
Substation Construction Emissions	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Water Sourcing	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Aggregate Sourcing	Medium (20)	Local (20)	Short-term (5)	Minor (45)
River Crossings and Floodplain Impacts	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Sedimentation	High (60)	Local (20)	Short-term (5)	Moderate (85)
Wastewater Discharge	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Hazardous Materials Spills	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Improper Solid Waste Disposal	Medium (20)	Local (20)	Medium-term (10)	Minor (50)
Noise from Transmission Line Construction	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Noise from three New Substation Construction	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Noise from two Existing Substation Construction	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Noise from Use of Helicopters	High (60)	Local (20)	Short-term (5)	Moderate (85)
Noise/Vibration from Use of Explosives and Implosives	High (60)	Local (20)	Short-term (5)	Moderate (85)
Degradation of Scenic Viewsheds	Low (10)	Local (20)	Long-term (20)	Minor (50)
Operations Phase				
Erosion and Landslides	High (60)	Local (20)	Medium-term (10)	Moderate (90)
Greenhouse Gas Emissions	Positive	Regional	Long-term	Positive
Substation Operation Emissions	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)

Impacts	Magnitude (Score)	Extent (Score)	Duration (Score)	Significance (Score)
Sedimentation	High (60)	Local (20)	Medium-term (10)	Moderate (90)
Floodplain Impacts	Low (10)	Local (20)	Long-term (20)	Minor (50)
Wastewater Discharge	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Hazardous Material Spills	Medium (20)	Site-specific (10)	Long-term (20)	Minor (50)
Improper Solid Waste Disposal	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Noise from Transmission Line Operation	Low (10)	Local (20)	Long-term (20)	Minor (50)
Noise from Substation Operation	Low (10)	Local (20)	Long-term (20)	Minor (50)
Degradation of Scenic Viewsheds	Low (10)	Local (20)	Long-term (20)	Minor (50)
Construction and Operation Phases				
Natural Disasters and Accidents	High (60)	Site-specific (10)	Short-term (5)	Moderate (75)

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7.3 ADVERSE IMPACTS TO THE BIOLOGICAL ENVIRONMENT

As described in Section 3.5, the remainder of this section describes Project impacts on each of these biological environment aspects, first discussing Project-wide impacts, which are common to most if not all of the transmission line segments, followed by Segment-specific impacts, which are somewhat unique to a specific transmission line segment. Section 3.1 defines the spatial scale of this impact assessment by defining the Project's direct and indirect impact areas. The direct impact area includes the Right-of-Way (RoW), substations, and ancillary facilities. The indirect impact area includes biological resources within approximately 500 meters of the centerline of the transmission line (TL) RoW (referred to as the Area of Analysis, or AoA).

The Project has reduced Project-wide adverse biological impacts through design by minimizing the need for forest clearance by:

- Using tall towers with an average height of 61 meters, which allows the transmission lines to span over much of the forest;
- Developing a new large tower type to allow the transmission lines to span longer distances over river and stream valleys;
- Committing to build no new roads to access tower construction sites; rather the Contractor will use porters and pack animals following existing and some new trails to transport construction equipment and materials;
- Prohibiting any tree clearing for all tower laydown areas, worker construction camps, storage areas, work areas, and transmission tower access trails;
- Ensuring that strung conductors are further apart that the maximum wingspan of at-risk bird species in order to avoid electrocution risks; and
- Using helicopters and possibly drones to deliver construction equipment and materials to remote tower locations and to help with tower erection and/or line stringing.

7.3.1 Project-Wide Adverse Biological Impacts

The sections below discuss Project-wide adverse biological impacts predicted to occur following application of these avoidance measures.

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7.3.1.1 Impacts to Protected Areas and Internationally Recognized Areas for Biodiversity

Construction and Operation Phases

Protected Areas

Potential impacts to protected areas may include:

- No direct impacts.
- Indirect impacts such as disturbance and/ or displacement of fauna; barrier creation, fragmentation and edge effects; induced impacts from facilitating poaching, logging, clearing of vegetation/firewood collection; soil erosion and invasive species.

Note that it is considered that the impacts to protected areas will occur mostly within the construction phase, however ongoing impacts due to induced access for the community are likely to continue during operation. These impacts however have been considered separately in relation to specific threats (such as hunting/poaching and invasive species) below.

In relation to specific impacts to the broad conservation landscapes screened into the assessment, impacts to each of these areas is discussed below.

President Chure-Terai Madesh Conservation Area

The Chure-Terai Madesh Conservation Areas (CCA) is a broad conservation unit that the ETP alignment will unavoidably traverse. Based on information from the baseline assessment, the data relevant to impacts to forests within the CCA is outlined in Table 7.3-1.

Table 7.3-1: Relevant Spatial Data for the CCA

Relevant Spatial Data for the President Chure-Terai Madesh Conservation Area	
Total Area of the CCA (ha)	1,903,119
ETP RoW area within the CCA (ha)	150
ETP alignment length within the CCA (km)	32.6
Forested area within RoW within CCA (ha)	124.2
Estimated area of forest loss within the ETP within CCA (ha)	81.5
ETP Area of Analysis within the CCA[1] (ha)	3,272
Forested area within ETP Area of Analysis within the CCA (ha)	2,597
Percentage forest loss within ETP RoW within the CCA	66%
Estimated number of trees to be cleared within RoW within the CCA	32,675

[1] Area of analysis is 500m either side of RoW

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The CCA is a hotspot of biological diversity in Nepal and home for many plant and animal species of conservation interest. From the desktop assessment, it was identified that forest clearance is one key threat posed to the CCA. Based on the geospatial assessment data, the impact to the CCA from the ETP alignment (150 hectares) within existing forested areas (124.2 hectares) will result in 66 percent forest loss (81.5 hectares) within the RoW. This corresponds to an estimated 32,675 trees/poles cleared within the RoW.

The assessment identified that erodible soils are also present within the CCA. Highly weathered and easily erodible mudstone geology contributes to erosion within the foothill areas of the CCA. This erosion, if not mitigated during construction and operation of the ETP can lead to erosion and subsequent increased pollution and sediment loading within waterways flowing from the CCA.

Additionally, the President Chure-Terai Madesh Conservation Development Board (PCTMCDB) recommended the following actions for the ETP: (1) Find alternatives to minimize adverse impacts on forest area, ponds/lakes, and areas with natural and biological significance. (2) Should the Project require forest land, get access rights from the government; (3) Ensure minimal impact on biodiversity and the environment and minimal impact on forest land; and (4) Allocate programs/budget for conservation of endangered and rare species, flora and fauna. The ETP alignment, during the design process, has applied measures to manage issues (1) through (3). Potential compensation mechanisms for forested lands are being considered for forest loss within the CCA. The Project's response to these management requests is shown in Table 7.3-2.

Table 7.3-2: The Project Response to PCTMCDB Recommendations

PCTMCDB Recommendations	ETP Response
1. Find alternatives to minimize adverse impacts on forest area, ponds/lakes and areas with natural and biological significance.	The Project has undertaken an assessment to identify a route that minimizes impacts to forests. All lakes and rivers along the ETP route will be overpassed by strung wires.
2. Should the Project require forest land, get access rights from the government.	The Project will coordinate with the MoFE to obtain access rights for all Project lands and a Forest Clearance Permit for all required forest clearance.
3. Ensure minimal impact on biodiversity and the environment and minimal impact on forest land.	The Project has minimized the area of impacts to forest by avoiding all protected areas and re-aligning the ETP to reduce impacts to forest management categories under the Forest Act 2019.
4. Allocate programs/budget for conservation of endangered and rare species, flora, and fauna.	See Section 8.2.2 that outlines the measures that will be undertaken to assess and manage the conservation of threatened species.

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The PCTMCDB has prepared a Conservation and Management Master Plan for the CCA (PCTMCDB 2015). The Plan has three main objectives with the first being relevant to sustainable natural resource use within the Chure, while the second and third objectives focus on mitigation of impacts of water induced disasters and access to forest produce and energy resources. Table 7.3-3 assessing the ETP impacts in relationship to these three objectives.

Table 7.3-3: ETP Consistency with CCA Conservation and Management Master Plan Objective 1

CCA Conservation and Management Master Plan Objectives	ETP Consistency
1. Forest management for all forests outside the PAS to be managed by adopting appropriate forest improvement on the basis of the slope of the terrain.	The Project will adopt mitigation measures to reduce impacts to forests and prevent soil erosion in steep terrain.
2. Control of invasive species: The four main invasive plant species found throughout the Chure-Tarai Madhesh Landscape are *Mikenia micrantha, Lantana camera, Chromolanea odorata, Eupatorium glandulosum* and *Parthenium hysterophorus.*	The Project will adopt mitigation measures to control invasive species during construction and operation. Specific weed hygiene protocols and controls will be adopted within sensitive areas of the ETP alignment.
3. Biodiversity conservation focusing aimed toward the conservation- of the ecosystems lying outside the protected areas and the endangered species of plants.	The Project has minimized the area of impacts to forest by avoiding all protected areas and re-aligning the ETP to reduce impacts to forest management categories under the Forest Act 2019.

The Project has undertaken an assessment to identify a route that minimizes impacts to forests. All lakes and rivers along the ETP route will be overpassed by strung wires. Given the avoidance of Natural forests and other biodiversity habitats we conclude the following.

Therefore, the Project's potential impact on the Chure Conservation Area is adverse, direct, high in magnitude, local in extent, and short-term in duration, with an overall pre-mitigation significance of Moderate.

Terai Arc Landscape

The Terai Arc Landscape (TAL) supports some of Nepal's most endangered wildlife, plays host to the highest human population densities, and is the country's most productive agricultural region.

Based on information from the baseline assessment, the data relevant to the impacts to forests within the TAL is outlined in Table 7.3-4.

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Table 7.3-4: Relevant Spatial Data for the TAL

Relevant Spatial Data for the Terai Arc Landscape (TAL)	
Total Area of the TAL (ha)	2,479,086
ETP RoW area within the TAL (ha)	293
ETP RoW length within the TAL (km)	63.8
Forested area within RoW within TAL (ha)	166.7
Estimated area of forest loss within the ETP within the TAL (ha)	111.4
ETP Area of Analysis within the TAL[1] (ha)	6,425
Forested area within ETP Area of Analysis within the TAL (ha)	3,775
Percentage Forest loss within ETP RoW within the TAL	66.8%
Estimated number of trees to be cleared within RoW within the TAL	46,263

[1] Area of analysis is 500m either side of RoW

Based on the baseline data and analysis of forest extent and clearance, the Project will result in the clearing of 111.4 hectares of the forest within the RoW, which represents about 67 percent of the forest cover within the RoW, but only about 3 percent of the forest within the AoA. This corresponds to an estimated 46,263 trees/poles cleared within the RoW. The ETP alignment will therefore contribute to a minor forest loss within the area of analysis and more broadly within the TAL based on this analysis.

The overall goal of the TAL is to conserve the ecosystems of the Terai and Chure Hills in order to ensure the integrity of ecological, economic, and sociocultural systems and communities. Sixteen strategies (each with specific strategic actions) have been identified to achieve the TAL goals and its outcomes (Ministry of Forests and Soil Conservation 2015). These strategies fall under thematic areas based on species and ecosystem conservation, forests, and land management. The strategic theme of species and ecosystem conservation is most relevant for the ETP development and has the following objective: "To conserve and ensure recovery of endangered species and critical ecosystems."

The Project aims to achieve this objective by adopting strategies relevant for the ETP development such as managing rare and endangered species and protecting and restoring critical habitats.

Therefore, the Project's potential impact on the Terai Arc Landscape is adverse, direct, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

Chitwan Annapurna Landscape

The Chitwan-Annapurna Landscape (CHAL) in central Nepal is known for its biodiversity. A management plan was prepared for the CHAL (Ministry of Forests and Soil Conservation 2015); however, the plan expired in 2017 and has not been superseded. Based on information from the baseline assessment, the data relevant to impacts to forests within CHAL is outlined in Table 7.3-5.

Table 7.3-5: Relevant Spatial Data for the CHAL

Relevant Spatial Data for the Chitwan Annapurna Landscape	
Total Area of the CHAL (ha)	3,206,761
ETP RoW area within the CHAL (ha)	1,238
ETP RoW length within the CHAL (km)	269.3
Forested area within RoW within CHAL (ha)	703.6
Estimated area of forest loss within the ETP within the CHAL (ha)	304.0
ETP Area of Analysis within the CHAL[1] (ha)	27,069
Forested area within ETP Area of Analysis within the CHAL (ha)	18,594
Percentage forest loss within ETP RoW within the CHAL	43%
Estimated number of trees to be cleared within the RoW within the CHAL	143,031

[1] Area of analysis is 500m either side of RoW

Based on the baseline data and analysis of forest extent and clearance, the impact to the CHAL from the ETP alignment will result in the loss of 304 hectares of existing forest and 143,031 trees/poles, which represents about 43 percent of the forest cover within the RoW within the CHAL, but only about 1.6 percent of the forest cover within the AoA within the CHAL. The ETP alignment will therefore contribute to a minor forest loss within the CHAL compared to the extent of forest within the area of analysis and more broadly within the CHAL.

The CHAL contains seven natural corridors and seven proposed north-south conservation corridors and three east-west corridors that link biodiversity areas such as community forests and protected areas across the landscape (WWF 2013). The transmission line will cross four of the proposed conservation corridors (Kali Gandaki River Valley, Trishuli River Valley twice, and the Seti River Valley), but in all cases will span over the river and associated riparian forest, as indicated in Table 7.3-6.

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Table 7.3-6: CHAL Conservation Corridor Crossings

S/N	CHAL Conservation Corridor Crossings	Segment/Towers
1.	Kali Gandaki River Valley	NB–ND Towers
2.	Seti River Valley	NB–ND Towers
3.	Trishuli River	ND–RTE Towers
4.	Trishuli River	ND–RTE Towers

The impacts will occur from forest loss within the ETP (304 hectares), potential impacts from the workforce undertaking illegal harvesting of forest resources and poaching; potential introduction and proliferation of alien invasive species along the ETP RoW; potential forest fires from worker campfires and sparks from machinery; and impacts to the ground surface during tower footing construction and laydown areas.

Given that the Project will take steps to avoid any impacts to the natural river valley corridors which are vital components promoting connectivity in the CHAL we conclude the following.

Therefore, the Project's potential impact to CHAL is adverse, direct, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

Shivapuri-Nagarjun National Park

The Shivapuri-Nagarjun National Park core area is located 2.5 kilometers away from the ETP alignment. The land between the ETP and the Shivapuri-Nagarjun National Park buffer zone boundary is mostly open forest and agricultural land. Given that there will be no direct impacts on Shivapuri-Nagarjun National Park, and that the ETP is located at a distance of 2.5 kilometers from the core area and 0.11 kilometers from the buffer area, it is unlikely that the ETP will contribute to any existing threats posed to Shivapuri-Nagarjun National Park. Mobile wildlife (such as deer and large cats) may occasionally venture beyond the boundary of Shivapuri-Nagarjun National Park and stray within the ETP alignment, however this is considered a low risk as there is little contiguous habitat between the Park and the ETP alignment and humans present with adjacent farmlands will act as a deterrent.

Therefore, the Project's potential impact to Shivapuri-Nagarjun National Park is adverse, indirect, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

Parsa National Park and associated Important Bird Area

The Parsa National Park (PNP) and Important Bird Area (IBA) is located 7.5 kilometers from the core area and 0.7 kilometers from the buffer area, south of the ETP alignment. The land between the ETP and PNP is open agricultural land and the township of Hetauda. The ETP alignment will not have any direct impacts on the park and indirect impacts are likely to be minimal given the distance from the ETP alignment to the PNP core area.

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Therefore, the Project's potential impact to PNP is adverse, indirect, low in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

Internationally Recognized Areas for Biodiversity

Internationally Recognized Areas for biodiversity include: Key Biodiversity Areas (including Important Plant Areas and Important Bird Areas), Ramsar wetlands, Alliance for Zero Extinction Sites, and World Heritage Sites. Additional areas of international conservation concern considered in this impact assessment include: tiger conservation areas; endemic bird areas; Central Asian flyway (birds); and World Wildlife Fund ecoregions and biodiversity hotspots.

Based on the results of the geospatial assessment discussed in Chapter 5 (Baseline Information of the Project), the ETP alignment does not pass through or interact with any Important Plant Areas, Ramsar wetlands, Alliance for Zero Extinction Sites, or World Heritage Sites. The ETP alignment does however pass through the Nawalparasi Forest (NF) IBA.

Additionally, the ETP alignment passes through areas of international conservation concern including the Terai Arc Tiger Landscape; Central Asian flyway and the Eastern Himalaya Biodiversity Hotspot. In relation to these areas, they generally overlap with the broad conservation areas assessed above (CCA, TAL, and CHAL) and hence the impact assessment for these features is also relevant. Assessment of species associated with these areas (such as tigers and vultures) is undertaken below.

Therefore the NF IBA is the only internationally recognized area assessed for potential impacts below.

Nawalparasi Forest IBA

The Nawalparasi Forest (NF) IBA located along the ETP Alignment corresponding to the India Border to New Butwal Substation and New Butwal to New Damauli Substation segments. The area consists of agriculture and remnant forest and almost all of the southern part is intensively farmed.

Based on information from the baseline assessment, the data relevant to impacts to forests within NF IBA is outlined in Table 7.3-7.

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Table 7.3-7: Relevant Spatial Data for the Nawalparasi Forest IBA

Relevant Spatial Data for the Nawalparasi Forest IBA	
Total Area of the NF IBA (ha)	5,891
ETP RoW area within the NF IBA (ha)	26
ETP RoW length within the NF IBA (km)	6
Forested area within RoW within the NF IBA (ha)	7.9
Estimated area of forest loss within the ETP within the NF IBA (ha)	628
ETP Area of Analysis within the NF IBA (ha)[1]	190
Percentage forest loss within ETP RoW within the NF IBA	99%
Forested area within ETP Area of Analysis within the NF IBA (ha)	3,015

[1] Area of analysis is 500m either side of RoW

Based on the baseline data and analysis of forest extent and clearance, the impact to the NF IBA from the ETP alignment (26 hectares) will result in a loss of existing forested area (7.9 hectares) of all of this forest (99 percent) forest loss. This corresponds to an estimated 3015 trees/poles cleared within the RoW. The ETP alignment will therefore contribute to a minor forest loss within the NF IBA compared to the extent of forest within the area of analysis and more broadly within the NF IBA.

Nawalparasi Forest IBA has been identified as an IBA because of its important colony of White Rumped Vulture (*Gyps bengalensis*). The IBA also contains nesting colonies of the Lesser Adjutant Stork (*Leptoptilos javanicus*) (Birdlife Datazone 2019a). Following three key threats have been identified by Bird Life for the IBA (Birdlife Datazone 2019a; Bird Conservation Nepal pers. comm.). Table 7.3-8 reviews the ETP impacts in relationship to these three key threats.

Table 7.3-8: ETP Response to Key Threats in the Nawalparasi IBA

IBA Threats	ETP Response
Human intrusion and development	The Project will manage and educate the workforce during construction and operation to reduce impacts from induced access to forested areas created by the ETP alignment.
Natural system modifications	The Project has minimized impacts on habitats and species through aligning the ETP away from sensitive habitats (including the Lesser Adjunct Stork).
Residential and commercial development.	Although the transmission line is considered to be a commercial development, The Project has worked closely with Bird Conservation Nepal to adjust the alignment of the ETP to avoid impacts.

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The Project is likely to result in disturbance to the trigger species of the IBA, including White Rumped Vulture and Lesser Adjunct Stork during flight. Note that the ETP alignment has avoided the Lesser Adjutant Stork Colony through placement of the alignment away from these areas. Impacts related to these species may include mortality events due to line strikes during operation. This impact is further discussed in the segment wide impact assessments at Section 7.3.3 below.

The ETP alignment crosses through 6 kilometers (26 hectares) of the NF IBA coinciding with approximately 7 hectares of forest within the IBA. Based on the forest inventory survey, the area of forest to be cleared within the CCA is 7 hectares.

Given the small loss of forests in the Nawalparasi IBA, which has limited forest cover the following is concluded:

Therefore, the Project's potential impact to the Nawalparasi IBA is adverse, direct, medium in magnitude, site-specific in extent, and long term in duration, with an overall pre-mitigation significance of Minor.

7.3.1.2 Forest and Vegetation Impacts

Habitats have been classified based on the understanding of land cover classification and species assemblages (as derived from field data and the assessment of forest type and distribution along the ETP RoW). Forests represent the predominant natural habitat found along the transmission line alignment.

Impacts to Forests

Construction Phase

Forest clearing is required for tower and substation construction and to meet the required clearance between the conductors and the top of the forest canopy. The assessment below analyses the impacts to vegetation class within the ETP alignment; impacts to forest management categories under the *Forest Act* 2019; and estimated tree/pole loss for each ETP segment and district. Additionally, the proportional loss of forest within the ETP segment and the area of analysis (AoA) (being 500 meters either side of the RoW) has been assessed. The impacts are discussed below.

Impacts to Vegetation Types within the ETP Alignment

Based on the geospatial assessment, the loss of vegetation types has been assessed. Table 7.3-9 and Table 7.3-10 below summarizes the results of the analysis. From the results, a total of approximately 354.4 ha of forest will be cleared within the ETP alignment. The corresponding tree/poles loss is 173,183 in forests and 28,835 in other wooded areas (estimated total of 202,018).

In terms of impacts to vegetation classes, tropical forests (at lower elevations will be impacted the most with 155.0 hectares of forest cleared. These forests are located on the lower to mid

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slopes where the ETP alignment passes alongside ridges (<1000m asl). Sub-tropical conifer forests (6.5 hectares) at higher elevations will have the least impacts (1000-2000m asl), generally as the ETP alignment will be constructed below elevations where this forest type occurs. In terms of comparative analysis of impacts within the Area of Analysis, the total loss equates to 1.7 percent of all vegetation within 500m of the centerline of the RoW. Within the RoW itself, the area of forest loss equates to 45.6 percent of all forest within the RoW. The remaining 54.4 percent will be left intact as the forest is below the minimum height of the canopy and the strung wires. These areas will be mainly in river valleys and edges of steep slopes where the ETP can pass above the canopy.

Table 7.3-9: Summary of Impacts to Vegetation Types within the ETP Alignment

Vegetation Classification	Forest Type	Total Area to be cleared within RoW (ha)	Tree Clearing from 1% Survey Estimate (Total trees)
Vegetation class	Tropical forest	155.0	76,705
	Subtropical Broadleaved Forest	70.4	35,689
	Subtropical Conifer Forest	6.5	2,082
	Not Specified	0.2	61
Other wooded land	Tropical Forest	15.6	7,576
	Subtropical Broadleaved Forest	10.9	5,538
	Not Specified	0.2	61
Trees that are not "Vegetation class" or "Other wooded land"		95.6	45,471
	Sub Total	**354.4**	**173,183**
All Other Trees (e.g., single trees in agricultural areas)		-	**28,835**
	Grand Total	-	**202,018**

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Table 7.3-10: Vegetation Type per Segment along the ETP RoW

ETP Segment	Area of Measurement	Tropical Forests	Subtropical Broadleaved Forests	Subtropical Conifer Forests	Other vegetation	Total	Percentage of Forest Loss (Row/AoA) (%)
India Border to New Butwal Substation	Area of forest within RoW[1] (ha)	4.3	0.0	0.0	6.2	10.5	100%
	Area of forest in AoA[2] (ha)	246.3	0.0	0.0	213.1	459.4	2%
New Butwal to New Damauli Substation	Area of forest within RoW (ha)	128.8	57.2	3.6	43.3	232.9	49.3%
	Area of forest in AoA (ha)	4,315.3	529.5	354.5	1,070.2	6,269.5	1.8%
New Damauli to Ratmate Substation	Area of forest within RoW (ha)	90.7	50.9	0	72.8	214.4	39.2%
	Area of forest in AoA (ha)	3,278.6	1,811.6	100.8	1,019.8	6,210.8	1.3%
Ratmate to New Hetauda Substation	Area of forest within RoW (ha)	73.5	59.2	0.6	50.6	183.9	51.6%
	Area of forest in AoA (ha)	1,909.1	1,769.7	33.7	683.8	4,396.3	2.2%
Ratmate to Lapsiphedi Substation	Area of forest within RoW (ha)	33.8	34.9	19.7	47.4	135.8	36.9%
	Area of forest in AoA (ha)	1,689.4	832.3	124.7	639.6	3,286.0	1.5%
Total	Area of forest within RoW (ha)	331.1	202.2	23.9	220.3	777.5	45.6%
	Area of forest in AoA (ha)	11,438.7	4943.1	613.7	3,626.5	20,622.0	1.7%

[1] Area calculated within the 46-meter RoW

[2] Area of analysis is 500m either side of RoW

Impacts to Forest Management Categories

Regarding impacts to forests classified under the Forest Act 2019, the project affects community, leasehold, and government managed forests Table 7.3-11 outlines the impacts of the project on forest according to forest management categories under the Forest Act 2019. As the table shows, out of a total of 777.5 hectare forests within RoW, only 354.4 hectare (45.6 percent of the total) forests need to be cleared. 48 percent of the total community forest area and 56 percent of total leasehold forest area within RoW needs to be cleared.

Table 7.3-11: Summary of Forest Clearing by Forest Management Categories

Area of Measurement	Forest Category		Government Managed Forest	Total
	Community Forest	Leasehold Forest		
Area within RoW (ha) [1]	330.4	4.4	442.7	777.5
Forest to be cleared (ha)[2]	158.7	2.4	193.3	354.4
Area of forest in AoA (ha)[3]	5,661.6	29.5	14,931.0	20,622.0
Length (km) [4]	88.9	1.1	94.7	184.8

[1] Area calculated within the 46-meter RoW
[2] Area calculated for forested areas contained within the Community and Leasehold Forest boundary and excludes areas that are not forested.
[3] Area of analysis is 500m either side of RoW
[4] length of forest intersecting the segment

Table 7.3-12 presents total area community and leasehold forests crossed by ETP transmission line, forest area within RoW, and the forest area that needs to be cleared by districts. The transmission line passes through 112 community forests with a total area of 12,231 hectare and 8 leasehold forests with a total forest area of 35 hectare. Of the total, only 1.3 percent of the total community and leasehold forest area needs to be cleared.

Table 7.3-12: CF and LHF area Affected in the Transmission Right-of-way by District

District	No. of Forests	Total CF/LHF Area (ha)	Total Users (Households)	Forest Area in RoW (ha) %		Forest Clearing (ha) %	
Nawalparasi East	2 CF	660	205	15.2	2.3%	8.9	1.3%
Nawalparasi West	7 CF	1640	5,853	19.8	1.2%	19.4	1.2%
Palpa	17 CF	1553	1,732	46.1	3.0%	18.8	1.2%
	2 LHF	20	19	2.2	10.9%	2.2	10.8%
Tanahu	20 CF	1928	1,938	44.0	2.3%	19.6	1.0%
Chitwan	3 LHF	7	23	0.6	7.8%	0.0	0.1%

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District	No. of Forests	Total CF/LHF Area (ha)	Total Users (Households)	Forest Area in RoW (ha) %		Forest Clearing (ha) %	
Dhading	25 CF	1629	3,562	68.9	4.2%	24.0	1.5%
	3 LHF	8	43	1.6	19.7%	0.2	2.8%
Nuwakot	31 CF	2326	3,781	73.9	3.2%	29.9	1.3%
Makwanpur	8 CF	2248	3,301	59.1	2.6%	37.8	1.7%
Kathmandu	2 CF	246	245	3.6	1.5%	0.4	0.2%
Total	112 CF/ 8 LHF	12,266	20,702	334.8	2.7%	161.1	1.3%

CF = community forest; ha = hectares; LHF = leasehold forest (indicated in cells shaded green); RoW = right of way; TL transmission line

Impacts to Estimated Tree/Poles for each ETP segment

Using the results of the 1 percent forest survey, the impacts to forests within the RoW and AoA were estimated. The results indicate that 45.6 percent of forest within the RoW will be cleared for ETP construction (including along the RoW, for tower pads and sub-stations). This equates to 354.4 hectares of forests in total, and would total to 202,018 trees/poles (see Table 7.3-13). This impact, when considered within the larger context, only represents 1.7 percent of the forest within the AoA.

Table 7.3-13: Summary of impacts to Estimated Tree/Poles

S/N	ETP Component	Area of Forest to be Cleared (ha)	Area of Forest within AoA[1] (ha)	Percentage of Forest Cleared within the AoA	Percentage of Forest Cleared within the RoW	Estimated Number of Trees/ Poles within RoW (Total)	Estimated Number of Trees/ Poles to be Cleared (Total)
	Total for ETP segments[2]	354.4	20,622	1.7%	45.6%	369,502	202,018
	Project components						
	Tower Pads	36.0	-	0.2%	6.8%	24,012	24,012
	RoW	312.9	-	1.5%	38.4%	360,144	145,502
	Substations	5.5	-	-	-	3,669	3,669
	Total[4]	**354.4**	-	**1.7%**	**45.6%**	**387,825**	**173,183**

[1] Area of analysis is 500m either side of RoW

[2] The results are for forest areas only and do not include results for areas outside of forests surveyed for the 1 percent survey (such as single trees or clumps in agricultural areas)

Overall, the impacts to forests is considered to be major given that 45.6 percent of forests within the RoW will be cleared during construction. 54.4 percent of forests will remain within the RoW. In context however, this equates to 1.7 percent of forest within the AoA.

In summary, the Project's potential impact during construction to forests is adverse, direct, high in magnitude, local in extent, and long term in duration, with an overall pre-mitigation significance of Major.

Operation Phase

Impacts to forests are likely to be minimal during the operations phase, as required clearing of vegetation along the ETP RoW will have occurred during the Construction Phase. Some ongoing impacts from the maintenance of vegetation within the RoW may occur, however this impact is not considered to be additional to the impact that occurs during the construction phase. The large construction workforce will be gone, and only occasional maintenance by small maintenance crews will occur.

Induced access from the transmission line, particularly in areas of forest will enable the local community to enter into areas of forest along the RoW and may subsequently increase the potential for unauthorized forest clearing and collection of Non-Timber Forest Products (NTFP) within forested areas.

Therefore, the Project's potential impact to forests during operation is adverse, direct, low in magnitude, site-specific in extent, and long term in duration, with an overall significance of Minor.

Introduction of Invasive Species

Construction Phase

In an assessment undertaken by IUCN Nepal during 2002-2003, 25 naturalized plant species have been reported as invasive in Nepal (Tiwari et al. 2005). Among these, four species (*Chromolaena odorata, Eichhornia crassipes, Lantana camara and Mikania micrantha*) are included in the world's 100 worst invasive species (Lowe et al. 2000).

Dispersal by vehicles and movement of construction materials often result in the formation of satellite populations at isolated geographic locations (Shreshta 2016). Invasive species such as *Eupatorium adenophorum*, *Ageratina adenophora* and *Lantana camara* form monoculture stands displacing native species and disrupting ecosystem processes. A full list of identified invasive species in Nepal and screened for the ETP alignment is outlined in Chapter 5.2, section 5.2.9.

The RoW is very susceptible to the introduction and proliferation of invasive species due to the presence and movement of the workforce within and entry of agricultural produce and construction material, all likely carriers of invasive species propagules. Maintenance clearance of saplings and other shrubs enhance the risk of proliferation of the invasive species. Proliferation of invasive species from RoW could suppress growth of grasses and trees and alter species composition and soil chemistry in natural forests.

Transmission and proliferation of invasive species within the RoW during construction is a key risk. The impacts due to invasive species include suppression of regeneration within disturbed areas and further transmission of these species into areas of natural habitat adjacent to the ETP RoW.

In summary, the potential impact of the introduction of invasive species during construction prior to mitigation is adverse, direct, low in magnitude, local in extent, and long term in duration, with an overall significance of Minor.

Operation Phase

There is likely to be a reduction in the risk of transmission of invasive species in the operation phase as use of vehicles and personnel entering the ETP will reduce. However, the proliferation of invasive species in the operation phase is likely to be a key risk due to invasive species potentially introduced during the construction phase taking hold as well as larger areas of disturbed areas becoming subject to growth. Management of invasive species in areas of natural habitat and areas likely to act as transmission pathways (such as modified habitats along roads) is recommended during operation.

In summary, the potential impact of the introduction of invasive species during operation prior to mitigation is adverse, direct, low in magnitude, local in extent, and long term in duration, with an overall significance of Minor.

Increase in Fire Hazard

Construction Phase

The use of open fires for cooking and heating by the work crews could pose a risk to the surrounding natural habitat, particularly in the dry season. The accumulation of vegetation material, once dried, could pose a further fire hazard to surrounding natural habitat.

Recurrent forest fires severely damage and prohibit regeneration and growth of seedlings, destroy non-timber forest products, injure and even kill ground fauna and flora and in some cases, encourage invasive species. In some forested areas along the ETP route, frequent burning has greatly reduced the regeneration and development of understory vegetation thereby leading to an open forest with relatively low biodiversity (GON/MoFSC 2014).

The management of open fires will require specific mitigation during construction.

In summary, the potential impact of the increase of fire hazards during construction prior to mitigation is adverse, direct, high in magnitude, local in extent, and medium-term in duration, with an overall significance of Moderate.

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Operation Phase

The risks of fire during the operations phase stem mainly from line drops and transmission tower failure. The risk is higher during natural disasters that may affect the transmission line infrastructure. Given that the ETP route will remain forested along some stretches, the risk of fire may also be increased in these sections.

In summary, the potential impact of the increase of fire hazards during operation prior to mitigation is adverse, direct, low in magnitude, local in extent, and long term in duration, with an overall significance of Minor.

Edge Effects

Construction Phase

Edge effects vary in their impact to surrounding forests with some impacts due to changes in moisture differentials estimated to impact the 120 meters whilst impacts due to invasive species can impact up to 250 meters in tropical forests (Voller 1998). In relation into changes in species mix due to forest edges, Sapkota et al. (2018) identified that impacts from villages adjacent to forests in the Terai are impacted by human disturbances between 0 – 1500 meters from human settlements, with the disturbance gradient reducing after the first 500 meters but continuing in extent. Note that this is an extreme example of human induced edge effects as human settlements are likely to have a much greater impact to adjacent forests. This level of impact is not expected along the ETP given human density is likely to be less than a permanent village during construction (worker force) and operation (maintenance crews). Biological and physical impacts however are likely to occur due to the ETP alignment.

In order to predict changes to forests along the ETP, an area of analysis has been defined, being 500 meters from the center line of the RoW to take into account impacts to adjoining forested lands from biological and physical changes brought about by the new forest edge. Given that forested areas impacted by the ETP alignment will not generally be associated with settlements, this distance is considered to be appropriate given the impact distances identified by Voller and Sapkota in Nepal.

Based on the results of the vegetation class assessment, the total forest edge adjacent to the RoW is 167.5 kilometers out of a total length of the ETP of 314 kilometers. The remaining 146.5 kilometers of the ETP alignment will pass through urban, agricultural lands and non-forested terrain. Of the 167.5 kilometers, it is estimated that 74.9 kilometers of forest edges will be adjacent to forests that will be cleared along the ETP alignment. The maximum distance of new edges measured along the ETP within forest patches to be cleared is approximately 1.5 kilometers.

Table 7.3-14 outlines the length of forest edges for vegetation classes along the ETP alignment.

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Table 7.3-14: Length of forest edges for all forests along ETP alignment (km)

S/N	ETP Segment	Tropical Forests	Subtropical Broadleaved Forests	Subtropical Conifer Forests	Other vegetation	Total length of forest edge	Length of forest edges in patches to be cleared
1.	India Border to New Butwal Substation	0.8	0	0.0	1.1	1.9	1.9
2.	New Butwal to New Damauli Substation	26.7	12.9	0.7	9.9	50.2	24.5
3.	New Damauli to Ratmate Substation	18.9	11.0	0.0	15.8	45.7	17.4
4.	Ratmate to New Hetauda Substation	15.9	12.8	0.1	11.3	40.1	20.6
5.	Ratmate to Lapsiphedi Substation	6.7	7.6	4.4	10.9	29.6	10.5
Total		**69.0**	**44.3**	**5.2**	**49.0**	**167.5**	**74.9**

Edge effects from the ETP RoW are likely to occur within approximately 500 meters of cleared areas, changing the species mix of forests. Impacts that will arise can include that some flora could colonize the RoW due to lack of competition from other tree species and gradually dominate the surrounding habitat leading to a reduction of flora diversity.

The largest impact from the ETP will be within tropical forests dominated by Sal (*Shorea robusta*) and subtropical broad-leaved forests. The impacts are likely to result in an increase in understory colonizing species as well as invasive species (such as *Lantana camara*). Mishra and Garkoti (2014) report that regeneration of tropical forests tend to be dominated by Sal (*S. robusta*), *Dalbergia latifolia* and *Syzgium cumini* within 5 years of disturbance. These species show a strong tendency to dominate tree stands following disturbance.

These impacts are likely to be localized to areas immediately adjacent to the RoW in forests (within 500 meters). It is estimated that approximately 74.9 kilometers of the ETP alignment (out of a total of 314 kilometers) will create new forest edges that will be subject to edge impacts (or 23.9 percent of the alignment length; or 44.7 percent of the total forested length). These impacts however are likely to reduce over time as forests regenerate, especially in areas dominated by Sal (*S. robusta*) given the propensity of this species to regenerate effectively (Adhikari et al. 2017).

In summary, the potential impact of edge effects during construction and prior to mitigation is adverse, direct, medium in magnitude, local in extent, and medium-term in duration, with an overall significance of Minor.

Operation Phase

Impacts due to edge effects during the operation phase will continue from the construction phase. These impacts are likely to be long term and result in changes of species mix along the ETP alignment, proliferation of invasive species. These impacts will be localized to new edges created (estimated at 74.9 kilometers with maximum length of 1.5 kilometers for each clearing patch).

In summary, the potential impact of edge effects during operation and prior to mitigation is adverse, direct, low in magnitude, local in extent, and medium-term in duration, with an overall significance of Negligible.

Induced Clearing and NTFP Collection

Construction Phase

The ETP alignment passes through natural forests and the opening up of the RoW and access trails could enhance access to timber for firewood, construction material and other purposes. While timber extraction is allowed with some restrictions in certain forest classes such as community forests, it is illegal in government owned forests and protected areas. The tree species protected in Nepal as described above could be illegally felled. Natural habitat areas may be opened up by local people, which may also be a major induced impact that will need to be carefully managed during construction and operation.

Extraction of wild edible plants and those used for medicinal purposes could disrupt sustainable harvesting techniques practiced by local communities in Community Forests. The impacts of both hunting and extraction of NTFPs could be exacerbated if there are commercial intents for sale outside the RoW as the volume of extraction would be much higher especially for higher value products.

Tubers and roots of *Dioscorea deltoidea* are likely to be extracted for medicinal reasons. Protected orchids and lichens are likely to be impacted by extraction for ornamental purposes, food, and commercial sale. As indicated in Section 5.2, there are several trees, shrubs and herbs whose roots, stems, leaves, fruits and bark are used as wild edible plants and for medicinal purposes. Orchids could also be extracted for ornamental purposes.

The ETP alignment passes through natural habitat and the opening up of the RoW and access trails could enhance access to timber and NTFP needed by local communities for firewood, construction material, and other purposes. Several protected plant species and threatened and protected birds may lose nesting tress as a consequence of induced clearing. These impacts are expected to be localized adjacent to settlements adjacent to or near the ETP alignment.

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In summary, the potential impact of induced clearing during construction and prior to mitigation is adverse, medium in magnitude, site-specific in extent, and long term in duration, with an overall significance of Minor.

Operation Phase

Impacts from induced clearing and NTFP collection during the construction phase will continue to occur during operation. With the workforce largely removed, the community are likely to be more of a risk to conduct the activity during operation. Impacts are likely to occur closer to existing settlements that may use the RoW as an access point to collect timber and forest products.

The subsequent impact will be localized loss of habitat for the collection of NTFP, firewood, construction materials and potential for illegal logging. Sapkota et al. (2018) suggests that these impacts are most pronounced within 1500 meters of settlements, however the impacts may go beyond this area as resources are depleted in closer proximity to the settlements.

In summary, the potential impact of induced clearing during operation and prior to mitigation is adverse, low in magnitude, site-specific in extent, and long term in duration, with an overall significance of Negligible.

Potential Impacts to Fauna Species

Fauna Disturbance and Displacement

Construction Phase

Vegetation clearance of Natural forests (and sometimes in modified areas) will result in loss of breeding, foraging, and resting/roosting sites for several threatened and protected species of mammals, reptiles, and birds.

Natural forests of the vegetation types mentioned above support a diversity of CR, EN and protected species (as per *NPWLC Act* 1973) as recorded during the Biological Environment Baseline surveys (Section 5.2). Species that are likely to be impacted due to vegetation clearance are less mobile fauna, including mammals, birds and herpetofauna. There are endemic or habitat specific species that are considered at risk specifically due to habitat clearing.

The presence of the work force is likely to disturb fauna during the construction phase. Workers will install each tower foundation excavation as well as erection and stringing of conductors within teams across the ETP alignment in any given time during construction. Fauna such as leopards, bears and potentially stray tigers may pose a particular risk to human/wildlife conflict. Acharya et al. (2016) reports that attacks by common leopards are of higher risk of conflict within forests and modified habitats. Other species (including bears) were reported to be of less of concern, however possible to occur in remote forested areas.

Additionally, noise, light, machinery and dust emissions from operation of machinery and vehicles is likely to have localized impacts on flora and fauna. Disturbance and displacement

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will be most pronounced for forest dwelling fauna that are less mobile species (including both the Indian and Chinese pangolins, herpetofauna such as turtles and lizards and forest dependent birds).

In summary there is likely to be a reduction of fauna utilization of habitats surrounding the RoW however these impacts are likely to be localized to areas of natural habitat that will be cleared or remain adjacent to the RoW. Given the linear nature of the development, adjacent areas of natural habitat are likely to provide sufficient resources for displaced fauna. As outlined in Table 7.3-11, although 39.03 percent of the forests within the ETP alignment will be cleared, 1.45 percent of the forest within a 500 meter buffer of the center line of the RoW will be cleared.

The species most at risk from forest clearing, disturbance and displacement have been screened from the baseline data and are outlined in Table 7.3-15.

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Table 7.3-15: Fauna Species at Risk during Forest Clearing

S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
Mammals				
1.	Asiatic Black Bear	VU, EN, Protected	All forests	New Butwal to New Damauli
2.	Sloth Bear	VU, EN, Protected	All forests	New Butwal to New Damauli Ratmate to New Hetauda
3.	Chinese Pangolin	CR, CR, Protected	All forests and agricultural lands	Ratmate to New Hetauda Ratmate to Lapsiphedi
4.	Indian Pangolin	EN, EN, Protected	All forests and agricultural lands	Ratmate to New Hetauda
5.	Leopard Cat	LC, VU, Protected	All forests	New Butwal to New Damauli New Damauli to Ratmate Ratmate to Lapsiphedi
6.	Assamese Macaque	NT, VU, Protected	All forests	New Butwal to New Damauli
7.	Common Leopard	VU, VU	All forests	New Butwal to New Damauli New Damauli to Ratmate Ratmate to Lapsiphedi
8.	Bengal Fox	LC, VU	All forests	Ratmate to New Hetauda Ratmate to Lapsiphedi
9.	Large Indian Civet	LC, VU	All forests	Ratmate to Lapsiphedi
Herpetofauna				
10.	Tricarinate Hill Turtle	VU, -	Tropical forests dominated by Sal	New Butwal to New Damauli
11.	Elongated Tortoise	CR, -	Tropical forests dominated by Sal	New Butwal to New Damauli Ratmate to New Hetauda
12.	Yellow Monitor	LC, Protected	All forests	Ratmate to New Hetauda
Birds				
13.	Great Hornbill	VU, EN, and Protected	Primary forests with nesting hollows	New Damauli to Ratmate
14.	Great Slaty Woodpecker	VU, EN	All forests	New Butwal to New Damauli
15.	Slender-billed Babbler	VU, CR	All forests	Not detected during surveys but likely present
16.	Jerdon's Babbler	VU, CR	All forests	Not detected during surveys but likely present
17.	Grey-Crowned Prinia	VU, CR	All forests	Not detected during surveys but likely present

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S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
18.	White-Throated Bushchat	VU, EN	All forests	Not detected during surveys but likely present
19.	Bristled Grassbird	VU, VU	All forests	Not detected during surveys but likely present
20.	Brown Fish Owl	LC, VU	All forests	Not detected during surveys but likely present
21.	Alexandrine Parakeet	NT, NT	All forests	Not detected during surveys but likely present
22.	Indian Peafowl	LC, NT	All forests	New Damauli to Ratmate
23.	White Rumped Vulture	CR,CR	Nest on *Bombax ceiba* trees	India Border to New Butwal New Butwal to New Damauli
24.	Red-Headed Vulture	CR, EN	Nest in *Pinus roxburghii* trees	India Border to New Butwal New Damauli to Ratmate Ratmate to Lapsiphedi

In summary, the potential impact of fauna disturbance and displacement prior to mitigation is adverse, direct, high in magnitude, site-specific in extent, and short-term in duration, with an overall significance of Moderate.

Operation Phase

Impacts to species associated with natural habitats are likely to be occur mainly within the construction phase. Impacts in the operations phase will occur due to maintenance of vegetation within the RoW. These impacts may disturb fauna that have re-inhabited forested areas along the ETP RoW. Of particular concern are impacts to nesting birds within the RoW that may be impacted during lopping of vegetation if nests are present. The list of birds within Table 7.3-15 are those of most conservation concern in relation to ongoing impacts due to clearing and disturbance/displacement during operation.

In summary, the potential impact of the fauna disturbance and displacement prior to mitigation is adverse, direct, low in magnitude, site-specific in extent, and short-term in duration, with an overall significance of Negligible.

Hunting and Poaching of Fauna

Construction Phase

Given the presence of the workers force along the RoW during construction and easy access to fauna habitats, there is likely to be attempted hunting of fauna.

The RoW and trails used for transporting construction material may also enhance access to local communities to areas where fauna and flora are found in higher densities and can be hunted and collected. Hunting pressure could further depress population sizes that are likely low due to the remoteness of some of the natural habitats and limited enforcement of wildlife laws. Extraction of wild edible plants and those used for medicinal purposes could disrupt sustainable harvesting techniques practiced by local communities in Community Forests.

The baseline data has been screened to identify species of conservation concern that may be targeted for hunting and poaching during construction. These species are outlined in Table 7.3-16.

Table 7.3-16: Fauna Species at Risk from Hunting and Poaching

S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
Mammals				
1.	Northern Red Muntjac	LC, VU	All forests	India Border to New Butwal New Butwal to New Damauli New Damauli to Ratmate Ratmate to New Hetauda Ratmate to Lapsiphedi
2.	Sambar	VU, VU	Dense Sal and riverine forests of the lowlands and in subtropical forests of higher elevations	Not detected during surveys but likely present
3.	Chinese Pangolin	CR, CR, Protected	All forests and agricultural lands	Ratmate to New Hetauda Ratmate to Lapsiphedi
4.	Indian Pangolin	EN, EN, Protected	All forests and agricultural lands	Ratmate to New Hetauda
5.	Large Indian Civet	LC, VU	All forests	Ratmate to Lapsiphedi
Herpetofauna				
6.	Tricarinate Hill Turtle	VU, -	Tropical forests dominated by Sal	New Butwal to New Damauli
7.	Elongated Tortoise	CR, -	Tropical forests dominated by Sal	New Butwal to New Damauli Ratmate to New Hetauda
8.	Yellow Monitor	LC, Protected	All forests	Ratmate to New Hetauda

In summary, the potential impact of illegal poaching during construction and prior to mitigation is adverse, high in magnitude (due to the presence of the Chinese Pangolin [CR, CR]), local in extent, and short-term in duration, with an overall significance of Moderate.

Operation Phase

Impacts due to illegal poaching of fauna and extraction of non-timber forest produce during the operation phase will likely continue from the construction phase. With the workforce

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largely removed, the community members are likely to carry out illegal poaching due to increased access afforded by the ETP alignment.

The species likely targeted are outlined in Table 7.3-16.

In summary, the potential impact of illegal poaching during operation and prior to mitigation is adverse, medium in magnitude (due to the presence of the Chinese Pangolin [CR, CR]), local in extent, and long term in duration, with an overall significance of Minor.

Increased Mortality from Vehicles

Construction Phase

Vehicles will travel along existing roads to transport the worker force and construction material to RoW locations. Vehicles, due to road conditions in Nepal move quite slowly and there are limited risks of collisions with threatened species in natural habitat. Therefore, increased mortality due to strike with vehicles is not likely to be a considerable impact. The species at risk from vehicle strike are outlined in Table 7.3-17.

Table 7.3-17: Fauna Species Susceptible for Vehicle Strike

S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
Mammals				
1.	Chinese Pangolin	CR, CR, Protected	All forests and agricultural lands	Ratmate to New Hetauda Substation Ratmate to Lapsiphedi Substation
2.	Indian Pangolin	EN, EN, Protected	All forests and agricultural lands	Ratmate to New Hetauda Substation
3.	Large Indian Civet	LC, VU	All forests	Ratmate to Lapsiphedi Substation
Herpetofauna				
4.	Tricarinate Hill Turtle	VU, -	Tropical forests dominated by Sal	New Butwal to New Damauli Substation
5.	Elongated Tortoise	CR, -	Tropical forests dominated by Sal	New Butwal to New Damauli Substation Ratmate to New Hetauda Substation
Birds				
6.	Indian Peafowl	LC, NT	All forests	New Damauli to Ratmate Substation

In summary, the potential impact of increased morality from vehicles during construction and prior to mitigation is adverse, low in magnitude, site-specific in extent, and short-term in duration, with an overall significance of Negligible.

Operation Phase

Impacts due to increased mortality from vehicles during the operation phase will be limited to the construction phase. Some additional but negligible risk will remain during operation.

Enhanced Risk of Wildlife-Human Conflict

Construction Phase

The workforce is likely to encounter large mammals such as Common Leopards and Sloth Bears leading to death or injury to workers or in extreme cases and when mobbed, death and injury to the species. Although the risk and impact cannot be quantified, this impact should be mitigated to reduce the risk to the worker force. The species most of risk for human/wildlife conflict are shown in Table 7.3-18.

Table 7.3-18: Fauna Species at Risk of Human/Wildlife Conflict

S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
Mammals				
1.	Tiger	EN, EN, Protected	Contiguous lowland forests	Ratmate to New Hetauda
2.	Asiatic Black Bear	VU, EN, Protected	All forests	New Butwal to New Damauli
3.	Sloth Bear	VU, EN, Protected	All forests	New Butwal to New Damauli Ratmate to New Hetauda
4.	Common Leopard	VU, VU	All forests	New Butwal to New Damauli New Damauli to Ratmate Ratmate to Lapsiphedi

In summary, the potential impact of enhanced risk of wildlife/human conflict during construction and prior to mitigation is adverse, low in magnitude, site-specific in extent, and short-term in duration, with an overall significance of Negligible.

Operation Phase

Impacts due to increased mortality from enhanced risk of wildlife-human conflict during the operation phase will be limited to the construction phase. The operational risks remain negligible.

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Increased Habitat Fragmentation

Construction Phase

The ETP alignment will fragment existing natural habitat patches in the CCA and community forests along the New Damauli to Ratmate Substation Alignment. However, there are no species found along the ETP alignment that disperse over long distances and require intact habitat contiguity (e.g., Asian Elephant). Mammals such as the Asiatic Black Bear, Sloth Bear, Common Leopard, and Leopard Cat are adapted to modified areas and can easily cross the 46-meter RoW. In support of this conclusion, it was reported that the existing 132 kV TL in Bardia National Park does not have any barrier effects on the regular movement and dispersal of Tiger, Leopard and Jungle Cat (ESSD 2013).

Through loss of habitat contiguity there may be some habitat fragmentation for forest dwelling birds, herpetofauna and less mobile fauna. These species may be restricted to forest patches and suffer predation when crossing the RoW (being 46 meters in width). Research undertaken by Kaluwal (2017) has identified that Chinese Pangolins (and most likely other pangolin species) are susceptible to predation and human collection for the wildlife trade where access is induced by forest clearing. Predators (such as common leopards) may also use cleared areas to target areas for predation (Acharya et al. 2016).

Such impacts to fauna however are likely to be localized to areas where forests are traversed by the ETP (167.5 kilometers). Of the 167.5 kilometers of total forest crossed by the ETP, 92.6 kilometers of forest edges will remain intact. The longest length of new forest edge that will be created is approximately 1.5 kilometers. The forested areas remaining will occur on valley floors and steep side slopes. Wildlife will therefore be able to utilize existing forested corridors beneath the ETP alignment where forests remain intact. Impacts however will occur where the ETP alignment crosses forests in flatter terrain or on side slopes where the ETP meets hillsides, requiring forest clearing. The conservation significant species that are most susceptible to risk are forest dwelling less mobile species, including pangolins (both Chinese and Indian), turtles and forest dwelling birds. These species have been screened from the baseline data and are shown in Table 7.3-19.

Table 7.3-19: Fauna Species at Risk due to Forest Fragmentation

S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
Mammals				
1.	Chinese Pangolin	CR, CR, Protected	All forests and agricultural lands	Ratmate to New Hetauda Ratmate to Lapsiphedi Substation
2.	Indian Pangolin	EN, EN, Protected	All forests and agricultural lands	Ratmate to New Hetauda
3.	Large Indian Civet	LC, VU	All forests	Ratmate to Lapsiphedi
Herpetofauna				

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S/N	Species	IUCN/Nepal Red Book	Habitat Preference	Relevant ETP Segment
4.	Tricarinate Hill Turtle	VU, -	Tropical forests dominated by Sal	New Butwal to New Damauli
5.	Elongated Tortoise	CR, -	Tropical forests dominated by Sal	New Butwal to New Damauli Ratmate to New Hetauda
Birds				
6.	Great Slaty Woodpecker	VU, EN	All forests	New Butwal to New Damauli
7.	Slender-billed Babbler	VU, CR	All forests	Not detected during surveys but likely present
8.	Jerdon's Babbler	VU, CR	All forests	Not detected during surveys but likely present
9.	Grey-Crowned Prinia	VU, CR	All forests	Not detected during surveys but likely present
10.	White-Throated Bushchat	VU, EN	All forests	Not detected during surveys but likely present
11.	Bristled Grassbird	VU, VU	All forests	Not detected during surveys but likely present
12.	Brown Fish Owl	LC, VU	All forests	Not detected during surveys but likely present
13.	Alexandrine Parakeet	NT, NT	All forests	Not detected during surveys but likely present
14.	Indian Peafowl	LC, NT	All forests	New Damauli to Ratmate

In summary, the potential impact of habitat fragmentation during construction and prior to mitigation is adverse, high in magnitude, site-specific in extent, and long term in duration, with an overall significance of Moderate.

Operation Phase

Impacts to fauna due to increased mortality from habitat fragmentation will continue into the operations phase. These impacts may mean long term population reductions in fragmented areas, however this will reduce in time as habitat naturally regenerates within the ETP alignment underneath the power lines, however subject to ongoing maintenance. Sharma et al. (2017) indicates that ongoing impacts due to infrastructure in Nepal outside of the protected area system is of particular concern with mitigation required in terms of siting and avoidance.

The impacts may lead to localized extinctions in extreme cases where habitat patches are permanently fragmented from larger forest complexes. This however is unlikely given that the fragmentation will be localized with sufficient remaining habitat remaining underneath the transmission wires along the ETP alignment. Richardson et al. (2017) supports this outcome, with research indicating that smaller forest patches impacted by linear infrastructure being most affected during the life of linear infrastructure.

Species at risk during operation are outlined in Table 7.3-19.

In summary, the potential impact of habitat fragmentation during construction and prior to mitigation is adverse, low in magnitude, site-specific in extent, and long term in duration, with an overall significance of Negligible.

Electrocution and Collision Risks for Birds

Background

Impacts to birds from electrocution and collision with transmission line infrastructure is a key issue of concern for the ETP alignment. Electrocution risk arises from where birds complete a circuit between two conductors and hence conduct electricity within their body, resulting in electrocution and death (Kagan 2016; Benítez-López et al 2014). This generally can be mitigated by ensuring that birds are prevented from entering areas (such as sub stations) and placing conductors at distances greater than the wingspan of the largest bird within the area of concern (BirdLife 2007; Smith et al 2016). To this end, the ETP alignment has been designed to avoid electrocution risks to birds. The design is such that the distance between the conductors is greater than the maximum wingspan of the largest bird detected (Himalayan Griffon, up to 3.1m in width). Further impacts may arise from nesting on towers however. Specific impact risks and mitigations have been embedded in the design of the ETP alignment in relation to this potential impact and have been described at the start of this chapter.

Collision with transmission line infrastructure involves strike or collision with towers, wires or sub-station infrastructure, resulting in injury or mortality. The risk of collision is derived from several factors, including the species that occur in the landscape (and their behavior) and the physical design and location of the transmission line within the landscape (SNH, 2018; Bevanger, et al 2004).

Infrastructure of most risk of collision tends to be strung wires with low visibility (being earth wires) (SNH 2018; Loss et al 2014). Bundled conductors, towers and sub-station infrastructure tends to present a lower collision risk as these components are larger and more visible for birds in flight (Smith 2016; (Bernadino et al 2014).

The most susceptible species to collision are large, long-lived and slow-reproducing birds, often habitat specialists with particular behavioral traits (especially flight height and flocking flight) (Martin et al 2010), with potential spatial exposure to collision risk with power lines (such as vultures, eagles and storks). These birds fly at the height of the transmission line (such as storks) or undertake soaring and/or diving behavior for foraging (Vultures and Steppe Eagles).

Smaller birds that fly low and fast (such as ducks and other water birds) may pose specific risks (D'Amico et al, 2019). Additionally, birds that flock have a higher collision risk due to their density in the airspace (APLIC 1994). Weather conditions and time of day can also lead to higher mortality rates, with flight during mist and high winds as well as at dawn, dusk and night time being of concern.

In terms of positioning of transmission lines in the landscape, those that pass over known flyways or that are adjacent to important habitats (e.g. wetlands) increase risks.

Bird Species at Risk

Based on the baseline data, the likely risk of collision due to species and flight behavior as described above has been assessed. The screened species most susceptible to strike based on the field data are all of the vulture species present, the Himalayan Griffon and the Steppe Eagle. This is supported by research that shows soaring and diving birds pose the highest risk of collision (Martin et al 2012; Bevanger et al 2004). The other species of concern is the Sarus Crane, however this species was only recorded in the India Border to New Butwal Substation route through the Nawalparasi IBA. These species are considered as species of concern as they are large, long-lived and slow-reproducing birds that fly or dive at the level of the transmission line wires. Other eagle and crane species may pose a collision risk from time to time but are not considered to be present in sufficient numbers as to warrant a significant risk to local populations.

There is very little information on collision risk of hornbills with transmission lines, however these are also deemed to be a collision risk due to their flocking behavior and tendency to fly at dawn/dusk at just above canopy height (Naish 2014). This species was detected in forested landscapes along the New Damauli to Ratmate Substation ETP segment.

Water birds (such as ducks) were not found in sufficient numbers to pose a collision risk along the ETP alignment, however may be susceptible to strike during the wet season at lower altitudes. The corresponding ETP segments with the greatest collision risk for water birds would be the India Border to New Butwal Substation and Ratmate to Lapsiphedi Substation segments.

More broadly across the ETP alignment, birds that fly across the ETP alignment between adjacent forest patches or forage within the alignment may from time to time be susceptible to strike (Martin 2010). These include nocturnal flying birds (owls, nightjars), pigeons/doves and other forest dwelling birds (D'Amico et al 2019). The risks to these birds is difficult to quantify, but localized mortality may occur. It is not considered to be a significant risk to the global populations of these species, although there maybe localized population impacts.

When flying at the height of the ETP conductor and earth wires (24 in number +2 earth wires), the majority of species are most likely to face collision risks during daytime flight only (apart from owls and nightjars discussed above). Based on the literature, the earth wires are those that are likely to pose the most significant collision risk due to the low visibility of these wires to birds in flight. It should be noted that the collision model used assesses collision risks for all wires and is therefore likely to be conservative in nature given that the higher collision risk is likely for the earth wires only (Bernadino et al 2014).

Information on vultures and steppe eagles' lifecycles and behaviors indicate that they do not fly at night and are generally only active during the day (Meyburg 2003); collision risk is therefore mainly a daytime concern.

The species considered to be of strike risk are shown in Table 7.3-20.

Table 7.3-20: Bird Species Susceptible to Collision Risk identified along the ETP Route from baseline data

S/N	Common Name	Scientific Name	Number of Individuals	Transmission Line Segment Found				
				IB - NB	NB - ND	ND - RTE	RTE - NH	RTE - LAP
1.	Himalayan Griffon	*Gyps himalayensis*	307	13	266	14		14
2.	Egyptian Vulture	*Neophron percnopterus*	32		25			7
3.	Red-Headed Vulture	*Sarcogyps calvus*	19		18			1
4.	White Rumped Vulture	*Gyps bengalensis*	54	10	44			
5.	Slender-Billed Vulture	*Gyps tenuirostris*	2		2			
6.	Cinereous Vulture	*Aegypius monachus*	10	1	9			
7.	Steppe Eagle	*Aquila nipalensis*	37	13	6	3		15
8.	Upland Buzzard	*Buteo hemilasius*	1					1
9.	Greater Spotted Eagle	*Clanga clanga*	4	4				
10.	Indian Spotted Eagle	*Clanga hastata*	1	1				
11.	Lesser Fish Eagle	*Ichthyophaga humilis*						X
12.	White Tailed Sea Eagle	*Haliaeetus albicilla*						X
13.	Asian Woollyneck	*Ciconia episcopus*	6	1	1			4
14.	Asian Openbill	*Anastomus oscitans*	1				1	
15.	Black Stork	*Ciconia nigra*	8	4	4			
16.	Sarus Crane	*Antigone antigone*	14	14				
17.	Demoiselle Crane	*Grus virgo*			X	X		X
18.	Ibisbill	*Ibidorhyncha struthersii*	8					8
19.	Great Hornbill	*Buceros bicornis*				X		

Locations of Collision risk along the ETP alignment

Based on the review of the ETP alignment and input from Bird Conservation Nepal based on survey results, historic data and professional; knowledge, important bird crossing points have been avoided along the alignment. However, important crossing points of the ETP remain as for species and have been identified (see Figure 7.3-1). They include:

- Kali Gandaki Gorge which is located in the New Butwal to New Damauli Substation Segment. The gorge is an important migratory pathway for several species of cranes.
- Steppe Eagle migratory corridor east of the Kathmandu valley (see Steppe Eagle Migratory Conservation Corridor in Figure 7.3-1), which overlaps with a section of the Ratmate to Lapsiphedi Substation Segment.
- Nawalparasi Important Bird Area and areas north (As marked as vulture crossings in Figure 7.3-1) contains several crossing points used by significant concentrations of vulture species and the Sarus Crane. The IBA coincides with the India Border to New Butwal Substation and New Butwal to New Damauli Substation segments
- Great Hornbill Crossing Area in forested land dominated by Sal in the mid slopes coinciding with the Ratmate to New Hetauda Substation segment (see Great Hornbill crossing in Figure 7.3-1)

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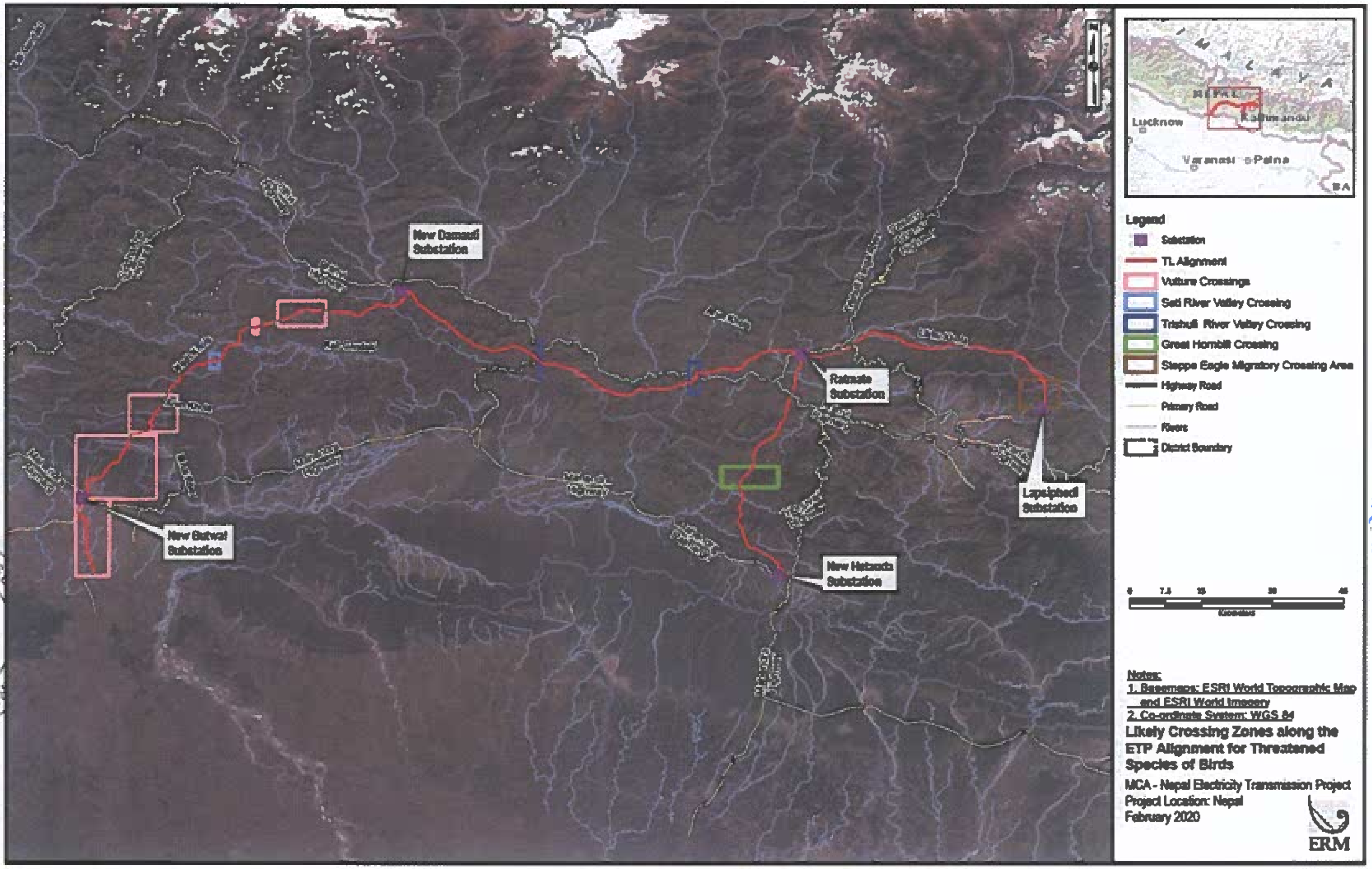


Figure 7.3-1: Likely Crossing Zones along the ETP Alignment for Threatened Species of Birds

In order to inform the impact assessment, several sources of data have been used to determine the presence and density of key indicator species at the high risk locations along the ETP alignment. This includes telemetry data collected by Bird Conservation Nepal within the Nawalparasi IBA and also specific vantage point surveys conducted by Bird Conservation Nepal. Based on the limited data available, it is not possible to calculate collision risks for all species contained in Table 7.3-20. However, two species have sufficient data available and may be used as indicator species, being the White Rumped Vulture and the Himalayan Griphon.

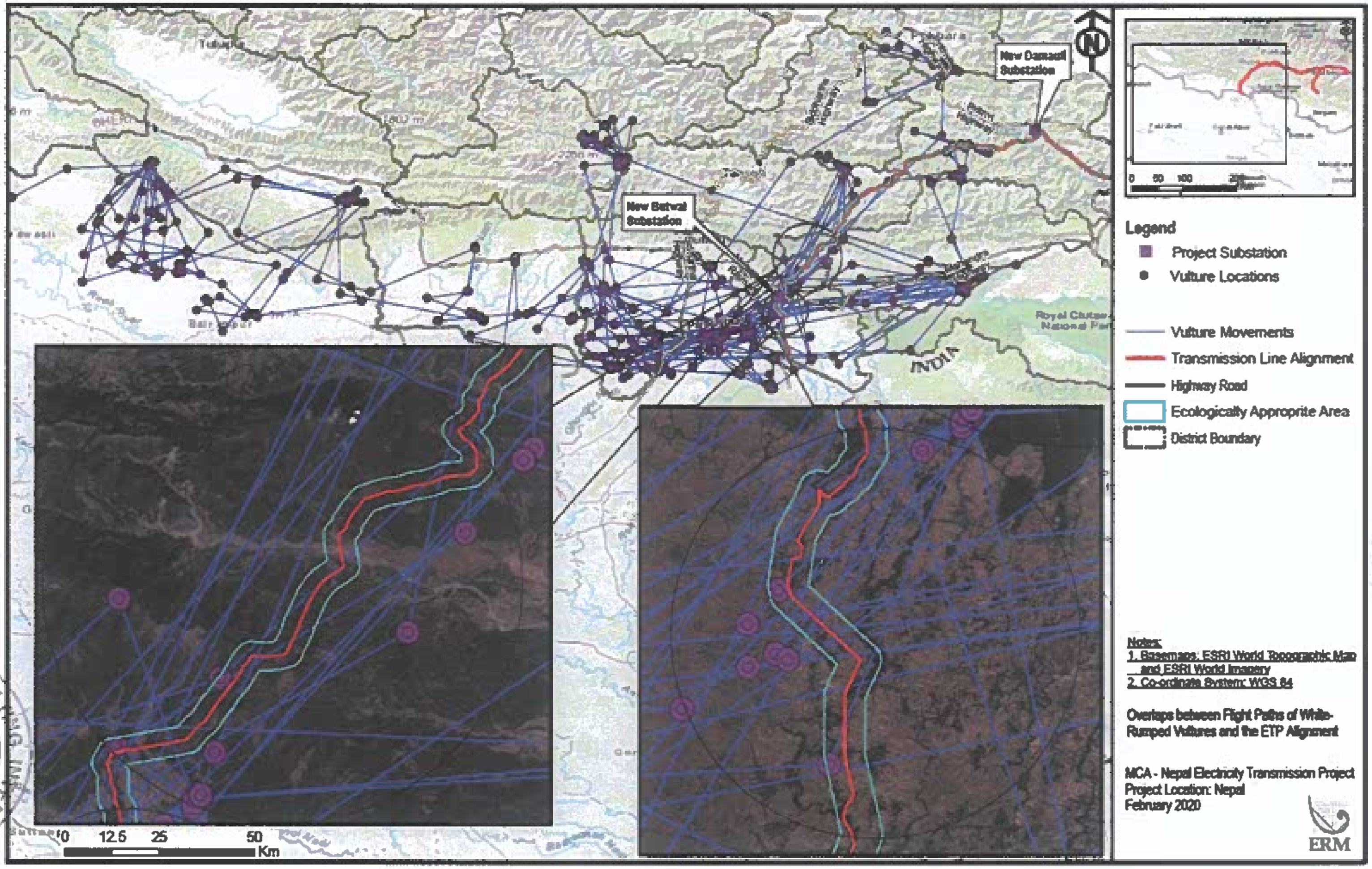
In relation to the telemetry data, there are a total of 37 satellite tagged White Rumped Vultures (20 wild birds and 17 captive released) ranging in the western midhills and lowlands of Nepal. All vultures were caught or released in the Nawalparasi IBA. Bird Conservation Nepal collaborating with Government of Nepal and Royal Society for the Protection of Birds (RSPB), UK attached Argos/GPS satellite transmitters to each individual. To also aid visual identification of vultures with satellite transmitters, wing tags were fitted to both wings of all tagged vultures and the number code could be read from both above and below; thereby maximizing the chances of identification.

Figure 7.3-2 provides movement data from telemetry of the White Rumped Vulture. The study commenced in April 2017 (Bhusal et al. 2019) and is ongoing as this EIA was prepared. As shown by the figure, many flights transverse the ETP alignment at several key points within the Nawalparasi IBA, indicating that collision mortality is a key risk in this segment.

The second source of data analyzed from the baseline data was from vantage points surveys conducted within the Nawalparasi IBA by Bird Conservation Nepal. From these data, a Collision Risk Model (CRM) was run to understand the likely impact on vulture species. In this model, it is assumed (SNH 2000) that the probability of a bird colliding is proportional to the extent of the risk window occupied by wires and excluding all the areas of airspace in between. The risk window is provided on Figure 7.3-3.

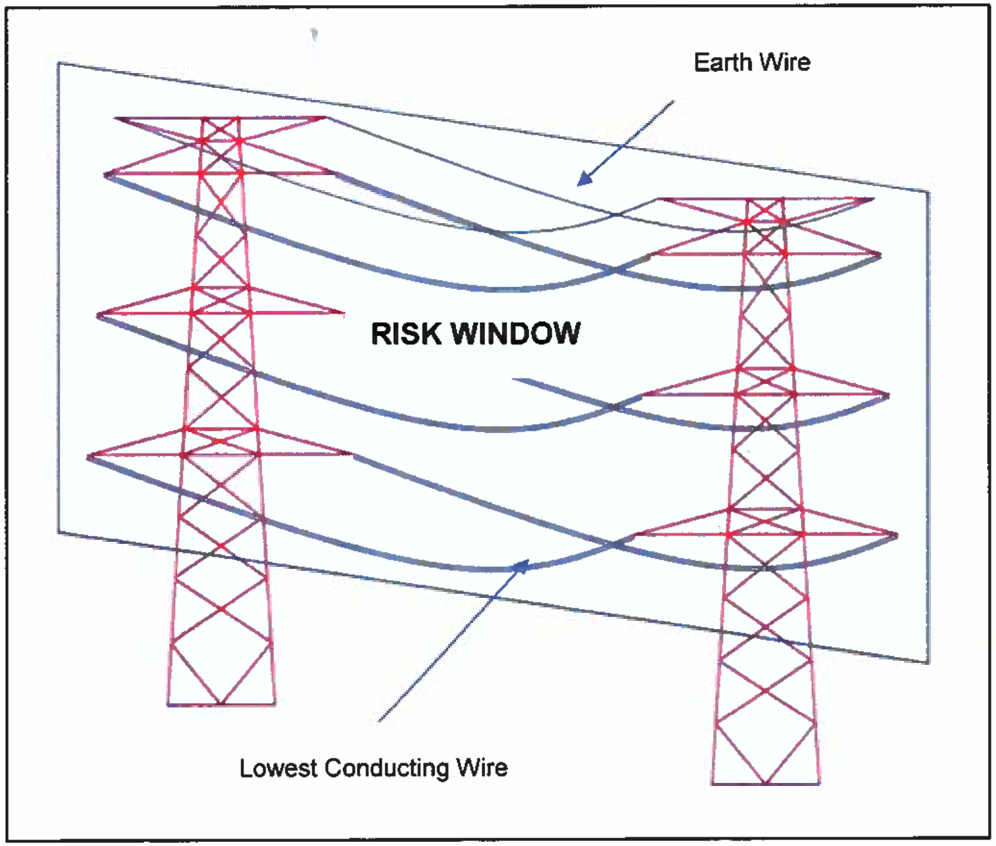
The probability of collision is calculated for all wires on a given the overhead lines (OHL), including any earth wire (total of 26 wires in the proposed tower design). This is a conservative approach which allows the collision risk for bird flights whose trajectory means that they could safely fly through the first set of wires (on one side of the towers), but could potentially hit the second set on the other side of the towers) to be taken into account. As the trajectory of birds entering the risk window is not taken into account in this model, it is important that all wires be assessed as an individual risk to any flying bird that crosses the risk window.

Note that the 99.9 percent avoidance rates used below have been determined based on the likely visibility of the conductors to flying birds in this assessment (particularly the large bundled conductors of the 400 kV power lines). The assessment though is conservative and visualization of the wires by birds may be higher. The number of birds estimated to be colliding with the wires was first estimated without avoidance. This number was then adjusted, by assuming that birds avoided all wires apart the earth wire.



Source: Bird Conservation Nepal 2019

Figure 7.3-2: Overlaps between Flight Paths of White Rumped Vultures and the ETP Alignment



Source: Adapted from Scottish Natural Heritage 2000

Figure 7.3-3: Risk Window Illustration

The following avoidance probabilities were used:

- 99 percent: This was inferred from data obtained by the Scottish Natural Heritage (SNH 2016) which predicts 98 percent avoidance rate for raptors potentially colliding with Wind Turbine Generators (WTG)s. Given less observed collision risks for transmission lines, this was then increased to 99 percent.

- 99.9 percent: Is inferred from a study carried out for a migratory corridor in the US, (Luzenski et al. 2016), suggesting an avoidance rate in excess of 99.9 percent. Similarly, high avoidance rates have been used for some bird species in relation to WTGs (e.g., geese have a 99.8 percent avoidance rate for wind turbines) (SNH 2013).

It was further assumed that mitigation, through the provision of bird diverters, would reduce collisions by 50 percent. A South African review of the success of mitigation measures for bird collisions with power lines estimates a 50-60 percent reduction in collisions (Jenkins et al. 2010).

The CRM provided the following estimates of the two species assessed for collision with the lines (Table 7.3-21) across each ETP segment for the migratory season alone as the survey was carried out in the migratory season. This is the anticipated mortality each year during the migratory season for Himalayan Griffon, as presence of this species in the Project area is largely confined to the migratory season. White Rumped Vulture presence is right through the year, so annual mortality is likely to be higher.

The estimates were obtained by first determining collisions/kilometer for each vantage point and then extrapolating for each segment length (Table 7.3-21).

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Table 7.3-21: Collisions for White Rumped and Himalayan Griffons (annual)

Segment	Assessed using a 99% avoidance rate with mitigation reduction of 50%		Assessed using a 99.9% avoidance rate with mitigation reduction of 50%	
	Himalayan Vulture (No. of Individuals)	White Rumped Vulture (No. of Individuals)	Himalayan Vulture (No. of Individuals)	White Rumped Vulture (No. of Individuals)
India Border to New Butwal Substation	9.55	0.96	1.94	0.19
New Butwal to New Damauli Substation	49.23	4.92	10.01	1.0
New Damauli To Ratmate Substation	48.56	4.86	9.88	0.99
Ratmate to New Hetauda Substation	31.32	3.13	6.37	0.64
Ratmate to Lapsiphedi Substation	31.86	3.19	6.48	0.65
Estimated Mortality	**171**	**17**	**35**	**4**
Estimated Global Population[1]	66,000–334,000	2,500–9,999	66,000–334,000	2,500–9,999
Estimated % Loss	**0.25–0.05%**	**0.68–0.17%**	**0.05–0.01%**	**0.16–0.04%**

[1] Based on data on estimated global populations on the IUCN Red List (IUCN 2019)

The Project has also coordinated with Bird Conservation Nepal to avoid or increase the buffer to important/common bird nesting, roosting and feeding areas. The ETP alignment has avoided soaring areas for vultures by moving the alignment either to lower altitudes or other locations that do not overlap. Known locations for foraging and nesting sites were also avoided. Despite this effort, the risk of collision remains

The potential for electrocution at sub-stations is considered to be negligible, given that these species are soaring species and are unlikely to use structures within the sub-stations to perch. Other birds dependent on open area foraging (such as Steppe Eagles) may use structures to perch, however it is not considered that sub-stations will offer an attractive perching location for these species.

As a consequence the following is concluded:

In summary, the potential impact of collision risks to birds during operation and prior to mitigation is adverse, high in magnitude, regional in extent, and long term in duration, with an overall significance of Major.

7.3.2 Segment-Specific Impacts

Table 7.3-22 provides segment-specific information on the area of forest, natural habitat, and clearing within each segment. The discussion below discusses salient threats to these species in each segment.

Given that risk assessments have been undertaken for habitats and species in the section above, a summary of impacts has not been provided for each specific segment.

Table 7.3-22: Length and Area of Impacts across Segments per Vegetation Type

S/N	ETP Segment	Area of Measurement	Tropical Forests	Subtropical Broadleaved Forests	Subtropical Conifer Forests	Other vegetation	Total	Area to be cleared within RoW	Percentage of Forest Loss (Row/AoA) (%)
1.	India Border to New Butwal Substation	Area of forest within RoW (ha)	4.3	0.0	0.0	6.2	10.5	10.5	100%
		Boundary length along RoW (km)	0.8	0.0	0.0	1.1	1.9	-	-
		Area of forest in AoA (ha)	246.3	0.0	0.0	213.1	459.4	-	2.3%
2.	New Butwal to New Damauli Substation	Area of forest within RoW (ha)	128.8	57.2	3.6	43.3	232.9	114.9	49.3%
		Boundary length along RoW (km)	26.7	12.9	0.7	9.9	50.2	-	-
		Area of forest in AoA (ha)	4,315.3	529.5	354.5	1,070.2	6,269.5	-	1.8%
3.	New Damauli to Ratmate Substation	Area of forest within RoW (ha)	90.7	50.9	0.0	72.8	214.4	84.1	39.2%
		Boundary length along RoW (km)	18.9	11.0	0.0	15.8	45.7	-	-
		Area of forest in AoA (ha)	3,278.6	1,811.6	100.8	1,019.8	6,210.8	-	1.4%
4.	Ratmate to New Hetauda Substation	Area of forest within RoW (ha)	73.5	59.2	0.6	50.6	183.9	94.8	51.5%
		Boundary length along RoW (km)	15.9	12.8	0.1	11.3	40.1	-	-
		Area of forest in AoA (ha)	1,909.1	1,769.7	33.7	683.8	4,396.3	-	2.2%
5.	Ratmate to Lapsiphedi Substation	Area of forest within RoW (ha)	33.8	34.9	19.7	47.4	135.8	50.1	36.9%
		Boundary length along RoW (km)	6.7	7.6	4.4	10.9	29.6	-	-
		Area of forest in AoA (ha)	1,689.4	832.3	124.7	639.6	3,286.0	-	1.5%
Total		**Area of forest within RoW (ha)**	331.1	202.2	23.9	220.3	777.5	354.4	45.6%
		Boundary length along RoW (km)	69.0	44.3	5.2	49.0	167.5		-
		Area of forest in AoA (ha)	11,438.8	4,943.2	613.7	3,626.5	20,622.0		1.7%

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Table 7.3-23: Distribution of Conservation Significant Species across Segments

India Border to New Butwal Substation	New Butwal to New Damauli Substation	New Damauli to Ratmate Substation	Ratmate to New Hetauda Substation	Ratmate to Lapsiphedi Substation
Conservation Significant Species (IUCN Red List CR, EN, VU & NT; Nepal Red list CR, EN, VU & NT) Detected				
Herpetofauna				
• Chitwan Frog (Hylarana chitwanensis)	• Chitwan Frog (Hylarana chitwanensis) • Elongated Tortoise *Indotestudo elongata*) • Tricarinate Hill Turtle (*Melanochelys tricarinata*)	• Chitwan Frog (*Hylarana chitwanensis*) • Burmese Python (*Python bivittatus*)	• Chitwan Frog (*Hylarana chitwanensis*) • Python (*Python bivittatus*) • King Cobra (*Ophiophagus Hannah*) • Elongated Tortoise (*Indotestudo elongata*)	• Chitwan Frog (*Hylarana chitwanensis*)
Mammals				
Northern Red Muntjac (*Muntiacus vaginalis*)	• Asiatic Black Bear (*Ursus thibetanus*) • Sloth Bear (*Melursus ursinus*) • Common leopard (*Panthera pardus*) • Northern Red Muntjac (*Muntiacus vaginalis*) • Assam Macaque (*Macaca assamensis*)	• Common leopard (*Panthera pardus*) • Leopard cat (*Prionailurus bengalensis*) • Northern Red Muntjac (*Muntiacus vaginalis*)	• Sloth Bear (*Melursus ursinus*) • Tiger (*Panthera tigris tigris*) • Leopard cat (*Prionailurus bengalensis*) • Bengal fox (*Vulpes bengalensis*) • Dhole (*Cuon alpinus*) • Chinese Pangolin (*Manis pentadactyla*) • Indian Pangolin (*Manis crassicaudata*) • Asiatic Elephant (*Elephas maximus*)	• Common leopard (*Panthera pardus*) • Leopard cat (*Prionailurus bengalensis*) • Bengal fox (*Vulpes bengalensis*) • Large Indian Civet (*Viverra zibetha*) • Northern Red Muntjac (*Muntiacus vaginalis*) • Chinese Pangolin (*Manis pentadactyla*)
Birds				
• Himalayan Griffon (*Gyps himalayensis*)	• Himalayan Griffon (*Gyps himalayensis*) • Egyptian Vulture (*Neophron percnopterus*)	• Himalayan Griffon (*Gyps himalayensis*) • Steppe Eagle (*Aquila nipalensis*)	• Asian Openbill (*Anastomus oscitans*) • Great Cormorant (*Phalacrocorax carbo*)	• Himalayan Griffon (*Gyps himalayensis*) • Egyptian Vulture (*Neophron percnopterus*)

India Border to New Butwal Substation	New Butwal to New Damauli Substation	New Damauli to Ratmate Substation	Ratmate to New Hetauda Substation	Ratmate to Lapsiphedi Substation
• White Rumped Vulture (*Gyps bengalensis*) • Cinereous Vulture (*Aegypius monachus*) • Steppe Eagle (*Aquila nipalensis*) • Greater Spotted Eagle (*Clanga clanga*) • Indian Spotted Eagle (*Clanga hastate*) • Asian Woollyneck (*Ciconia episcopus*) • Black Stork (*Ciconia nigra*) • Lesser Adjutant (*Leptoptilos javanicus*) • Sarus Crane (Antigone Antigone) • Grey Francolin (*Francolinus pondicerianus*) • Alexandrine Parakeet (*Psittacula eupatria*)	• Red-Headed Vulture (*Sarcogyps calvus*) • White Rumped Vulture (*Gyps bengalensis*) • Slender-Billed Vulture (*Gyps tenuirostris*) • Cinereous Vulture (*Aegypius monachus*) • Steppe Eagle (*Aquila nipalensis*) • Asian Woollyneck (*Ciconia episcopus*) • Black Stork (*Ciconia nigra*) • Lesser Adjutant (*Leptoptilos javanicus*) • Sarus Crane (*Antigone Antigone*) • Demoiselle Crane (*Grus virgo*) • Great Slaty Woodpecker (*Mulleripicus pulverulentus*) • Sarus Crane (*Antigone Antigone*) • Alexandrine Parakeet (*Psittacula eupatria*) • Brown Fish Owl (*Ketupa zeylonensis*)	• Great Hornbill (*Buceros bicornis*) • Demoiselle Crane (*Grus virgo*) • Indian Peafowl (*Pavo cristatus*)		• Red-Headed Vulture (*Sarcogyps calvus*) • Steppe Eagle (*Aquila nipalensis*) • Lesser Fish Eagle (*Ichthyophaga humilis*) • White Tailed Sea Eagle (*Haliaeetus albicilla*) • River Lapwing (*Vanellus duvaucelii*) • Yellow-Wattled Lapwing (*Vanellus malabaricus*) • Asian Woollyneck (*Ciconia episcopus*) • Demoiselle Crane (*Grus virgo*) • Ibisbill (*Ibidorhyncha struthersii*) • Great Cormorant (*Phalacrocorax carbo*)
Flora				
		• Maire's Yew (*Taxus mairei*) • Rose wood (*Dalbergia latifolia*)	• East Himalayan Yew (*Taxus wallichiana*)	• Maire's Yew (*Taxus mairei*) • Chirayita (*Swertia chirayita*)

7.3.2.1 India Border to New Butwal Substation Segment

Construction Phase

Disturbance and displacement of fauna due to construction activities may occur within this segment. This is likely to disturb nesting colonies of Lesser Adjutant Storks and White Rumped Vulture nesting approximately 800 meters from the ETP alignment in the Nawalparasi IBA (see Figure 7.3-1). Discussion on impacts to these species is outlined above (including collision risk modelling for vultures).

This segment has the lowest density of forest with 4.3 ha of tropical forest and 6.2 ha of other forest within the RoW. All of this forest (100 percent) will be cleared within the RoW.

Operation Phase

Collision risks are likely to occur during operation within this segment. The entire ETP alignment in this segment is used for White Rumped Vulture accessing feeding sites; west and east of the alignment as described from radio-telemetry data (see Figure 7.3-2). Lesser Adjutant Storks flying from colonies and soaring could face collision risks. The baseline data indicates that Himalayan Vultures and Steppe Eagles were seen soaring in this area and could face collision risks with the ETP alignment.

Impacts to forests will continue from the construction phase and no additional clearing is anticipated.

7.3.2.2 New Butwal to New Damauli Substation Segment

Construction Phase

Illegal poaching of fauna and extraction of non-timber forest produce is likely to be an impact in this segment due to the larger forested landscape. The Northern Red Muntjac (LC, VU) is reported in this segment. One CR species, the Elongated Tortoise is found in the segment. Furthermore the Yellow Monitor Lizard (LC, LC, Protected) and the Tricarinate Hill Turtle (VU,-) have been recorded on reported in this segment. All these species are likely to be impacted by illegal poaching for meat.

Disturbance and displacement of fauna due to construction activities will occur due to the large extent of Natural habitat to be cleared within the segment. The segment largely passes through community forests in this segment, there are likely to be several mammal EN species such as Asiatic Black Bear Sloth Bear and several VU species such as Common Leopard and Leopard Cat, displaced by construction activities. Several EN bird species such as the Great Slaty-Headed Woodpecker and Great Hornbill are also likely to avoid nesting close to the RoW.

Impacts due to vegetation clearing will be high in this segment with an estimated 49.3 percent of vegetation within the RoW cleared. This equates to approximately 114.9 hectares of forest within the RoW that will be cleared. This forest is predominately tropical forests at mid-level altitudes beside ridgetops. These forests are dominated by Sal (*Shorea robusta*) and are widely distributed within Nepal at these altitudes.

Vegetation clearance for RoW and other Project infrastructure may displace several CR and EN bird species such as the White Rumped Vulture, Red-Headed Vulture, Great Slaty-Headed Woodpecker and Great Hornbill may lose nesting trees from vegetation clearance.

Enhanced risks of conflict is likely with Asiatic Black Bear, Sloth Bear, and Common Leopard. It is likely that these species may be present within the RoW in both natural and modified habitats and may pose a threat to the workforce in this segment during construction.

Operation Phase

As indicated in Figure 7.3-1 a major crossing of White-Backed and Red-Headed Vulture occurs between Towers 1 to 55 and 65-90. These are to access foraging locations east and west of the ETP alignment. There are also White Rumped Vulture crossings to access nesting sites, between Towers 160 and 162 and 173 and 201. There is one location where the ETP alignment crosses the Seti River between Towers 124-129. Migratory birds may use this river valley and face some risk of collision.

Impacts to forests will continue from the construction phase and no additional clearing is anticipated.

7.3.2.3 New Damauli to Ratmate Substation Segment

Construction Phase

Illegal poaching of fauna and extraction of non-timber forest produce, including the Northern Red Muntjac that is reported in this segment and is likely to be hunted for its meat. There are several orchid species that may be extracted for their ornamental values and for commercial purposes in this segment.

Disturbance and displacement of fauna due to construction activities may occur given the moderate extent of natural habitat, largely passing through community forests in this segment. The forests impacted consist mainly of Sal forests dominated by *Shorea robusta* and also include *Dalbergia latifolia* which is highly exploited in Nepal. There are likely to be VU species such as Common Leopard and Leopard Cat that may be present during construction activities, however they are likely to avoid camps.

Impacts to forests within the RoW will consist of clearing of 84.1 hectares of forests, representing 39.2 percent of the forest within this RoW segment.

Operation Phase

There are two locations where the ETP alignment crosses the Trishuli River between Towers 93-96 and 176-185. Migratory birds may use these river valleys and face some risk of collision.

Impacts to forests will continue from the construction phase and no additional clearing is anticipated.

7.3.2.4 Ratmate to New Hetauda Substation Segment

Construction Phase

Illegal poaching of fauna and extraction of non-timber forest produce may occur for the Northern Red Muntjac and Chinese Pangolin, which are reported in this segment and are likely to be hunted for their meat.

Given the moderate extent of natural habitat, largely passing through community forests in this segment, there are likely to be mature hollow bearing trees in primary forests where Great Hornbills nest. This species is likely present in areas near to Chitwan national park and Barandbahar IBA. Clearance may result in the loss of these trees. This species is however widely distributed throughout forested areas and the impact is considered to be minor.

Enhanced risks of conflict is likely with Sloth Bear and Common Leopard with the worker force in areas adjacent to natural habitats.

Clearing of forests within this segment will result in the removal of 94.8 hectares of forests, representing a loss of 51.5 percent of the forest cover within this RoW segment.

Operation Phase

Collision risk may occur where Great Hornbills cross the ETP alignment due to the presence of intact mature forests, these sections are likely to be between Towers 69-80. This risk however is considered to be minor.

Impacts to forests will continue from the construction phase but vary during maintenance of forest canopies underneath the transmission line on a regular (5-7 year basis). As such, there will recurrent habitat disturbances during the operational phase where forest regrowth is controlled.

7.3.2.5 Ratmate to Lapsiphedi Substation Segment

Construction Phase

Illegal poaching of fauna and extraction of non-timber forest produce may occur within this segment with the Chinese Pangolin possibly targeted as the species is likely present in modified and natural habitats.

Clearing of forests in this segment will result in a loss of 50.1 hectares of forests, which equates to a loss of 36.9 percent of the forest in this RoW segment.

Operation Phase

Due to a large number of Steppe Eagles migrating from east to west into the Kathmandu Valley, collision risks are faced by the species in this segment. Most of the migration occurs between Towers 159–175.

Impacts to forests will continue from the construction phase and no additional clearing is anticipated.

7.3.3 Pre-Mitigation Significance Rating for Biological Environment

The table below provides the significance for the various impacts assessed prior to the implementation of mitigation measures. There are likely to be some variances across the significance categories in keeping with the segments and Project lifecycle phases. Significance ratings are provided for the construction phase, separately from the operations phase.

Table 7.3-24: Pre-Mitigation Significance Rating for Construction and Operation Phases

Impacts	Magnitude	Extent	Duration	Overall Significance
Construction Phase				
Chure Conservation Area	High (60)	Local (20)	Short-term (5)	Moderate (85)
Terai Arc Landscape (TAL)	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Chitwan Annapurna Landscape	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Shivapuri-Nagarjun National Park	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Parsa National Park and IBA	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Nawalparasi Forest IBA	Medium (20)	Site-specific (10)	Long-term (20)	Minor (50)
Forest Management	High (60)	Local (20)	Long-term (20)	Major (100)
Introduction of Invasive Species	Low (10)	Local (20)	Long-term (20)	Minor (50)
Increase in Fire Hazard	High (60)	Local (20)	Medium (10)	Moderate (90)
Edge Effects	Medium (20)	Local (20)	Medium-term (20)	Minor (60)

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Impacts	Magnitude	Extent	Duration	Overall Significance
Induced Clearing and NTFP Collection	Medium (20)	Site-specific (10)	Long-term (20)	Minor (50)
Fauna Disturbance and Displacement	High (60)	Site-specific (10)	Short-term (5)	Moderate (75)
Hunting and Poaching of Fauna	High (60)	Local (20)	Short-term (5)	Moderate (85)
Increased Mortality from Vehicles	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Enhanced Risk of Wildlife-Human Conflict	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Increased Habitat Fragmentation	High (60)	Site-specific (10)	Long-term (20)	Moderate (90)
Operations Phase				
Chure Conservation Area (CCA)	Medium (20)	Local (20)	Long-term (20)	Minor (60)
Terai Arc Landscape (TAL)	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Chitwan Annapurna Landscape	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Shivapuri-Nagarjun National Park	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Parsa National Park and IBA	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Nawalparasi Forest IBA	Medium (20)	Site-specific (10)	Long-term (20)	Minor (50)
Forest Clearing	Low (10)	Site-specific (10)	Long-term (20)	Minor (40)
Introduction of Invasive Species	Low (10)	Local (20)	Long-term (20)	Minor (50)
Increase in Fire Hazard	Low (10)	Local (20)	Long-term (20)	Minor (50)
Edge Effects	Low (10)	Local (20)	Medium-term (10)	Negligible (40)
Induced Clearing and NTFP Collection	Low (10)	Site-specific (10)	Long-term (10)	Negligible (40)
Fauna Disturbance and Displacement	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)

Impacts	Magnitude	Extent	Duration	Overall Significance
Hunting and Poaching of Fauna	Medium (20)	Local (20)	Long-term (20)	Minor (60)
Increased Habitat Fragmentation	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Bird Collision Risk	High (60)	Regional (60)	Long-term (20)	Major (140)

7.4 ADVERSE IMPACTS TO THE SOCIOECONOMIC AND CULTURAL ENVIRONMENT

7.4.1 Overview

Baseline studies on socioeconomic and cultural aspects (see Section 5.3) described the status of development within the Project impact area, based on secondary data and a sample socioeconomic survey (499 households), a census of 101 households in Ratmate substation area, and community level consultations (more than 100 FGDs and KIIs) with key stakeholder groups. Concerns and sensitivities that are inherent and/or particular to areas or communities (e.g., Adivasi Janajati/ Indigenous People, trafficking in persons (TIP)related risks, Leasehold Forestry groups, cultural practices) were identified for particular focus. Baseline socioeconomic and cultural conditions along with particular sensitivities have informed the impact assessment of Project activities. These impacts are especially significant for vulnerable people, which includes marginalized and disadvantaged individuals or families such as women, children, female-headed households, individuals with disabilities, those already living below the poverty line, Dalits, and some Adivasi Janajati (e.g., Chepang, Tamang, Tharu, and Magar).

Avoidance measures were incorporated in the development and finalization of the TL alignment. Measures taken to avoid or minimize adverse socioeconomic and cultural impacts included:

- Avoiding crossing any towns and large villages and minimized the need for physical displacement by avoiding existing villages or individual structures, to the extent feasible;
- Reducing potential economic displacement by skirting fertile agricultural land parcels to the extent feasible;
- Reducing the need for permanent acquisition of private land by avoiding construction of new roads;
- Reducing the need (area) for tree clearing within Community and Leasehold Forests along the TL Right-of-Way (RoW), thus reducing impacts on people and groups dependent on these forests; and
- Avoiding all known cultural heritage sites.

Beneficial impacts, including to the socioeconomic and cultural environment, have been described at the beginning of this chapter (7.1). This section on socioeconomic and cultural impacts discusses adverse impacts resulting from Project requirements and activities as summarized in Table 7.4-1 below.

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Table 7.4-1: Summary of Key Impacts from Project Requirements and Activities

Socioeconomic/Cultural Aspect, Impact	Project Requirement or Activity	Project Phase
Change in land ownership and use • Physical displacement • Economic displacement • Temporary loss of use, access	• Permanent land acquisition at Ratmate Substation site (19.8 ha), under tower pads [103.6 ha], and for the New Damauli Substation access road (0.6 ha). A total of 187 households with 943 people will be displaced. • Permanent use restrictions within the TL RoW [1,347.1 ha] • Temporary land access requirement for laydown areas, worker camps 13.2 ha)	All permanent land acquisition must be complete before construction starts. Primarily construction phase impacts Very few impacts in the operations phase
Change in community health, safety and security • Risk of TIP and Employment of Under-Age Children • Nuisance Impacts on Local Communities • Risk of Communicable and Vector-Borne Diseases • Potential Community Conflict • Potential Safety and Security Impacts • Increased risk of gender-based violence • Effects of EMF • Potential Safety and Security Risks	• Increased influx of construction workers, including from other areas • Establishment and operation of construction camps • Construction related activities, increased vehicular movement- of goods and people, including on public roads, near and through inhabited areas • Operation of Project components-transmission line, substations • Routine operation and maintenance activities; repair of break-downs	Primarily construction phase impacts Fewer and less frequent operations phase impacts
Change in community resources • Change in forest resources within Community Forests and Leasehold Forests • Risk to natural resources (common resources)	• Permanent clearing of forest and acquisition of land for tower pads within Community Forests and Leasehold Forests • Permanent clearing of forest within some areas within RoW in CF and LHF • Temporary occupation of forest land for tower construction camps (no forest clearing)	Largely, construction phase impacts

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Socioeconomic/Cultural Aspect, Impact	Project Requirement or Activity	Project Phase
Stress on community infrastructure • Stress on Physical Infrastructure (Roads and Bridges) • Stress on Social Infrastructure (Health Care and Recreational Infrastructure) • Stress on Social Infrastructure (Hospitals, Schools)	• Increased influx of construction workers, including from other areas • Construction related activities, increased vehicular movement- of goods and people, including on public roads, near and through inhabited areas • Permanent staff and workers for regular operations and maintenance activities of the Project	Largely, construction phase impacts Fewer and less frequent operations phase impacts
Effects on local economy and employment • Effects on Local Economy • Effects on tourism	• Same as above	Construction phase and operations phase
Effects on tangible and intangible cultural resources Potential impacts to Landscape Values and Visual Amenity have been discussed in an earlier section of this chapter on Impacts to the Physical Environment (7.2)	• Ground disturbance during construction activities, • Increased influx of construction workers, including from other areas • Establishment and operation of construction camps	Primarily construction phase impacts

The potential impacts to Indigenous People/Adivasi Janajati and the prevalence of social exclusion based on gender, caste, and ethnicity have been highlighted due to the prevalence of inequalities in the context of Nepal and the effect of this on impacts and/or risks for women and vulnerable and traditionally marginalized groups (risks such as increased gender based violence, discrimination in employment and wages, other discriminatory and exclusionary practices based on social and gender norms) These sensitivities have also been noted during baseline studies for this Project.

The mitigation hierarchy described as part of the impact assessment methodology in Chapter 3 has been applied throughout design of the Project. The aim has been to avoid and/or minimize potential socioeconomic impacts where possible (see Chapter 6, Alternative Analysis). As a result, the final TL alignment has been able to:

- Avoid all towns and larger villages, except near the Project substation sites (Ratmate and New Hetauda);
- Avoid all known cultural heritage sites;
- Reduce the amount of physical displacement at Ratmate Substation site and along the TL alignment, including through avoiding construction of new access roads; and
- Reduce tree clearing within the TL RoW that crosses Community Forests and Leasehold Forest areas. The criteria for assessing this requirement is described in Section 7.3.

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The remaining, unavoidable, adverse potential Project impacts are described in this section while the corresponding mitigation measures are described in Section 7.3.

A table summarizing the predicted impact significance, including magnitude, extent, duration, and severity of the potential impacts, before applying mitigation measures is included at the end of this section. This assessment has been presented separately for the construction and operation phase of the Project, following the methodology described in Section 3.

7.4.1.1 Area for Socioeconomic and Cultural Impacts Assessment

The socioeconomic and cultural baseline studies focused on the Project Impact Area for the purpose of assessing direct and indirect impacts. Within the Project Impact Area, the Project footprint is defined as the area directly affected by the Project and includes the 46 m wide RoW for the transmission line (approximately 313.9 kilometers long, with 856 towers), and the five substation locations. Most of the predicted impacts will be within the Project footprint, both for the construction and operations phases. However, there are a few impacts likely to affect areas beyond the Project footprint, in the form of indirect impacts (e.g., the Project will benefit areas where labor is sourced) and will have adverse traffic-related impacts on regional road networks for limited periods. The impact significance ratings include the areal spread of impacts and this is noted for each impact discussed in the subsections below. This EIA follows the impact assessment methods described in the Nepal *Hydropower Environmental Impact Assessment Manual* (Manual) and determines the significance of a potential project impact by taking into consideration its nature, type, magnitude, extent, and duration (MoFE 2018).

7.4.2 Project-Wide Adverse Socio-economic Impacts

Adverse impacts to the socioeconomic environment will occur during the construction phase of the Project and with the impacts of easement restrictions continuing into Project operations. All permanent land acquisition (for the substation and tower pads) and agreement for the easement restrictions associated with creation of the TL RoW will be completed before beginning Project construction activities. Impacts from the resulting change of land ownership and use – relocation, resettlement and changes in livelihoods, which could have serious and long lasting impacts if not mitigated, have been included in the assessment of construction phase impacts and are discussed in the subsections below.

Other key construction phase Project impacts are likely to flow from temporary land access requirements along the TL on private and used public land[1], community land and resources, and from construction phase activities including an influx of non-local workers, and increases in traffic, dust and noise.

[1] The term 'used land' applies to land that is being used, regardless of its ownership status. Used land may therefore be categorized as 'public land' but have 'users' who cultivate it, occupy it (for residential purposes), or otherwise depend on it for their livelihoods including by encroachment, or informal or unauthorized use.

Operations phase impacts, by comparison, are likely to be far fewer and much lower in magnitude. Impacts in the operations phase will also include temporary access for occasional repair work and regular maintenance of the TL, as described in Section 2.7.2

7.4.2.1 Change in Land Ownership and Use (Permanent)

Construction Phase

Land will need to be permanently acquired for the construction of the Project components as described in Section 2.8.1. This will result in the conversion of some private land to public ownership. Additionally, it will change how the land within the transmission lines RoW can be used due to land use restrictions. In addition, land use will be temporarily altered or disturbed in the areas used for temporary access by the Project for the duration of the construction phase, which is estimated to be for a 3.5-year period.

The total land requirement of the ETP is 1,471.1 hectares (see Table 2.8.1). Of this area, 124.0 hectares will be acquired permanently for substations, tower pads, and access roads to Ratmate and New Damauli substations; 1,347.1 hectares will have restrictions on use and future development of land within the 46 m RoW. About 13.2 hectares will be used temporarily, during the construction phase (outside of the Transmission Line RoW and substation for work camps, laydown areas). In addition, temporary access trails may be required to reach locations without existing road access. Some of these areas may also be accessed using helicopters during the construction phase. No new roads are proposed for the towers, thus avoiding any additional permanent land acquisition for this purpose. The Project will also construct the New Damauli and New Butwal substations on land previously acquired by NEA. This construction will disturb an additional 10.6 ha.

The 124.0 ha of permanent land acquisition will include 49.8 ha of forest and 68.7 ha of cultivated (agricultural) land.

Land parcel details were identified through available cadastral information, half of which were geo-referenced. Ownership (public vs private land) is based on cadastral data obtained from government records (Department of Land Survey) and will be ground-truthed during the resettlement action planning process (RAP surveys). Based on this method, it is estimated that a total of 1,412 private parcels will be acquired for construction of 856 proposed towers. Each tower may either impact one or more land parcels. Amongst the total private land parcels 176, 391, 378, 93 and 374 private parcels falls under India Border to New Butwal, New Butwal to New Damauli, New Damauli to Ratmate, Ratmate to New Hetauda and Ratmate to Lapsiphedi segments respectively. Details of the land parcels to be acquired by district is included in Annex T-1.

The 1,347.1 ha of permanent land use restrictions includes 727.7 ha of forest and 542.7 ha of cultivated (agricultural) land. A total of 5,985 private land parcels is estimated to fall under the RoW of the proposed alignment. Amongst those 901, 1434, 1442, 273 and 1935 private parcels falls under the India Border to New Butwal, New Butwal to New Damauli, New Damauli to Ratmate, Ratmate to New Hetauda and Ratmate to Lapsiphedi segments, respectively. Details of the land parcels under the RoW by district is included in Annex T-2.

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The Project includes five substations, but MCA-Nepal has responsibility for permanently acquiring land (19.8 ha) for only one substation (including its access road) at Ratmate and one new access road (0.6 ha) at the New Damauli Substation (Table 7.4.2). Land for all other substations has already been acquired by NEA.

Table 7.4-2: Entities Responsible for Substation Land Acquisition and Construction

Substation	Land Acquisition Responsibility	Site Area	MCA-Nepal Construction Responsibility
New Butwal	NEA—land has already been acquired	No additional land acquisition	Construct 400 kV GIS substation. Provide space for two future 220 kV AIS bays to be permitted and constructed by others
New Damauli	NEA—land acquisition is in process	0.6 ha	Construct access road (280 m long within a 20 m RoW) and new 400 kV GIS substation Acquire land for access road only
Ratmate	MCA-Nepal	Substation - 19.8 ha including access road	Construct access road (0.34 km long x 7.5 m road width) and new 400 kV and 220 kV GIS substation Acquire land for substation and access road (see Figure 7.4-1)
New Hetauda	NEA—land has already been acquired	No additional land acquisition	Tie transmission lines coming from Ratmate Substation into existing substation
Lapsiphedi	NEA—land has already been acquired	No additional land acquisition	Tie transmission lines coming from Ratmate Substation into existing substation

Source: Consultant Team 2020

GIS = Gas Insulated System; km = kilometers; kV = kilovolts; NEA = Nepal Electricity Authority

Figure 7.4-1: Proposed Layout for Ratmate Substation Showing Land Acquisition Boundary (19.8 hectares)

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Land acquisition for the substation and tower pads will permanently convert the existing land uses, primarily agriculture and forest, to developed land. These changes to land use and ownership are likely to result in permanent physical displacement, economic displacement, and temporary disturbance during the construction phase, and some temporary disturbance in the operations phase, as discussed below. Crop loss due to implementation of the project was calculated based on the field survey data and some secondary information available at district level. The loss of cereal crops caused by the permanent acquisition of land for ETP project is about 241 tons per year. Total annual crop loss of the major three crop is 67, 55 and 119 tons of paddy, wheat and maize respectively. Based on local market price total value of crop loss is NRs 5,622,757 per year.

Project-affected structures/buildings within the Project footprint were identified based on LiDAR data and will be ground-truthed during the RAP surveys. All structures at the Ratmate Substation location were verified. A summary is given in the table below. Annex P provides a list of structures by segments, districts and wards. Of the total structures, 187 households with 943 persons will be seriously affected by the project (SPAFs).

Table 7.4-3: Structure Verification to Assess Potential Displacement Impacts for EIA

Description	TL RoW[1]	Ratmate Substation[2]	Total
Total structures	201	104	305
Residential	150	37	187
Other structures- wall, large stone, fence,	Not included	Not included	Not included
Physically displaced households (SPAFs)	150 households (750 persons)	37 households (193 persons)	187 households ~943 persons)

Source: Consultant Team 2020

[1] Based on aerial imagery and not ground truthed yet

[2] Based on RAP survey data and has been verified on ground.

Physical Displacement

Although complete avoidance of physical displacement was not possible, the need for physical displacement has been minimized during the finalization of the Ratmate Substation footprint and the TL alignment.

Land acquisition and access easements within the RoW will be undertaken prior to the commencement of Project construction activities. Change in land ownership and use can result in major adverse impacts on the affected households and communities in the form of physical displacement and/or economic displacement, if not mitigated and managed appropriately. Land will be acquired for Ratmate Substation and the tower pads along the length of the TL, under the provisions of the Government of Nepal's *Land Acquisition Act* (1977), while the RoW easements are being procured under the provisions of the *Electricity Act* (1992) and *Electricity Rules* (1993).

As indicated in Table 7.4-3, the Project will result in the physical displacement of an estimated 187 households with a population of approximately 943 people. Other structures used for storage, livestock sheds, or other non-residential purposes (e.g., walls, fences) within the RoW will also be acquired and demolished for public safety and RoW maintenance reasons. There will also be a restriction on further and future construction on the land within the RoW. These physical displacement impacts are discussed separately for each segment of the TL in Section 7.4.4.

Direct adverse impacts resulting from permanent displacement, if not mitigated, can result in homelessness, landlessness, impoverishment, hunger (from reduced food security), poor health and increased morbidity, reduced access to community and natural resources, reduced social and economic resilience (to withstand shocks like natural and other adverse events) and increased marginalization. These effects may be more severely manifested among vulnerable groups. In the Project Direct Impact Area, several households were severely affected as a result of the 2015 Gorkha earthquake and may not have fully recovered from the effects (physical and economic displacement), leaving them in the vulnerable category. These households may experience physical displacement resulting from the Project as a cumulative impact and more severely, if not adequately managed and mitigated.

Adverse impacts are also likely to be more severe for those who may be occupiers, are informal users of the Project-affected residential buildings, or lack legal title or formal rental/lease agreements. In many cases, such households are also likely to be from marginalized or disadvantaged social groups. A detailed assessment of physical displacement related impacts will be undertaken through the Resettlement Action Plan (RAP) surveys across the TL RoW and at the Ratmate Substation site for all affected land parcels and households to estimate the scale and magnitude of such direct impacts.

Indirect impacts of permanent displacement can include increased out-migration, increased risk to women and children being subject to trafficking and gender-based violence, malnutrition, and reduced literacy. Overall, there can be a reduced capacity of the affected households to access resources and opportunities, over time.

Given the linear nature of the Project, physical displacement is not likely to affect whole clusters of communities living together, but will be largely dispersed along the length of the TL RoW. The only locations where a cluster of houses (affecting 37 households) is likely to be displaced is the Ratmate Substation site (discussed further in Section 7.4.4.3) and near New Hetauda substation.

The potential Project impacts resulting in physical displacement of approximately 187 households and about 943 people during the construction phase is assessed to be direct, adverse, high in magnitude, local in extent, long term in duration, with an overall pre-mitigation significance of Major.

All physically displaced households are considered to be in the category 'Severely Project Affected Families' (SPAF) for this Project. Other criteria for SPAF category other than physical displacement, are discussed under economic displacement impacts below.

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Economic Displacement and Livelihood Impacts

Economic displacement and livelihood impacts attributable to the Project can result from (1) the loss of private and public land that is used for economic/livelihood purposes (e.g., acquisition of agricultural land or businesses such as local shops); (2) the direct loss of access to resources used for economic/livelihood purposes (e.g., community forest land that is restricted from being re-established in forest); and (3) the indirect restriction on existing businesses located outside of the RoW (e.g., the required closure for safety reasons of an existing paragliding operation near the RoW in Shankarapur). Each of these are discussed in more detail below.

Permanent land acquisition of private and used land for the Project can lead to economic displacement of those losing land or access to land being used for economic activities. Many of those households that are physically displaced are also likely to be economically displaced as they use their land for agricultural and other livelihood purposes.

Permanent land acquisition requirements affecting shops, small businesses, commercial enterprises (like poultry), and more specifically, the brick making unit located (in part) on the proposed Ratmate Substation site are also likely to result in economic displacement impacts on both owners and workers (permanent employees or seasonal/temporary workers). The RAP survey for the Ratmate substation site has estimated that 10 businesses will be displaced, of which the brick-works is the largest. Annex Q summarizes the list of businesses impacted within Ratmate substation.

The potentially affected brick-works unit is the Nuwakot Itta Bhatti, registered as a cottage industry under the Industrial Enterprises Act of Government of Nepal (1992), and operates on land that is taken on a 20-year lease from the owners, most of whom live in and around Ratmate. The potential economic displacement impacts are likely to be sustained across several categories- people who lease land to the operations and will stand to lose rental income, seasonal migrant and local labor (estimated to be between 600-700 persons, drawn largely from the Terai region and bordering areas in India) who are likely to lose wage-labor for the affected season; owners/shareholders of the company who could incur losses for the period for which the operations will be disrupted (as fixed assets will need to be removed from the Project area). Owners/shareholders are also likely to be affected due to the loss of investment in the brick-works infrastructure and machinery.

While the impacts on the owners are assessed to be long term, the workers may be affected for a shorter period, assuming their ability to access other employment elsewhere.

Permanent economic displacement impacts and livelihood impacts are likely to result not only from permanent land acquisition for the Project of private and used land (largely agricultural land), but also from the use restrictions within the TL RoW. These use restrictions will affect those dependent on community forests, leasehold forests, and other common or community resources. Tree clearing requirements within the RoW and at the Ratmate Substation site, will also result in economic displacement where the trees are privately owned, part of a private forest, or otherwise productive trees (e.g., fruit trees) on common land, in community forests,

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or leasehold forests. People whose land falls within the RoW also find it harder to mortgage these land parcels to raise loans from banks. The use restrictions in the RoW effectively reduces the value of their asset (land).

Permanent economic displacement can result in landlessness, loss of income and livelihoods, reduced food and fodder security, poor health and increased morbidity, reduced social and economic resilience of households (to withstand shocks like natural and other adverse events) and increased marginalization.

As with physical displacement, the more vulnerable groups and households may be more significantly impacted by economic displacement given their already reduced ability to withstand shocks like the loss of land and assets, or access to land and community resources, upon which they are wholly dependent.

Land use and land cover analysis based on interpretation of aerial imagery of the TL RoW, indicates that of the total land requirement of the Project, 41.5 percent is currently in use for agriculture. Though this proportion varies widely across segments, 80 percent in the India Border to New Butwal Substation segment and 23 percent in the Ratmate to New Hetauda Substation segment, economic displacement relating to agriculture is likely to be a key impact of the land permanently acquired for tower pads. However, since agriculture as an activity and use will be allowed to continue within the RoW, there will be no adverse impacts on private or used agricultural land within the RoW. The Project requirement of 103.6 hectares for 856 tower pads across 313.9 kilometers is also dispersed enough to not have a significant impact on food production (and therefore food security) of regions.

Although regionally dispersed, economic displacement impacts are likely to affect individual land losers. Other than legal titleholders of Project-affected land, traditional and informal users[2] may also sustain adverse impacts. This category of economically displaced people are more likely to also be from disadvantaged and marginalized groups or households, and therefore more vulnerable and more likely to experience Project impacts more severely. These households/individuals may not have access to alternate lands, or capacity to easily move to other livelihood options. The average size of land holdings varied greatly across the TL with larger size holdings in the Terai region (approximately 20 ropani[3] or 1 ha), while the Hills region the average land holding was less than 10 ropani or 0.5 ha, with holdings less than 2.5 ropani for those in the last quartile, as discussed in the socioeconomic baseline for the Project Impact Area (Section 5.3). However, people also reported relying on informal arrangements of cultivation (share cropping) on other available land (as noted during the baseline survey). The average tower pad land requirement is 927 m^2, which is less than 0.1 ha. Economic displacement impacts are, therefore, likely to disproportionately affect those with smaller or marginal agricultural land holdings. The potentially more significant impacts on disadvantaged and marginalize groups and households, are discussed later in this chapter

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[2] Those who have informal share cropping arrangements, are non-registered users/cultivators, encroachers, agricultural labor, etc.

[3] 1 ropani is about 509m^2

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(Section 7.4.2.7). These are also groups that are likely to have smaller agricultural land holdings, as noted in the previous chapter on baseline studies (Section 7.3).

Economic displacement related impacts may also result from RoW restriction that require tree clearing of forest areas as well as on private land. Those with economic dependence on either forest trees in Community Forests (CF) or Leasehold Forests (LHF), or on private trees, are likely to be adversely affected. Tree clearing related impacts in CF/LHF are discussed in Section 7.3 (Biological Impacts), and Section 7.4.2.4 (Community Resources).

Indirect adverse impacts from economic displacement (that are not mitigated or managed) may accrue to other dependent households, at community level, and/or to businesses that are dependent on the directly affected entities. However, this is of greater consequence in areas where economic displacement impacts are more concentrated, such as at Ratmate Substation.

The Project's potential impacts resulting in economic displacement during the construction phase is assessed to be direct, adverse, high in magnitude, local in extent, and long term in duration with an overall pre-mitigation significance of Major.

Operations Phase

No additional land is planned to be permanently acquired or additional land use restrictions established in the operations phase, thus no additional economic displacement impacts are expected to occur.

7.4.2.2 Temporary Access Related Impacts

The Project will need to access land temporarily during the construction phase for laydown areas, temporary material storage, worker camps, helipads, or for access trails to some tower locations that may not have existing access. Other than occasional access for maintenance or repair works, the Project is unlikely to require temporary access to private or used land in the operations phase.

Construction Phase

Tables 7.4-5 and 7.4-6 show temporary land requirements for the construction phase. MCA-Nepal estimates that construction of the ETP will take approximately 3.5 years. There are no current plans for temporary land access at substation locations, as the laydown areas, worker camps, material storage areas, and helipads (if needed) will be located within the substation sites for which all land will be acquired.

Locations of 11 tower laydown areas (including two proposed helipad sites) have been identified along the ETP, with most of these being between two and three hectares, although the two helipad sites are smaller at less than one hectare. These areas will be rented/leased by the D&B contractors/sub-contractors on mutually agreed lease/rental terms and arrangements with the owners of private land. The laydown areas have been located to avoid tree clearing and any physical displacement of owners or occupiers. Section 2.6.4 describes the required siting criteria to be followed for selection of additional laydown areas, if required) to avoid/minimize environmental and social impacts. Project construction will require temporary access to each of the 847 towers (excluding the 9 gantry towers located on substation sites) for access trails, tower work camps, and temporary storage areas of approximately 2,000 m^2 per tower. The land will be located within the proposed RoW and immediately adjacent to the tower sites to the extent possible, and therefore will not result in any additional physical displacement.

Table 7.4-4: Temporary Land Access Requirements for the Construction Phase

Project Component	Facilities	Land Area
Temporary Land Access/Restrictions/Use		
Substation Work Camps	Located within existing substation area	0.0 ha
Tower Laydown Areas	10 laydown areas, excluding Ratmate laydown area	13.2 ha
Tower Access/Work Camps/Temporary Storage Areas	847 towers @ 2,000 m^2/tower	169.4 ha*
Sub-Total		182.6 ha

* Within proposed transmission line RoW
Source: Consultant Team 2020

Table 7.4-5: Temporary Land Access Requirements (Construction Phase) by District

District	Tower Laydown Areas (ha)	Tower Work Camps (ha)
Nawalparasi West	0.5	20.2
Nawalparasi East	0.0	4.6
Palpa	1.9	14.8
Tanahu	2.0	39.4
Dhading	1.3	29.2
Nuwakot	2.4	30.6
Chitwan	0.0	4.0
Makawanpur	4.1	19.0
Sindhupalchok	1.0	5.6
Kathmandu	0.0	2.0
Total	13.2	169.4

Source: Consultant Team 2020

These temporary access areas will be required for short durations (i.e., from a few days to over a month) multiple times during the 3.5 year construction phase (see Section 2.7.1 for a description of the multiple construction mobilizations (e.g., clearing and grading, excavation and foundation installation, tower erection, and conductor stringing) for each tower. These mobilizations could result in damage to crops/trees/other assets or interfere with planting of crops multiple times during Project construction. Further, these impacts are likely to be accompanied by other community impacts (e.g., increased community health, safety and security risks).

If not mitigated or compensated, such impacts from temporary land access have the potential for affecting the income and livelihoods of those (i.e., owners, users, farm labor) who depend on small and marginal land holdings that may be affected, especially given the multi-year duration of the impacts.

The Project's potential impacts from temporary access requirements during the construction phase is assessed to be direct, adverse, medium in magnitude, local in extent, and medium term in duration, with an overall pre-mitigation significance of Minor.

Operations Phase

No additional land acquisition or additional restrictions on land are envisaged during the operations phase, thus, no additional physical or economic displacement is likely to be caused by Project operations.

Operation related activities for the TL RoW will include regular maintenance and checks, and occasional repair works. While most locations are likely to have the needed access to the towers or other areas within the RoW, some areas may continue to be accessible only via foot trails. Where access is required through private land (whether within the RoW or outside it), some small clearing of undergrowth or standing crops, in the case of private or used land, may be required. This may result in a loss to the owner/user. There is also a small likelihood of damage to existing structures, buildings, or other privately-owned assets, during this access (creating or using the access for maintenance or repair works). The land owner may incur some costs or economic losses as a result of any damage.

The Project's potential impacts from temporary access requirements during the operations phase is assessed to be direct, adverse, low in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Negligible.

7.4.2.3 Change in Community Health, Safety, and Security

Impacts relating to community health, safety and security, including TIP risks, are more likely to result from construction phase activities of the Project, rather than in the operations phase.

Construction Phase

TIP, Gender- based Violence and Employment of Under-Age Children

There is a risk that the Project could contribute to the risk of TIP, gender based violence (GBV) and/or the employment of under-age children, if appropriate employment practices are not put in place.

TIP can result from a range of employment practices, such as not paying workers fairly in a timely manner, withholding (without access) passports or other identification, and using recruitment agencies that charge large fees. In addition, large-scale developments have been shown to contribute to an increase in the commercial sex trade, as discussed later in this chapter (Section 7.4.2.8, Gender and Social Inclusion). This too can contribute to TIP risk, and typically, disproportionately affects women and minors.

Vulnerable populations, including women and children with disabilities, are often at higher risk of being subject to TIP and GBV. Discussion on this risk as it relates to Indigenous People/Adivasi Janajati is in5.4.2.*The Project's potential impacts on risk of TIP during the construction phase is assessed to be direct, adverse, high in magnitude, local in extent, and medium term in duration, with an overall pre-mitigation significance of Moderate.*

Nuisance Impacts on Local Communities

Construction will likely generate noise, dust, and traffic, all of which can create a nuisance, or if severe enough, can cause health problems (e.g., respiratory issues, depression, and anxiety). The extent of the potential impacts associated with noise and dust are discussed in Section 7.2.2 (Impacts to the Physical Environment). The Project will also generate traffic as workers and goods are transported to and from the Project sites. This can lead to congestion, resulting in frustration on the part of the local communities. The potential for traffic accidents or increased wear and tear on the roads is discussed later in Section 7.4.2.4.

The Project's potential impacts associated with addition to noise, dust and traffic during the construction phase is assessed to be direct, adverse, medium in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Minor.

Risk of Communicable and Vector-Borne Diseases

An increase in the transmission of communicable diseases may occur as the result of the introduction of workers into the area (i.e., an influx in labor), creation of vector habitat, and/ or the presence of commercial sex workers. This includes the potential for the workforce to introduce a new disease and/or a more virulent strain of an existing disease.

The introduction of a large (mainly male) workforce has been shown in other large-scale developments to increase the local commercial sex trade or introduce it in areas where this previously did not occur. A few case of sexually transmitted infections (STIs) were reported within the Project Impact Area, however, these were not widespread. If appropriate precautions are not taken, the commercial sex trade can increase the rates of communicable diseases in areas surrounding the Project, specifically sexually transmitted infections.

If the Project's human waste streams are mismanaged, this can increase the spread of communicable diseases. This includes diseases, such as typhoid fever, which is known to be present in the Project Impact Area.

In addition, the Project may contribute to the spread of vector-borne diseases through the creation of vector habitat during construction and potentially operation. There were reported cases of vector-borne diseases within the Project impact area, such as malaria which is

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prevalent in the Terai region. Standing water (i.e., vector habitat) can be created in a variety of ways, such as alterations to drainage patterns, during construction activities and excavation activities required to install the transmission towers (which can fill with water during rainy periods). Vector habitat is of particular note in a location such as Nepal–where heavy rainfall occurs during the wet season creating large areas of standing water. This could be exacerbated by the Project (e.g., if excavations for the towers are filled with water).

The transmission of communicable and vector-borne diseases can be exacerbated by a number of factors. Health care facilities are limited in the Project Impact Area. At present, most communities have health posts that are equipped to address only very basic health problems and may not have a resident doctor. Therefore, local capacity (e.g., availability of diagnostic equipment and medicine) to respond to an increase in the transmission of communicable and vector-borne diseases is limited.

The Project's potential impacts on transmission of communicable diseases during the construction phase is assessed to be direct, adverse, medium in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Minor.

Potential for Community Conflict

Although steps will be taken to maximize local employment, many of the skilled and semi-skilled roles will likely be filled by workers from outside the Project districts, given the low local skill base in the area. As a result there will be an influx of workers residing along the TL and at the substations throughout the construction phase.

An influx in workers can lead to disruptions in daily activities, often resulting in frustration on the part of the local community. Construction of the TL will involve several groups of workers, with 20 or more workers at a time in each group, for several weeks at each work camp. The group will work at one tower prior to moving on to the next. This will result in disruptions in daily community activities at several points throughout the construction phase as workers move from one tower location to the next.

An influx in workers can also lead to conflict between the Project and local communities. This typically stems from a variety of issues including differences in ethnicity and/ or religious values as well as jealousy that 'outsiders' have successfully secured positions within the Project. Such situations are likely to create tension and conflict.

The introduction of non-local workers can also change the social structures and networks, which will likely be more prevalent at the substations, as the workers will be based there for a longer period of time.

The Project's potential impacts resulting in community conflicts during the construction phase is assessed to be direct, adverse, high in magnitude, local in extent, and short term in duration with an overall pre-mitigation significance of Moderate.

Potential Safety and Security Impacts

An active construction site, including the laydown areas where large materials and equipment are stored, creates a range of safety issues. Community members can fall into unsecured excavations and/or interact with unsecured equipment. This can lead to onsite accidents and injuries.

The sites will employ unarmed security person to help reduce the potential for the community to access the Project site, particularly active construction areas. Security personnel will be employed during construction and operation. If conflict arises, there is potential for security personnel, as has been seen in other development projects, to use excessive force.

The Project's potential to create/increase safety and security risks during the construction phase is assessed to be adverse, medium in magnitude, local in extent, and short term in duration with an overall pre-mitigation significance of Minor.

Operations Phase

Aircraft Safety

The construction of high transmission towers, especially along ridges and hills, has the potential to increase the risk to aviation safety (i.e., planes or helicopters striking a tower or conductors). As indicated in Chapter 2 (Project Introduction), the CAAN has required that obstruction lights be placed on all towers taller than 60 m that are located on hilltop or paint upper 30 meter parts of towers with red and white colors. Safety markers will also be installed at locations along the route as specified by CAAN to aid pilots in visually identifying the transmission lines.

The Project's potential risk to aviation safety during the operations phase is assessed to be low in magnitude, site specific in extent, and long term in duration, with an overall significance of Negligible, taking into consideration the CAAN requirements.

Electromagnetic Fields Effects

Project consultations have found that local residents are concerned about potential health risks associated transmission line electric and magnetic fields (EMF). Research has not documented any health impacts associated with living near transmission lines. The World Health Organization has adopted recommended exposure standards to EMF based on a careful examination of the research data. MCA-Nepal has evaluated EMF from its transmission lines and found that it will be less than half of the World Health Organization's recommended exposure standard at the edge of the RoW (Figure 7.4-2).. This indicates that it is safe to live immediately adjacent to the RoW and to work or farm within the RoW. In response to community concerns and consistent with international good practice, MCA-Nepal will remove existing structures within the RoW, compensate the affected households, and prohibit the construction of any new houses or other structures within the RoW.

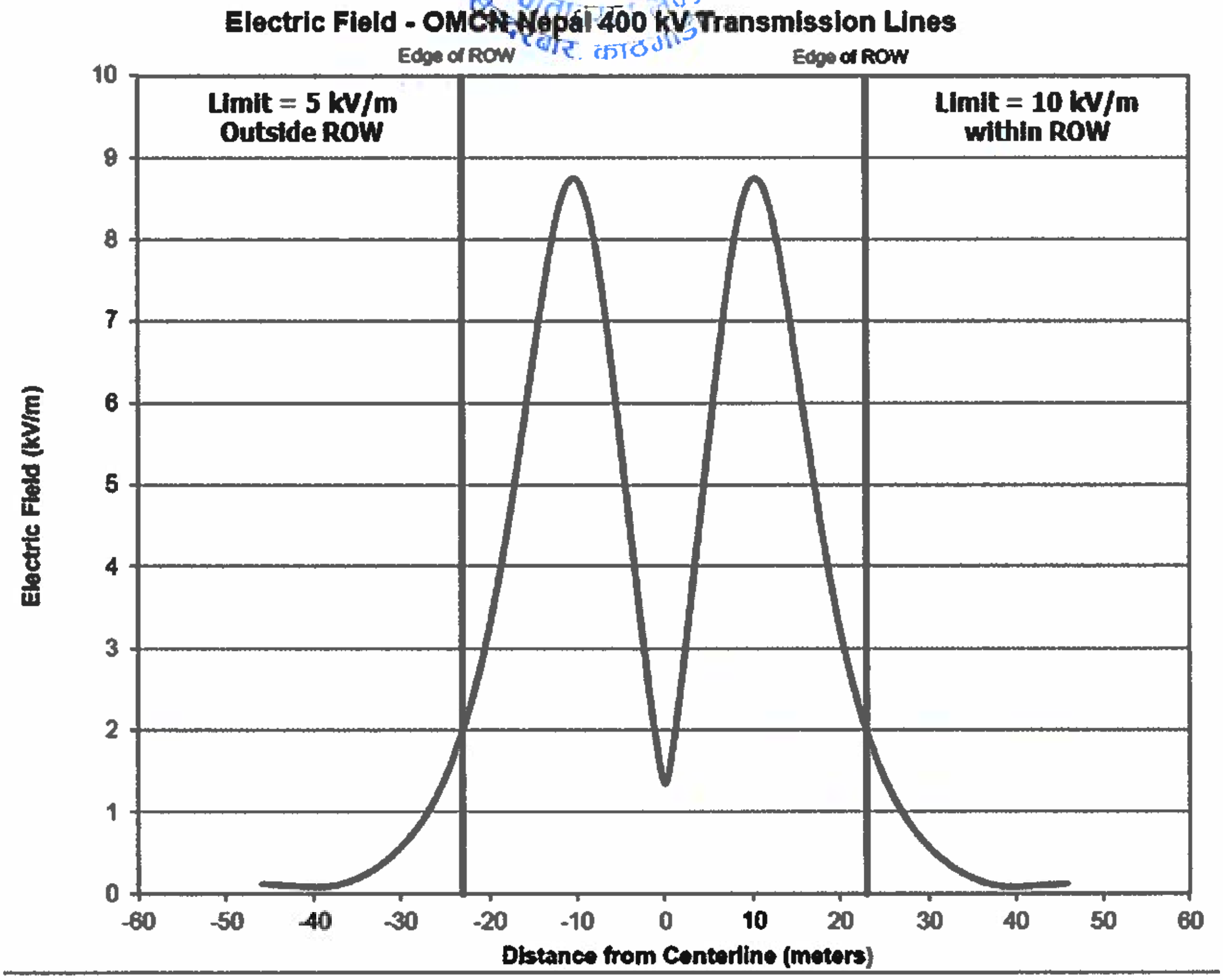

Figure 7.4-2: Electric Field for MCA Nepal 400 kV Transmission Lines

The RoW ensures there will be no future incompatible development that will affect transmission line operations and protects local residents from any adverse health effects from electromagnetic fields.

The Project's potential risk of effects of EMF during the operations phase is assessed to be low in magnitude, site specific in extent, and long term in duration, with an overall pre-mitigation significance of Negligible.

Potential Safety and Security Risks

Sections 2.6.2.3 and 2.6.3.5 describe the safety and security measures MCA-Nepal will put in place for transmission lines and substations, respectively, to minimize the risk to community health from Project operations. Project infrastructure may be put at risk by bad actors within the local community who may want to steal parts, risking weakening or even failure of pylons or failure and collapse of towers, if safety and security arrangements are not adequate during the operations phase.

7.4.2.4 Community Resources

Community forests (CF) and leasehold forests (LHF) are a key community resource affected by the land requirements for the Project, including the land required for the RoW. Other community resources that may be affected by the Project include water resources, non-timber forest products (NTFP), and naturally available construction materials, such as aggregates and sand.

The adverse biological impact of the project on community and leasehold forests is discussed in Section 7.3. However, the impact on community and leasehold forests has socioeconomic and cultural significance also. The significance of CF/LHF for local communities, as discussed in Section 7.3, is not only for their economic contribution (e.g., fuelwood, fodder, timber, insulation materials, NTPF), but also their cultural, recreational, and traditional values. While avoidance of all known religious forests and cultural resources within CFs has been achieved, land for tower pads falling within CF/LHFs and forest clearing for some areas within the TL RoW will likely result in impacts to the respective user communities. Some impacts may also result from additional land requirements for temporary access during the construction phase.

As noted in the baseline studies, the nature of economic dependence of CF and LHF user groups is different in that users of LHFs are formed by bringing together landless households and leasing degraded forest land to them for a period of 30 years[4] to allow them to grow crops and trees for economic benefit. Since no more than 0.5 or 1 hectare per household, and no more than 20 households are included in one group, the area occupied by LHFs is usually much smaller than CFs. For these reasons, the impact assessment below distinguishes between CFs and LHFs.

Construction Phase

The transmission line passes through 112 community forests affecting its 20,617 user households. However, only 1.3 percent of total community forest area needs to be cleared for the project out of which 0.2 percent (20.6 hectare) will be permanently acquired for tower foundations. Impacts of loss of forest land and trees on CFUGs are likely to be less as such impacts are dispersed across a larger population and since other areas of the forests will remain available for resources like fuelwood, fodder, and NTFPs.

The transmission line also passes through 8 leasehold forests which will affect 85 associated user households. LHF groups are likely to be impacted more than CFUGs, as they are more dependent on these forests for their livelihood. About 6.8 percent of total area of 8 leasehold forests needs to be cleared for the project. Two LHFs in particular may be more significantly impacted, as about 10 to 11 percent the area of each forest may be cleared for the RoW. This

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[4] These leases may be renewed for another 30 year period based on criteria described in the Forest Department's rules for LHFs.

will reduce availability of resources, such as fuelwood, fodder, productive trees, NTFPs and income from all these.

In addition to permanent land acquisition for tower pads and forest clearing in some areas within the RoW, construction activities will also require temporary land access adjacent to tower pads, intermittently over the construction period. During this period, there is a risk of non-local workers using community resources like collecting fuelwood, foraging for food, collecting valuable NTFP, hunting, and/or poaching of wild animals in community forests, and using community water sources for washing and bathing. Within forest areas, all these activities will adversely affect the resource base available to the users of the CFs and LHFs, or be illegal activities (hunting and poaching animals). The risk of improper disposal of waste in the forest, or setting off forest fires (especially during the dry season) due to the carelessness of workers, may also increase, potentially resulting in loss of forest resources. See also Section 7.3 (Impacts to the Biological Environment). Use of community water resources may create health and safety risks for the community, especially women users. During the summer season, it may also create additional stress on the resource and the dependent user community, as some water sources run dry.

During the construction phase, there will be a space requirement of about 2,000 m^2 around each tower pad for construction activities. Though this area will be used temporarily, it is likely that it will be disturbed/used several times during the construction phase. There are 222 towers located within CF/LHF areas where this space for construction phase activities will be temporarily used. At each location, for the duration of each phase of construction activity, generally between 10 and 50 workers are likely to be working at one time, as described in the Project Introduction (Chapter 2). Some workers may also set up temporary tower camps, and for the duration of their stay, use water or other natural resources (firewood) that are locally available for their own consumption/use or for construction. In addition to disruption to the natural resources, such activities, should they be undertaken without prior consultations and with permissions, have the potential to cause conflicts with the local user groups and communities with rights to these resources.

If access of non-local workers is not restricted or controlled, other risks, such as poaching of wild animals and birds, forest fires from carelessness, littering and improper disposal of waste around worker camp areas within forests and unsafe or improper use of water resources, may add to community conflict risks (See 5.3 for risks to Biological environment, in this context).

The Project's potential to impact community resources during the construction phase is assessed to be direct, adverse, medium in magnitude, local in extent, and long term in duration, with an overall pre-mitigation significance of Moderate.

Operations Phase

No additional land in CF or LHF land is likely to be required for Project activities in the operations phase. Access to towers located within CF/LHF for maintenance activities will use existing roads or trails. The forest area cleared within the RoW in the construction phase, will be maintained and regeneration is likely to be limited to bush and undergrowth, as discussed in Section 7.3. No additional stress to natural resources/community resources is expected during the operations phase.

The Project's potential to impact community resources during the operations phase is assessed to be low in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Negligible.

7.4.2.5 Community Infrastructure

The impacts on the existing physical and social infrastructure are likely to result from increased vehicular movement for transportation of equipment and personnel and the influx of workers for the construction and operation phases of the Project.

Construction Phase

Stress on Physical Infrastructure (Roads and Bridges)

The Project intends to use the existing roads and trails for movement of equipment and personnel to and from construction sites. In certain sections that are inaccessible, the Project may utilize helicopters. Increased vehicular traffic (mostly large vehicles) will result in an increase in traffic movements, which can lead to increased wear and tear on the existing road and bridge infrastructure. This impact may be higher in magnitude in rural municipalities, where road connectivity and quality are already deficient and maintenance is irregular. Increase in vehicular movement may also result in increased risks of traffic-related accidents, congestion along narrow roads and hilly roads, which, in turn, may at times create conflict with local communities, and in extreme cases, social unrest.

The Project's potential to stress physical infrastructure during the construction phase is assessed to be direct, adverse, medium in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Minor.

Stress on Social Infrastructure (Health Care and Recreational Infrastructure)

The influx of workers for the Project can also result in an increased stress on the existing hospital and health care infrastructure available in the municipalities along the segments. The magnitude of this stress is likely to be higher in rural municipalities where health care facilities are already under pressure, with limited supplies both in terms of staff and medical resources. The increased impact on rural health facilities is likely to adversely affect their ability to service the local community, especially during the rainy season when water-borne infections like cholera and typhoid are reported.

Local recreational places and infrastructure, such as fairs, cinemas, playgrounds, may experience greater traffic during periods when Project workers are present. However, since at any time, the numbers are not likely to be high at any one location, this impact is likely to be short term and negligible.

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The Project's potential impact on social infrastructure during the construction phase is assessed to be direct, adverse, low in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Negligible.

Operations Phase

Stress on Social Infrastructure (Hospitals, Schools)

During the operations phase, the stress on existing social infrastructure will primarily result from the Project employees who relocate from other areas to the substation sites and may be accompanied by their family. At each substation, no more than 50 employees will be required during the operations phase, of which several are likely to be residents of surrounding settlements. The proportion of external workers is likely to be low and therefore, little added stress from demand for health care, education or recreational facilities is likely to result.

The Project's potential impact on social infrastructure during the operations phase is assessed to be direct, adverse, low in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Negligible.

7.4.2.6 Local Economy and Employment

The Project activities will directly and indirectly result in both adverse and beneficial impacts on the local economy. This includes benefits such as opportunities for employment, local contracts for small entrepreneurs and suppliers of goods and services in turn resulting in an impetus to the local economy. While the beneficial impacts from the Project are discussed in Section 7.1, this section discusses the adverse impacts likely to result from the Project activities on the local economy.

Construction Phase

The Project is likely to result in some adverse impacts on the local economy and employment due to economic displacement, discussed in earlier subsections on land acquisition and use restrictions in the RoW for the TL. Other adverse potential impacts are noted below.

Effects on Local Economy

The influx of external workers may result in an increase in demand for food and other consumable items in the area, for the period of their stay, especially if it is during the pre-harvest lean season[5]. This in turn, may result in increased food and vegetable prices for the local community. This may result in added economic stress on the local community, especially the poorer sections.

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[5] It was noted in the baseline consultations that household expenditure on food increased during the pre-harvest period as the reserves of food-stock grown by farmers ran out. Typically, this is also the period when the food prices in the market, rise.

The Project's potential impact on the local economy during the construction phase is assessed to be direct, medium in magnitude, local in extent, and short term in duration, with an overall pre-mitigation significance of Minor.

Effects on Tourism

The economic displacement of local tourism-related businesses along the RoW and substation area is likely to result in an impact on the workers (trainers, pilots, etc.) engaged by these businesses and the associated local suppliers, as well as local tourism economy. This may also affect associated workers such as guides or porters who work with these businesses.

In particular, paragliding operations of one company, "Shankarapur Paragliding Pvt. Ltd." located near Lapsiphedi will be affected as the TL will cut across their flight path. These impacts are discussed in more detail in Section 7.4.4.

The Project's potential impact on the local tourism during the construction phase is assessed to be direct, low in magnitude, local in extent, and short term in duration with an overall pre-mitigation significance of Negligible.

Operations Phase

While the Project has made efforts to avoid any existing tourism projects, once the Project is constructed and operational, it may adversely affect the potential for the future development of tourism projects from the loss of aesthetic and visual qualities to the environment. During consultation, people in the Project Impact Area have pointed out that the TL will prevent them from setting up paragliding operations for the adventure tourism segment, thus affecting the future potential of adventure tourism at locations near the TL.

The Project's potential impact on the local economy during the operations phase is assessed to be direct, medium in magnitude, local in extent, and long term in duration with an overall pre-mitigation significance of Moderate.

7.4.2.7 Impacts on Ethnic Groups - Indigenous People/Adivasi Janajati

Project activities are likely to result in adverse impacts that in some areas may lead to greater stress on Indigenous People (Adivasi Janajati). Some Indigenous People/Adivasi Janajati groups have historically been socially excluded and underrepresented in political and development decisions as noted in the socioeconomic baseline for this Project (4.3). Areas with higher population concentration of such Indigenous People/Adivasi Janajati groups (Chepang in Chitwan, Dhading and Makwanpur, Tamang in Sindhupalchok, Dhading, Makwanpur, and Nuwakot) report inadequate social and physical infrastructure, lower literacy rates, higher proportions of landlessness or unregistered land, higher food deficiencies, higher susceptibility to natural disasters and greater dependence on natural resources (IIDS 2008).

As noted in the baseline analysis (Section 5.3), according to the Nepal Federation of Indigenous Nationalities (NEFIN) categories of developmental stages of Indigenous Peoples, Chepang are highly marginalized, while the Tharu and Tamang are marginalized groups

(IFAD 2012)[6]. All these groups live in the hilly areas. The Tamang group have a significant population in Kathmandu, Sindhupalchok, Dhading, Makwanpur, Nuwakot. Similarly, the Tharu group has a high population in Chitwan, and Nawalparasi. The Chepang group is concentrated in Dhading, Chitwan and Makwanpur. Where the TL RoW crosses areas native to Tharu, Tamang and Chepang peoples the potential for adverse impacts may be greater due to the inherent vulnerability of the inhabitants likely to be affected.

Construction Phase

Physical/Economic Displacement-Related Impacts

The overall impacts on physical and economic displacement from land acquisition and use restrictions have been discussed earlier in this chapter (Section 7.4.2). Baseline surveys brought out that several Indigenous People/Adivasi Janajati households owned small land holdings (less than 0.5 hectare on an average). Although the permanent land acquisition for tower pads is small and dispersed across a long RoW, land owners/users affected at each tower pad location, if they are small or marginal farmers are likely to be more severely impacted. Thus, marginalized and highly marginalized Indigenous People/Adivasi Janajati households could be more adversely impacted by the land acquisition and use restrictions. These impacts are likely to be in the form of reduction in land holding size or even landlessness, leading to loss of livelihood and the risk of further impoverishment (IFAD 2012).

About 30 percent of marginalized hill Indigenous Peoples[7], 25 percent hill Indigenous Peoples (other than Newar) and another 25 percent of Terai Indigenous Peoples (other than Tharu) have and cultivate lands that are not yet registered in their names (i.e., title to the lands is not on official records as part of the last land survey done in year 1993). Some 38 percent Tharu and 28 percent Terai Indigenous Peoples (other than Tharu) cultivate lands of others. This may result in inadequate compensation/mitigation of the impacts if traditional rights are not recognized and taken into consideration for compensation (LAHURNIP 2018).

Inadequate compensation and its associated risk of impoverishment could result in increased incidence of trafficking of women from these groups. As discussed in Section 5.3, the majority of victims of TIP belong to, Tamang, , and Chepang communities that reside in hilly areas of the country. The districts with highest concentration of TIP incidence are Nawalparasi, Chitwan, Makwanpur and Palpa (NHRC 2018).

In the past land acquisition for development projects has been associated with forced eviction and lack of adequate engagement and consent of these communities in the decision-making and compensation determination process (LAHURNIP 2018). This may create a risk of trust deficit for the Project in these areas, especially where there are legacy issues from previous projects. For example, there is a pending land acquisition case in New Damauli; issues

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[6] NEFIN has categorized the groups based on developmental indicators including literacy and education, income, wealth, land holding and other assets (IFAD 2012).
[7] Including Tharu, Gurung and Chepang

surrounding the 220 kV transmission line by NEA in Nawalparasi; Benighat Rorang resistance toward additional transmission lines, etc.

Project impacts are likely to be more severely felt in rural municipalities, where Indigenous People/Adivasi Janajati groups are reported to have faced higher instances of exclusion and discrimination especially among the Chepang (in locations in Dhading, Chitwan, Makwanpur), the Tamang (in locations in Kathmandu, Sindhupalchok, Dhading, Makwanpur, Nuwakot), and Tharu (Palpa, Nawalparasi). (Refer to Segment-specific impacts in Section 7.4.4.)

Impacts on Access and Resources Use in CF and LHF

Traditionally, Indigenous People/Adivasi Janajati groups have had a high dependence on the surrounding natural resources including CF and LHF. Ethnic groups such as Chepang have traditionally relied on foraging and hunting for their livelihood (IFAD 2012).

The Indigenous People/Adivasi Janajati groups that participate in and benefit from leasehold forest regimes include Chepang, Kipat, Kharbari and Newar (IFAD 2012). Three LHFs where about 10 percent of the area falling within the RoW is likely to be cleared are all managed by Indigenous People/Adivasi Janajati users, mostly Magar and some Chepang. The potential impacts are discussed in the segment-specific impacts in Sections 7.4.4.

According to baseline information (based on available secondary data supplemented with consultations), a total of 112 CF and 8 LHF have been identified along the RoW. CF user groups on an average have 150-200 dependent households, and usually comprise more than 50 percent Indigenous People/Adivasi Janajati households. The following table provides a summary of the dependence of Indigenous People/Adivasi Janajati groups on the CF/LHF along the RoW.

Table 7.4-6: Proportion of Indigenous People/Adivasi Janajati Members in CF/LHF User Groups

District	Forest Type	Number of Forest User Groups	Number of User Households (HH)	Average Indigenous People/Adivasi Janajati HHs members
Nawalparasi East	CF	2	205	80.1%
Nawalparasi West	CF	7	5853	47.2%
Palpa	CF	17	1732	61.9%
	**LHF	2	19	100%
Tanahu	CF	20	1938	69.1%
Chitwan	**LHF	3	23	100%
Dhading	CF	25	3562	73.5%
	**LHF	3	43	94.4%
Makawanpur	CF	8	3301	52.0%

District	Forest Type	Number of Forest User Groups	Number of User Households (HH)	Average Indigenous People/Adivasi Janajati HHs members
Nuwakot	CF	31	3781	0.0%
Kathmandu	CF	2	245	63.1%
Total		120	20,702	

Source: Primary Data Collection undertaken by as part of the EIA; CF- Community Forests; **LHF Leasehold Forest (only present in 2 districts that are crossed by the TL RoW)

Risk of Discrimination in Project Employment

The Indigenous People groups are presently dependent primarily on agriculture and natural resources as their main sources of livelihood, as noted in the baseline assessment. A few groups, such as the Gurungs, are also dependent upon industrial activities for income (LAHURNIP 2018). Thus, the Indigenous People/Adivasi Janajati population is less likely to have the requisite skills required for employment in Project activities, barring their role as porters. Furthermore, these groups have historically faced social exclusion due to the existing caste structures in the country. This may result in discriminatory practices by the Project contractor in terms of hiring these groups.

The Project's potential impacts on Indigenous Peoples/Adivasi Janajati and vulnerable groups during the construction phase is assessed to be high in magnitude, local in extent, and medium term in duration with an overall pre-mitigation significance of Moderate.

Operations Phase

No additional impacts from land acquisition or use change are likely to be sustained by the Indigenous People/Adivasi Janajati groups in this phase.

Risk of Discrimination in Project Employment

The impacts/risks are as discussed in the construction phase of the Project, but for fewer positions as the workforce requirement will be much lower in the operations phase.

The Project's potential impacts on Indigenous Peoples/Adivasi Janajati and vulnerable groups during the operations phase is assessed to be medium in magnitude, local in extent, and medium term in duration with an overall pre-mitigation significance of Minor.

7.4.2.8 Impacts for Gender and Social Inclusion Aspects

Project activities may result in disproportionate impacts on women and socially disadvantaged groups. These impacts are likely to result from the existing socio-cultural status of these groups, specifically in terms of existing disparities in land and asset ownership, historical discrimination, literacy rates, livelihood profiles, access to and dependence on natural and other resources. These disparities make for impacts from the Project to be unequally borne by women and the socially disadvantaged groups, including those self-identifying as the third gender.

Construction Phase

Impacts/Risks from Physical/Economic Displacement

While the overall impacts of physical and economic displacement from land acquisition and use restrictions have been discussed in Section 7.4.2.1, the land acquisition process could put some women at a greater disadvantage or increase their risk of landlessness and poverty (due to loss of wages or livelihood opportunities), especially for female-headed households.

There are few women landowners. Those women who do own land tend to have smaller land holdings, as noted in the baseline (Section 5.3).

Lower literacy levels and little to no diversity in livelihood options, as most women in rural areas depend on agriculture, could create greater risks of impoverishment for those experiencing a loss of livelihood and/or delays in provision in compensation and entitlements for land and asset losses. For the majority of women landowners, land-based livelihoods are their only source of income without alternate options.

In some areas such as the rural municipalities, especially in the hilly region, due to greater dependence on agricultural and forest-based activities the impacts on livelihoods from the land acquisition are likely to have a higher magnitude. This may add to their existing vulnerabilities if not mitigated adequately through compensation and other allowances and livelihood restoration support.

Evan where the land ownership is in the name of the male Head of Household or a male family member, women members of the household are also dependent upon the land for their livelihoods and sustenance. Compensation for land is paid to the owner and not other family members who may also cultivate and depend on the affected agricultural land. Some women may be put at risk if the compensation amount and entitlements as part of the resettlement and rehabilitation process are appropriated only by the male members of the households, who may independently decide how to use the money. The risk of abandonment may also increase for some women.

Compensation payments will result in relatively large sums of money becoming available. Women receiving cash (from compensation payments) may also put them at risk for gender based violence, if mitigation measures are not put in place. Where financial literacy is low, this access to cash may result in an increase in impulsive spending, substance abuse, gambling and prostitution. In turn, these may increase the risk of gender based violence within the community (discussed further below).

Limited decision-making powers among women may also result in lower access to the community level entitlements identified for mitigation of loss of CF area.

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Risk of Increased Gender Based Violence

In addition to the general occupational and community health and safety concerns, women workers and women living in settlements near Project sites (and those person who self-identify as belonging to the third gender), may be at greater risk of physical or sexual harassment (when compared to males) and have a higher risk of being potential victims of trafficking.

An increase in the interaction between non-local workers and the local community, especially young girls and women, may increase their risk of sexual harassment or even being trafficked. This risk is assessed as higher in cases where the workers are not accompanied by their families and during community festivals such as Mahashivratri.

Gender-based violence risks may also increase following receipt of compensation payments. Cash inflows from compensation payments, when combined with alcohol and substance abuse and/or unequal decision-making and control over how payments are spent, may also lead to the increase in gender based violence. Other contributors to this risk are delayed payments, severe and unmitigated livelihoods related impacts, and/or other increased financial or social stresses..

Risk of Discrimination in Project Employment, Wages

Women are presently limited to agricultural and allied activities for their livelihoods. Therefore, local women are less likely to actively access employment opportunities for Project work. Women from Magar community, landless households, and households with only (baari) unirrigated land, WHHs, etc. may be exceptions to this normative pattern and may be more keen and available to join the Project workforce. Frequently, local contractors will prefer male workers from the local communities, due to perceived notions of differential abilities to undertake work. Nepal also has a general acceptance of gender based differential wage rates for jobs. These aspects are likely to result in discriminatory practices by the Project in terms of hiring of women (with the required skill set) and differences in wages paid for same quantity and nature of jobs, further disadvantaging women.

The Project's potential impacts on women during the construction phase is assessed to be high in magnitude, local in extent, and medium term in duration with an overall pre-mitigation significance of Moderate.

Operations Phase

Risk of Discrimination in Project Employment, Wages

The impacts/risks are as discussed in the construction phase of the Project, but for fewer positions as the workforce requirement will be much lower in the operations phase.

The Project's potential impacts on women during the operations phase is assessed to be medium in magnitude, local in extent, and medium term in duration with an overall pre-mitigation significance of Minor.

7.4.3 Project-wide Adverse Cultural Impacts

The purpose of the cultural heritage impact assessment is to evaluate the significance of potential Project impacts to cultural heritage resources, tangible and intangible (to the extent possible) in the Project Impact Area, and more specifically, in the Project Area.

A few cultural heritage resources including temples and shrines were identified within the Project Impact Area during the cultural heritage baseline study. Prior to the finalization of the alignment, the team conducted additional meetings in each ETP municipality along with a detailed review of the alignment to ensure that all known cultural heritage sites including cultural buildings and relics, temples, shrines, religious sites, sacred groves/sites, locations where ceremonies are held, cultural resources with archeological, paleontological, mythological, historical, cultural, artistic and religious values, graves and cremation sites, community meeting places including common property resources, unique natural features such as rocks, lakes, waterfalls, are avoided.

All known tangible cultural sites are therefore avoided and therefore no impacts on any known cultural resources with the ETP alignment. However, some impacts on intangible cultural heritage may occur during Project construction and operation phases for areas where these cultural resources (tangible or intangible) are not known yet.

Construction Phase

The Project adopted avoidance criteria to ensure that all adverse impacts on tangible cultural resources are avoided to the extent possible. As a result, all known cultural heritage resources are avoided by the Project. However, there is a potential for Project activities to adversely affect undiscovered cultural heritage resources.

Adverse impacts are likely to be indirect during the construction phase including increased noise levels in close proximity of cultural sites, disturbance during festivals, cultural gatherings, and traditional ceremonies.

Influx of non-local workers may potentially have impacts on existing cultural and traditional norms of the community, distinct cultural and religious practices, language and respect to local culture and traditions, traditional knowledge and lifestyle, rituals and cultural practices. However, the nature of a linear Project is such that workers will not be concentrated in one area for an extended period of time, thus minimizing potential impacts to such cultural attributes.

Impacts to cultural resources that are not yet known may occur during the construction phase of the Project, from 'Chance Finds', during clearing or excavation work. Adverse impacts from the loss of such resources, uncovered by chance, are avoided by suitable mitigation measures.

The Project's potential impacts on tangible cultural heritage during the construction phase is assessed to be low in magnitude, site-specific in extent, and short term in duration with an overall pre-mitigation significance of Negligible.

The Project's potential impacts on intangible cultural heritage during the construction phase is assessed to be medium in magnitude, local in extent, and short term in duration with an overall pre-mitigation significance of Minor.

Operations Phase

Adverse impacts to cultural resources are likely to result from changes to the setting of cultural heritage resources such as changes to the views to and from a resource. However, proximity and visibility of the transmission line from any cultural heritage resource was not identified as a concern during community consultations.

However, temporary changes to the setting of the cultural heritage resources such as change to the views to and from a resource (viewshed impacts) are considered residual impacts of the Project, as no mitigation is available for this impact.

The Project's potential impacts on cultural resources during the operations phase is assessed to be low in magnitude, local in extent, and short term in duration with an overall pre-mitigation significance of Negligible.

7.4.4 Segment-Specific Adverse Socioeconomic Impacts

This section provides segment specific impacts for the Project, with a focus on construction phase impacts of the Project as the operations phase impacts have been discussed at the Project level, in the earlier sections (Section 7.4.1 to 7.4.3).

A summary table of segment-specific impacts is followed by details of only those impacts that are relevant to the particular TL segment.

No significance rating has been provided at a segment-level, as the highest significance rating for each impact has been taken into consideration for the whole Project., These impacts, discussed in Section 7.4.1 to 7.4.3, earlier, are summarized in a table in Section 7.4.5, separately for the construction phase and the operation phase.

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7.4.4.1 India Border to New Butwal Substation Segment

Table 7.4-7: Summary of Project Impacts Applicability to India Border to New Butwal Substation Segment

Aspect	Impact	Phase	Applicability to India Border to New Butwal Substation Segment
Land ownership, and land use/land cover	Permanent change in ownership, and use resulting in physical displacement	C	8 structures/buildings are noted within the RoW based on aerial imagery, which may be residential and therefore, result in physical displacement of 8 households.
Land ownership, and land use/land cover	Permanent change in ownership, and use resulting in economic displacement	C&O	Of the 92.6 ha within the RoW, about 84% is private land where use will be restricted for the duration of the Project. 5.0 ha will be permanently acquired for tower pads resulting in economic displacement and income and livelihoods impacts. Used land (other than private land) may also be permanently acquired resulting in economic displacement.
Land ownership, and land use/land cover	Temporary change in ownership, LULC	C&O	About 10.8 ha of land may be temporarily occupied for construction activities resulting in temporary economic and livelihoods impacts to owners and users of privately owned and used.
Community health safety and security	Risk of TIP and employment of under-age children	C&O	Nawalparasi (West), is identified as a high risk area for TIP especially for women of the Madhesi community. This risk may increase due to influx of external workers during the construction phase.
Community resources	Permanent acquisition of land for tower pads within CF and LHF	C	About 0.2 ha will be required for permanent land acquisition within CFs as 2 towers are located within CFs in this segment. No LHFs are crossed by the TL RoW in this segment.
Community resources	Forest clearing within RoW in CF	C	About 1 ha is likely to be permanently cleared of trees, within the RoW in 2 CFs, resulting in some livelihoods and economic dependence impacts to user-households in this segment, as discussed below.
Community resources	Effects on natural resources: forests, NTFP, etc.	C	Temporary land access requirements for construction activities is likely to result in some temporary disruption as this segment has 2 tower pads located in CFs
Community infrastructure	Stress on physical infrastructure (roads and bridges)	C	Impacts are likely to be lower due to relatively better quality road infrastructure in this (Terai) segment, and are consistent with Project-wide impact discussion in Section 7.4.2 above.

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Aspect	Impact	Phase	Applicability to India Border to New Butwal Substation Segment
Indigenous Peoples (Adivasi Janajati)	Impacts on access and resources use in CF and LHF	C	Impacts are consistent with Project-wide impact discussion in Section 7.4.2 above, for CFs. No LHFs are crossed by the TL RoW in this segment.

C = Construction Phase; EMF = electromagnetic field; ha = hectares; LHF = leasehold forest; LULC =Land Use Land Cover; NTFP = Non-timber Forest Produce; O = Operations Phase; RoW = right of way; TL = transmission line

Impacts/Risks from Physical/Economic Displacement

The TL RoW for this segment is 18.2 kilometers long and is in largely in Nawalparasi West. Permanent land acquisition for tower pads (54 towers) in this segment is likely to affect 5.0 hectares and is likely to largely affect private land (84 percent) that is currently used for agriculture.

Since this segment is entirely located in the Terai, most affected land is agricultural and very little land with forest cover is affected. Since agriculture can continue to be practiced within the RoW, the impact of the permanent land acquisition of 5.0 hectares is unlikely to have any impacts on food security; however, individual owners and users are likely to be affected by the loss of productive land.

Table 7.4-8: Land for Temporary Access

Details of Temporary Access Requirement	Area (ha)
Land for lay down area (including helipads)	0
Land for tower work areas	10.8
Total	10.8

ha = hectare;;

Land for laydown areas is likely to be decided based on mutually agreed rental/lease arrangements and terms on private land. Land for tower work areas will result in temporary economic displacement where located on private or used land. Intermittent temporary access will be required on these areas over the 3.5 year long construction period.

Impact on Community Resources

The TL RoW crosses two CFs, one of which is in the process of being officially designated. No LHFs are crossed by the TL RoW.

Table 7.4-9: Community Forest Area Affected

Description	Value	%	Remarks
Number of CF in IB–NB TL segment	2	-	TL RoW crosses 2 CF, no LHF affected
Total users (households)	296	-	

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Description	Value	%	Remarks
Total area of CF (ha)	18.		
Project Effects			
Area under TL RoW (ha)	2.4	13%	Proportion of total CF area in RoW
Forest clearing requirement (ha)	1.1	6%	Forest are to be permanently cleared
Number of towers with CF	2		
Permanent land acquisition (ha)	0.2		Area required for tower pads

CF = community forest; ha = hectare; RoW = right of way; TL = transmission line

The impacted CFs are in Palhinandan Gaonpalika, with 200 user households and in Ramgram, with 96 user households. All 296 user households are Madhesi. The impacts are likely to be moderate as only about 6 percent of the total forest will need to be cleared.

Risk of TIP

Nawalparasi West and East are identified as a high risk area for TIP, as noted in the baseline. There is an increased risk of TIP, especially for women of the Madhesi community, primarily sex trafficking of women and children, which may increase due to the influx of external workers, for Project construction activities.

Impact on Indigenous People

Of the total population in Nawalparasi district (307,919 individuals) 48 percent are Adivasi Janjati (CBS 2011), and the key marginalized group is Tharu. No CF areas used by Tharu are likely to be affected.

7.4.4.2 New Butwal to New Damauli Substation Segment

Table 7.4-10: Summary of Project Impacts Applicability to New Butwal to New Damauli Substation Segment

Aspect	Impact	Phase	Applicability to New Butwal to New Damauli Substation Segment
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in physical displacement	C	32 structures/buildings are noted within the RoW based on aerial imagery, 18 of which are likely to be residential and therefore, result in physical displacement of 18 households.
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in economic displacement	C&O	Of about 418.2 ha within the RoW, about 40% is likely to be private land where use will be restricted for the duration of the Project, though most of the private land is agricultural and activities can continue. 23.4 ha will be permanently acquired for tower pads resulting in some economic displacement and income and livelihoods impacts. Used land (other than private land) may also be permanently acquired resulting in economic displacement.

Aspect	Impact	Phase	Applicability to New Butwal to New Damauli Substation Segment
Land ownership, and land use/land cover	Temporary change in ownership, LULC	C&O	51.6 ha of land may be temporarily occupied for construction activities resulting in temporary economic and livelihoods impacts to owners and users of private or used land.
Community health safety and security	Risk of TIP and employment of under-age children	C&O	Nawalparasi East and West and Palpa have a high risk of TIP. This risk may increase due to influx of workers.
Community resources	Permanent acquisition of land for tower pads within CF and LHF	C&O	Less than 7 ha of permanent land acquisition within CFs and LHFs is envisaged as 73 towers are located within CFs and LHFs in this segment. 2 LHFs are crossed by the TL RoW in this segment and 2 towers are located within these areas, requiring approximately 0.2 ha of land.
Community resources	Forest clearing within RoW in CF and LHF	C	Approximately 53.0 ha is likely to be permanently cleared of trees, within the RoW in CFs and LHFs, resulting in some livelihoods and economic dependence impacts to user-households in this segment, as discussed below.
Community resources	Effects on natural resources: forests, NTFP, etc.	C&O	Temporary land access requirements for construction activities is likely to result in temporary disruption as this segment has 73 tower pads located in CFs and LHFs.
Indigenous Peoples (Adivasi Janajati)	Physical/economic displacement related impacts on Adivasi Janajati groups	C&O	19 Magar community households are likely to be affected by permanent loss of forest resources in 2 LHFs in Nisdi rural municipality

C = Construction Phase; EMF = electromagnetic field; ha = hectares; LHF = lease hold forest; LULC =Land Use Land Cover; NTFP = Non-timber Forest Produce; O = Operations Phase; RoW = right of way; TL = transmission line

Impacts/Risks from Physical/Economic Displacement

Permanent acquisition of 23.4 hectares of land for tower pads (246 towers) will be required, within the 89.5-kilometer TL RoW which crosses three districts (Nawalparasi, Palpa, and Tanahu) in this segment. Of the 23.4 ha, a greater proportion is private land (60 percent) that is mostly under agricultural land use. The remaining land will be public land (40 percent) including forest land.

The segment is located across the Terai and hilly regions. About 38 percent of the land within the TL RoW is agricultural, and therefore unlikely to adversely affect food security as, agricultural activities are permitted under the RoW. However, owners and users may be impacted by loss of productive land under tower pads.

Some 32 buildings and structures have been identified within the RoW in this segment based on aerial imagery, of which 18 may be residential and will be required to be removed, causing 18 households to be physically displaced.

Table 7.4-11: Land for Temporary Access

Component	Area (ha)
Land for lay down area (including helipads)	2.4
Land for tower work areas	49.2
Total	51.6

ha = hectares ;

Impact on Community Resources

On an average, less than 2 percent of the forest is likely to be cleared within most affected CFs in this segment (31) indicating that there will be lower economic impacts on users. However, about 12 percent of the area within 2 LHFs is likely to be cleared, which is likely to have adverse economic impacts on its 19 user households, all of whom are from the Magar Janajati (Indigenous People/Adivasi Janajati).

Table 7.4-12: CF and LHF Area Affected

Description	CF	%	LHF	%	Total	%
Number of forests in TL segment (CF/LHF)	31		2		33	
Total users (households)	8446		19		8,465	
Total area of CF/LHF (ha)	4,286	100%	20	100%	4,306	100%
Project Effects						
Area under TL RoW (ha)	116.5	2.7%	2.3	11.6%	118.8	2.8%
Forest clearing requirement (ha)	50.8	1.2%	2.2	10.8%	53	1.2%
Number of towers within CF/LHF	71		2		73	
Permanent land acquisition (ha)	6.4	0.2%	0.2	0.9%	6.6	0.2%

CF = community forest; ha = hectares; LHF = lease hold forest; RoW = right of way; TL transmission line

Risk of TIP

The districts of Nawalparasi and Palpa reportedly have a high risk of TIP. While Nawalparasi primarily reported sex trafficking of women and children, Palpa also reported instances of labor trafficking among men and children.

Impact on Indigenous People

In the districts along this segment, 54 percent of the population is Indigenous People, of which majority are Magar. Of the Indigenous People groups reported along the segment, Tamang and Tharu are classified as the marginalized Indigenous People groups by NEFIN. Magar are classified as disadvantaged groups.

Nineteen Magar community households are likely to be affected by permanent loss of forest resources in two LHFs.

7.4.4.3 New Damauli to Ratmate Substation Segment

Table 7.4-13: Summary of Project Impacts Applicability to New Damauli to Ratmate Substation Segment

Aspect	Impact	Phase	Applicability to New Damauli to Ratmate Substation Segment
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in physical displacement	C	29 structures/buildings are noted within the RoW based on aerial imagery, 20 of which are likely to be residential and result in physical displacement of 20 households. **Ratmate Substation:** 107 structures/buildings are noted within the boundary of land to be procured for Ratmate Substation. Of these 37 have been found to be residential and are likely to result in the physical displacement of 37 households, based on the RAP survey.
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in economic displacement	C&O	Of 430.3 ha of land within the RoW, more than 45% is private land and used for agriculture where use will be restricted for the duration of the Project. About 23.0 ha will be permanently acquired for tower pads for 248 towers resulting in economic displacement and income and livelihoods impacts. Used land (other than private land) may also be permanently acquired resulting in economic displacement. **Ratmate Substation:** 19.8 hectares has been identified for the Ratmate Substation; of which more than 90% is private land. . Economic displacement of owners and users of private and used land. Owners, employees, temporary workers at the Brick works unit affected in the substation area; owners and workers at other commercial units (shops, poultry units) affected.
Land ownership, and land use/land cover	Temporary change in ownership, LULC	C&O	52.9 ha of land may be temporarily occupied for construction activities resulting in temporary economic and livelihoods impacts to owners and users of privately owned and used land.
Community health safety and security	Risk of TIPI and employment of under-age children	C&O	Chitwan District is already flagged as an area from/through where sex-trafficking is reported. Influx of external (largely male) workers is likely to increase the risk of sex trafficking of women and children.
Community resources	Permanent acquisition of land for tower pads within CF and LHF		Approximately 5 ha of permanent land acquisition within CFs is envisaged as 56 towers are located within CFs in this segment. No tower pads are located within the 6 LHFs crossed by the TL RoW in this segment.

Aspect	Impact	Phase	Applicability to New Damauli to Ratmate Substation Segment
Community resources	Forest clearing within RoW in CF and LHF		Approximately 34.8 ha is likely to be permanently cleared of trees, within the RoW in CFs, and approximately 0.2 hectare across 6 LHFs, resulting in minor livelihoods and economic dependence impacts to user-households in this segment, as discussed below.
Community resources	Effects on natural resources: forests, NTFP, etc.		Temporary land access requirements for construction activities is likely to result in temporary disruption as this segment has 56 tower pads located in CFs.
Indigenous Peoples (Adivasi Janajati)	Physical/economic displacement related impacts on Adivasi Janajati groups	C	Some Chepang and Magar households will be economically displaced resulting from impacts to CF and LHF.

C = Construction Phase; EMF = electromagnetic field; ha = hectares; LHF = lease hold forest; LULC =Land Use Land Cover; NTFP = Non-timber Forest Produce; O = Operations Phase; RoW = right of way; TL = transmission line

Impacts/Risks from Physical/Economic Displacement

Requirement of land for tower pads in this segment will result in 23.4 hectares being permanently acquired. This will be for 248 towers, over the 89.5-kilometer-long TL segment that will cross four districts: Dhading, Chitwan, Tanahu and Nuwakot. Of the permanently acquired land for tower pads, 84 percent is likely to be private land, largely under agricultural use while the remaining is public land.

Based on aerial imagery, 29 buildings and structures are noted within the RoW of which 20 may be residential and will be required to be removed, causing approximately 20 households to be physically displaced.

In addition to this, 19.8 hectares has been identified for permanent acquisition for the Ratmate Substation; of which 95 percent is private land and only 5 percent is government land. Within this boundary, 107 structures/buildings are likely to be affected by the land procurement for Ratmate Substation. Of these 37 are residential structures and likely to result in physical displacement of 37 households, affecting 193 persons. Economic displacement impacts will be sustained by 101 households losing land and assets, and, in addition to the brickworks (Nuwakot Ita Bhatti) ten other commercial enterprises will be affected [six shops, two poultry sheds and one flour mill].

The Nuwakot Itta Bhatti, registered as a cottage industry under the Industrial Enterprises Act of Government of Nepal (1992), and operates on land that is taken on a 20-year lease from the owners, most of whom live in and around Ratmate. The potential economic displacement impacts are likely to be sustained across several categories- people who lease land to the operations and will stand to lose rental income, seasonal migrant and local labor (estimated to be between 600-700 persons) who are likely to lose wage-labor for the affected season; owners/shareholders of the company who could incur losses for the period for which the operations will be disrupted (as fixed infrastructure will need to be removed from the Project

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area). Owners/shareholders are also likely to be affected due to the loss of investment in the brick-works infrastructure and machinery.

The above estimates are based on the RAP survey that has been done for this site. RAP surveys are yet to start for the transmission line.

Table 7.4-14: Land for Temporary Access

Component	Area (ha)
Land for lay down area (including helipads)	3.3
Land for tower work areas	49.6
Total	52.9

ha = hectares;;

Impact on Community Resources

Six LHFs are crossed by the TL Row in this segment,

Of the 6 LHFs in the TL RoW in this segment, 3 user groups have all Chepang users and 3 have both Magar and Chepang users. In 5 LHFs less than 4 percent of area is likely to be permanently cleared and is unlikely to have a significant impact.

Richok Bhairavi CF in Benighat Rorang rural municipality is likely to be cleared of 20 percent (2.6 ha) of its total area (13 ha) affecting Magar, Newar and Gurung households who are members of the CFUG.

Table 7.4-15: CF and LHF Area Affected in TL Segment

Project Effects	CF	%	LHF	%	Total	%
Number of forests in TL Segment (CF/LHF)	37		6		43	
Total users (households)	4,278		66		4,344	
Total area of CF/LHF (ha)	3,053.7		15.2		3,068.9	
Area under TL RoW (ha)	105	3.4%	2.9	18.9%	107.9	3.5%
Forest clearing requirement (ha)	34.8	1.1%	0.2	1.6%	35.1	1.1%
Number of towers within CF/LHF	56		0		56	
Permanent land acquisition (ha)	5.1	0.2%	0	0%	5.1	0.2%

CF = community forest; ha = hectares; LHF = lease hold forest; RoW = right of way; TL transmission line

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Risk of TIP

Chitwan district is already flagged as an area from/through where sex-trafficking is reported. Influx of external (largely male) workers is likely to increase the risk of sex trafficking of women and children unless risk mitigation measures are in place.

Impact on Indigenous People

Of the total population in the districts along the segment, 52 percent is characterized as Indigenous People groups. The main marginalized Indigenous People groups are Chepang (highly marginalized), Tamang, and Tharu.

7.4.4.4 Ratmate to New Hetauda Substation Segment

Table 7.4-16: Summary of Project Impacts Applicability to Ratmate to New Hetauda Substation Segment

Aspect	Impact	Phase	Applicability to Ratmate to New Hetauda Substation Segment
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in physical displacement	C	92 structures/buildings are noted within the RoW based on aerial imagery, 81 of which may be residential and result in physical displacement of 93 households.
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in economic displacement	C&O	Of 263.5 ha of land within the RoW, about 23% is private land where use will be restricted for the duration of the Project. 14.9 ha will be permanently acquired for tower pads resulting in economic displacement and income and livelihoods impacts. Used land (other than private land) may also be permanently acquired resulting in economic displacement.
Land ownership, and land use/land cover	Temporary change in ownership, LULC	C&O	35.6 ha of land may be temporarily occupied for construction activities resulting in temporary economic and livelihoods impacts to owners and users of privately owned and used land.
Community health safety and security	Risk of TIP and employment of under-age children	C&O	Chitwan and Makwanpur report trafficking (sex trafficking of women and children). This may increase due to the influx of workers.
Community resources	Permanent acquisition of land for tower pads within CF and LHF		Approximately 4 ha of permanent land acquisition within CFs is envisaged as 46 towers are located within CFs in this segment. No LHFs are crossed by the TL RoW in this segment.
Community resources	Forest clearing within RoW in CF and LHF		Approximately 45.8 ha is likely to be permanently cleared of trees, within the RoW in CFs, resulting in some livelihoods and economic dependence impacts to user-households in this segment, as discussed below.

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Aspect	Impact	Phase	Applicability to Ratmate to New Hetauda Substation Segment
Community resources	Effects on natural resources: forests, NTFP, etc.		Temporary land access requirements for construction activities is likely to result in temporary disruption as this segment has 46 tower pads located in CFs.

C = Construction Phase; EMF = electromagnetic field; ha = hectares; LHF = lease hold forest; LULC =Land Use Land Cover; NTFP = Non-timber Forest Produce; O = Operations Phase; RoW = right of way; TL = transmission line

Impacts/Risks from Physical/Economic Displacement

The segment is 57.5 kilometers long and has 138 transmission line towers. About 14.9 hectares will be permanently acquired for tower pads within the TL RoW. Of this, 64 percent is likely to be private land, resulting in economic displacement of owners and users.

Some 92 buildings/structures have been noted within the RoW of which 81 may be residential and will be required to be removed, causing approximately 93 households to be physically displaced. Physical displacement impacts may be clustered near the Hetauda substation area, under the TL RoW, as this area is more densely populated.

The segment is located in the hilly areas in Dhading and Makwanpur districts. As the land owners will be able to continue agricultural activities under the RoW, the Project is unlikely to result in a risk of food scarcity at the regional level. Some individual marginal land owners or users are likely to sustain economic displacement impacts.

Table 7.4-17: Land for Temporary Access

Component	Area (ha)
Land for lay down area (including helipads)	4.1
Land for tower work areas	27.6
Total	31.7

ha = hectares;

Impact on Community Resources

The TL RoW is likely to require permanent forest clearing on approximately 45.8 hectares in this segment, affecting 12 CFs and no LHFs. Simpanikalika CF in Galchi RM, with an area of approximately 41 hectares and 304 user households, is likely to have approximately 6 percent of its area requiring permanent clearing. The CFUG comprises 40 percent Dalit, 22 percent Magar and the remaining households are Chhetri and a few Newar. Members of this group are likely to sustain some economic impacts from the loss of resources base in the CF.

In all other CFs, an average of less than 2 percent of the forest area is likely to be cleared.

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Table 7.4-18: CF Area Affected

Description	Value	%	Remarks
Number of CF in TL Segment	12		TL RoW crosses 12 CF, no LHF affected
Total users (households)	4,032		Total number of user households across 12 CF
Total area of CF (ha)	2,728	100%	
Project Effects			
Area under TL RoW (ha)	87.3	3.2%	Proportion of total CF area in RoW
Forest clearing requirement (ha)	45.8	1.7%	Forest area to be permanently cleared
Number of towers with CF	46		
Permanent land acquisition (ha)	4.2	0.2%	Area required permanently within CF, for tower pads

CF = community forest; ha = hectares; RoW = right of way; TL transmission line

Risk of TIP

Among the districts in the segment, Chitwan and Makwanpur have an existing high prevalence of trafficking (sex trafficking of women and children). This may increase due to the influx of workers in the area as discussed in the Project-wide impacts discussion.

7.4.4.5 Ratmate to Lapsiphedi Substation Segment

Table 7.4-19: Summary of Project Impacts Applicability to Ratmate to Lapsiphedi Substation Segment

Aspect	Impact	Phase	Applicability to Ratmate to Lapsiphedi Substation Segment
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in physical displacement	C	40 structures/buildings are noted within the RoW based on aerial imagery, 11 of which are residential and will result in physical displacement of 11 households.
Land ownership, and land use/land cover	Permanent change in ownership, LULC resulting in economic displacement	C&O	Of 270.7 ha of land within the RoW, about 44% is private or agricultural land where use will be restricted for the duration of the Project. 14.9 ha will be permanently acquired for tower pads resulting in economic displacement and income and livelihoods impacts. Used land (other than private land) may also be permanently acquired resulting in economic displacement.
Land ownership, and land use/land cover	Temporary change in ownership, LULC	C&O	35.6 ha of land is likely to be temporarily occupied for construction activities resulting in temporary economic and livelihoods impacts to owners and users of privately owned and used land.

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Aspect	Impact	Phase	Applicability to Ratmate to Lapsiphedi Substation Segment
Community resources	Permanent acquisition of land for tower pads within CF and LHF	C	Approximately 4 ha of permanent land acquisition within CFs is envisaged as 46 towers are located within CFs in this segment. No LHFs are crossed by the TL RoW in this segment.
Community resources	Forest clearing within RoW in CF and LHF	C	Approximately 26.2 ha is likely to be permanently cleared of trees, within the RoW in CFs, resulting in some livelihoods and economic dependence impacts to user-households in this segment, as discussed below.
Community resources	Effects on natural resources: forests, NTFP, etc.	C	Temporary land access requirements for construction activities is likely to result in temporary disruption as this segment has 46 tower pads located in CFs.
Local economy and employment	Effects on local economy	C	Shankarapur municipality is likely to face impacts on the local economy due to the closure of an existing paragliding operation with 28 permanent employees and about 40 seasonal/temporary workers.
Local economy and employment	Effects on tourism	C	Impacts are consistent with Project-wide impact discussion in Section 7.4.2.4 above. Paragliding operations in Shankarapur are likely to be displaced.
Indigenous Peoples (Adivasi Janajati)	Physical/economic displacement related impacts on Adivasi Janajati groups	C	Impacts are consistent with Project-wide impact discussion in Section 7.4.2.6 above.
Indigenous Peoples (Adivasi Janajati)	Impacts on access and resources use in CF and LHF	C	Impacts are consistent with Project-wide impact discussion in Section 7.4.2 above, for CFs. No LHFs are crossed by the TL RoW in this segment.

C = Construction Phase; EMF = electromagnetic field; ha = hectares; LHF = lease hold forest; LULC =Land Use Land Cover; NTFP = Non-timber Forest Produce; O = Operations Phase; RoW = right of way; TL = transmission line

Impacts/Risks from Physical/Economic Displacement

Requirement of land for tower pads in this segment will result in 14.9 hectares of land being permanently acquired. This impact will be for 161 towers, over the 59.0-kilometer-long TL segment. Of the permanently acquired land for tower pads, 73 percent is likely to be private land under agricultural use while the remaining is public land.

Some 40 buildings/structures were noted within the RoW of which 11 may be residential and will be required to be removed, causing approximately 11 households to be physically displaced.

This segment is located in the hilly regions of Nepal. As the Project will not result in the diversion of land use under the RoW and will allow agricultural activities to continue, there is unlikely to be any significant impact in terms of food security for the region.

Some individual land owners and users on permanently acquired land for tower pads who own marginal land parcels may sustain greater economic impacts.

Table 7.4-20: Land for Temporary Access

Component	Area (ha)
Land for lay down area (including helipads)	3.4
Land for tower work areas	32.2
Total	35.6

ha = hectares

Impact on Community Resources

All affected CFs have users belonging to Indigenous People/Adivasi Janajati groups. Other than three CF, all others also have Dalit user households in the CFUGs. On an average, less than 2 percent of the forest areas will need to be cleared; however, Furkesallo CF in Panchakanya Gaonpalika and Birtako Salsaliaghari CF in Shivapuri Gaonpalika, may have about 6 percent of the forest area cleared for the TL RoW. Together, these CFs have a user household base of approximately 150 which is a mix of Indigenous People/Adivasi Janajati, Dalit, Brahmin, Chhetri social groups.

Table 7.4-21: CF Area Affected

Description	Value	%	Remarks
Number of CF in TL segment	30		TL RoW crosses 30 CF, no LHF affected
Total users (households)	3,565		Total number of user households across 30 CF
Total area of CF (ha)	2,144.6	100%	
Project Effects			
Area under TL RoW (ha)	97.3	4.5%	Proportion of total CF area in RoW
Forest clearing requirement (ha)	26.2	1.2%	Forest area to be permanently cleared
Number of towers with CF	46		
Permanent land acquisition (ha)	4.2	0.2%	Area required permanently within CF, for tower pads

CF = community forest; ha = hectares; RoW = right of way; TL transmission line

Local Economy and Employment

The overall adverse impacts on the local economy have been discussed in the Project-wide impacts. The use restrictions in the RoW will result in the permanent displacement of an existing paragliding operation at Shakarapur. This in turn will result in the economic displacement of the owners, workers and local suppliers associated with the business. Shankarapur Paragliding Pvt. Ltd. has been operational for the last three years and has 28 full time employees and additionally employs about 40 workers on a temporary basis during the tourist season. There are other tourism activities associated with the paragliding operations but not all are dependent on paragliding alone. These are, homestays involving 150 local households, zonal treks and Friday Parties (both of which utilize the local homestays). While the TL will not directly impact these locations, it will cross the flight path of the paragliding routes, resulting in its displacement.

The closure of the paragliding activities, in addition to economic displacement of employees and seasonal workers, is also likely to result in a reduction of revenue generated from tourism in the Shankarapur Municipality.

7.4.5 Impact Assessment Matrix for Socioeconomic and Cultural Impacts

Table 7.4-22 summarizes the impact assessment and provides the significance for the various impacts assessed prior to the implementation of mitigation measures (i.e., pre-mitigation). There are likely to be some variances across the significance categories in keeping with the segments and Project lifecycle phases. Significance ratings are provided for the construction phase, separately from the operations phase.

Table 7.4-22: Pre-Mitigation Significance Rating for Construction and Operation Phases

Impacts	Magnitude (Score)	Extent (Score)	Duration (Score)	Significance (Score)
Construction Phase				
Physical Displacement (due to land acquisition, RoW use restriction, on private land)	High (60)	Local (20)	Long term (20)	Major (100)
Economic Displacement and Livelihood Impacts (due to land acquisition on private land)	High (60)	Local (20)	Long term (20)	Major (100)
Temporary Access Related Impacts	Medium (20)	Local (20)	Medium term (10)	Minor (50)
Risk of TIP and Child Labor	High (60)	Local (20)	Medium term (10)	Moderate (90)
Nuisance Impacts on local communities (associated with Noise, Dust and Traffic)	Medium (20)	Local (20)	Short term (5)	Minor (45)
Risk of Communicable and Vector Borne Diseases	Medium (20)	Local (20)	Short term (5)	Minor (45)
Potential Community Conflict	High (60)	Local (20)	Short term (5)	Moderate (85)
Potential Safety and Security Impacts	Medium (20)	Local (20)	Short term (5)	Minor (45)
Effect on Natural Resources	Medium (20)	Local (20)	Long term (20)	Moderate (60)
Stress on Physical Infrastructure	Medium (20)	Local (20)	Short term (5)	Minor (45)

Impacts	Magnitude (Score)	Extent (Score)	Duration (Score)	Significance (Score)
Stress on Social Infrastructure	Low (10)	Local (20)	Short term (5)	Negligible (35)
Effects on Local economy	Medium (20)	Local (20)	Short term (5)	Minor (45)
Impacts on Indigenous People and Vulnerable Groups	High (60)	Local (20)	Medium term (10)	Moderate (90)
Impacts on women	High (60)	Local (20)	Medium term (10)	Moderate (90)
Impacts on Tangible Cultural Heritage	Low (10)	Site specific (10)	Short term (5)	Negligible (25)
Impacts on Intangible Cultural Heritage	Medium (20)	Local (20)	Long term (20)	Moderate (60)
Operations Phase				
Temporary Access Related Impacts on private land	Low (10)	Local (20)	Short term (5)	Negligible (35)
Potential Safety and Security Risks	Low (10)	Local (20)	Short term (5)	Negligible (35)
Electromagnetic Fields Effects	Low (10)	Site specific (10)	Long term (20)	Negligible (40)
Impact of natural resources—forests and rivers	Low (10)	Local (20)	Short term (5)	Negligible (35)
Pressure on Physical and Social Infrastructure	Low (10)	Local (20)	Short term (5)	Negligible (35)
Impacts on Tourism	Medium (20)	Local (20)	Long term (20)	Moderate (60)
Impacts on Indigenous People and Vulnerable Groups	Medium (20)	Local (20)	Medium term (10)	Minor (50)
Impacts on women	Medium (20)	Local (20)	Medium term (10)	Minor (50)
Impacts on cultural resources	Low (10)	Local (20)	Short term (5)	Negligible (35)

7.5 CUMULATIVE IMPACTS

"Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones" (IFC 2013, page 19). The multiple and successive environmental and social impacts caused by existing activities or conditions, combined with the possible incremental impacts that could result from future proposed and/or planned projects, can potentially generate greater cumulative impacts than would be expected in the case of a single project (IFC 2013). According to the IFC, the assessment and management of cumulative impacts is appropriate when there is concern that a project or activity under consideration could contribute to generating cumulative impacts on one or more valued environmental and social component (VEC) (IFC 2013).

This chapter presents the cumulative impact assessment (CIA) for the ETP conducted to evaluate the potential contribution of the ETP towards the cumulative impacts on the resources identified as VECs. The application of CIAs are encouraged by the Ministry of Forests and Environment (MoFE), through their 2018 Hydropower Environmental Impact Assessment Manual. Following good international industry practice, this CIA follows the IFC's *Good Practice Handbook—Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets* (IFC Handbook) (IFC 2013).

7.5.1 Project Spatial and Temporal Boundaries

Based on a review of other transmission line projects and the Nepal physical, biological, and social context as described in Chapter 5 (Existing Environmental Condition), the CIA spatial boundary was established as areas within 10 kilometers of the ETP, which encompasses the largest area within which the project may have any direct or indirect effects (e.g., wide-ranging mammals) and/or interact with other projects resulting in a cumulative impact. From a temporal perspective, we have included all projects that are under construction, or are planned and disclosed. Other projects are not sufficiently well defined to meaningfully evaluate in the CIA.

7.5.2 Other Projects and External Drivers

Sixteen existing transmission lines (or portions thereof) are located within the limits of the CIA spatial boundary (Table 7.5-1). In addition to the Project, 24 planned transmission lines (or portions thereof) were identified for the purpose of this CIA. These lines are not yet completed, but are in some stage of design, approval, or construction as summarized in Table 7.5-2. The ETP will require construction of three new substations, Ratmate, New Damauli, and New Butwal, along with connections to the existing Lapsiphedi and New Hetauda Substations.

Table 7.5-1: Summary of Existing Transmission Lines

Number	Node 1	Node 2	Voltage (kV)	Length (km)	RoW (meters)
E1	Hetauda	Amlekhgunj	66	20.2	18
E2	Hetauda	Kulekhani I	66	15.1	18
E3	GarjyangGrang S/S	Trishuli HPP	66	18.0	18
E4	Trishuli HPP	Devighat HEP	66	4.7	18
E5	Devighat HEP	New Chabel	66	24.9	18
E6	Trishuli HPP	Balaju	66	16.4	18
E7	Lower Marsyangdi	Upper Marsyangdi	132	28.1	27
E8	Marsyangdi	Siuchatar	132	52.7	27
E9	Hetauda	Kulekhani II	132	8.2	27
E10	Bharatpur	Hetauda	132	70.9	27
E11	Hetauda	Kamane	132	6.5	27
E12	Bharatpur	Marsyangdi	132	25.5	27
E13	Damauli	Lekhnath	132	40.0	27
E14	Damauli	Bharatpur	132	43.6	27
E15	Butwal	Bardghat	132	35.7	27
E16	Lower Marsyangdi	New Marsyangdi	132	7.8	27

Source: Power Engineers 2019

kV = kilovolt; km = kilometer.

Table 7.5-2: Summary of Future Transmission Lines

Number	Node 1	Node 2	Voltage (kV)	Commitment and Status (2017)	Finance (if known)	Length (km)	Typical RoW (meters)
F1	Hetauda	New Hetauda	132	Future (committed)	-	3.1	27
F2	Damauli	Dumre	132	Future (committed, construction started)	ADB	14.7	27
F3	Damauli	New Marsyangdi	132	Future (committed)	-	25.6	27
F4	Marsyangdi	New Marsyangdi	132	Future (committed)	-	6.5	27
F5	Mulpani	Lapsiphedi	132	Future (committed)	ADB /Norway	15.0	27
F6	New Marsyangdi	Trishuli Galchhi	132	Future (committed by IPP)	-	52.2	27
F7	Tap-Third Trishuli Nadi (Marsyangdi)	Third Trishuli Nadi	132	Future (committed by IPP)	-	0.4	27
F8	New Hetauda	New Dalkhebar	400	Future (committed, construction started)	World Bank	108.0	52
F9	New Kolhapur	New Butwal	400	Future (committed)	ADB	221.4	52
F10	Lapsiphedi	Barhabise	400	Future (committed)	ADB/ Norway	44.6	52
F11	New Hetauda	Parwanipur	400	Future (planned but not committed)	-	40.8	52
F12[1]	India Border (New Butwal)	Gorakhpur (PG)	400	Future (planned but not committed)	-	96.8	52
F13	Trishuli 3A	Matatirtha	220	Future (committed, construction started)	China Exim Bank	37.1	35
F14	New Butwal	New Bharatpur	220	Future (committed, construction started)	World Bank	76.3	35
F15	New Damauli	New Bharatpur	220	Future (committed)	GoN	31.1	35
F16	New Marsyangdi	New Bharatpur	220	Future (committed)	EIB	28.0	35

Number	Node 1	Node 2	Voltage (kV)	Commitment and Status (2017)	Finance (if known)	Length (km)	Typical RoW (meters)
F17	New Hetauda	New Bharatpur	220	Future (committed, construction started)	World Bank	70.3	35
F18	Kushma HUB	New Butwal	220	Future (committed)	ADB	87.6	35
F19	New Damauli	Lekhnath	220	Future (committed)	KfW	42.0	35
F20	New Butwal	Bardaghat	220	Future (committed)	ADB/ Norway	Not available	35
F21	Tanahu Seti HEP	New Damauli	220	Future (committed)	ADB/JICA	23.7	35
F22	Marsyangdi	Bad Bhaniyan (Matatirtha)	220	Future (committed, construction started)	ADB/Norway	82.0	35
F23	New Marsyangdi	Super Trishuli Galchhi	220	Future (committed by IPP)	-	18.8	35
F24	Trishuli 3B HIB	Naubise	220	Future (planned but not committed)	-	33.5	35

Source: Power Engineers 2019

kV = kilovolt; km = kilometer; ADB = Asia Development Bank; GoN = Government of Nepal; EIB = European Investment Bank; JICA = Japan International Cooperation Agency; IPP = independent power producer; - = no information known.

[1] this transmission line is located in India. It is included as it is adjacent to ETP and within the CIA spatial boundary.

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7.5.3 VEC Selection and Description

In order to be considered as a VEC, a resource must first be confirmed to be highly valued by affected stakeholder group, the government, and/or the scientific community. Second, the VEC must be reasonably expected to be affected by *both* the project under evaluation (i.e., the ETP), directly or indirectly, and some combination of other projects and/or external drivers. Based on several rounds of consultations with affected stakeholders, NGOs, and government officials, Table 7.5-3 summarizes the VECs included in this CIA.

Table 7.5-3: Selected VEC for Inclusion in CIA

VEC	Valued by Stakeholders or Scientific Community	Potentially Affected by the Project	Potentially Affected by One or More Other Projects	Potentially Affected by One or More External Drivers
Forests	Yes	Yes	Yes	Yes
Bird Species with Special Conservation Status	Yes	Yes	Yes	Yes
Communities Near Substations	Yes	Yes	Yes	Yes

7.5.3.1 VEC Description

This section provides a brief summary of the selected VECs (also see Chapter 5 – Existing Environmental Condition).

Forests

Forests are considered highly valued in Nepal for a variety of physical (e.g., groundwater recharge, soil protection), biological (e.g., wildlife habitat), and social (e.g., religious forests, non-timber forest products (NTFP) upon which many communities are highly dependent) reasons. Forests in the Chure are considered particularly important because it is a designated Conservation Area, the soils there are especially susceptible to erosion, and this is an important groundwater recharge area for the Terai, where intense agricultural use is dependent on groundwater.

Bird Species with Special Conservation Status

Bird species of conservation significance include critically endangered (CR), endangered (EN), and vulnerable (VU) species listed in either the International Union for Conservation of Nature (IUCN) Red-List Version 2018-2 or the Red-List for Nepal's Birds (Inskipp et al. 2016), species protected under the *NPWLC Act* (1973) and those on Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices I or II, restricted range (with an extent of occurrence of < 50,000 square kilometers), and migratory species. Bird species of concern include forest birds (e.g., Great hornbill and Slaty woodpecker), migratory birds using important flyways along the Kali Gandaki and Trishuli rivers (e.g., Steppe eagle), and endangered vultures (e.g., Himalayan, white-rumped, red-headed, slender-billed, cinerous, and Egyptian vultures).

Communities near Substations

The various existing, under construction, and proposed transmission lines identified in Tables 7.5-1 and 7.5-2 intersect in numerous locations and can result in cumulative impacts to a village and a single property owner. Communities located near substations, however, are especially vulnerable because of the many transmission lines that typically connect to a single substation (e.g., the proposed Ratmate Substation is designed to accommodate as many as 13 transmission lines).

7.5.4 Assessment of Cumulative Impacts on VECs

This section summarizes the assessment of cumulative impacts for the VECs, considering potential impacts from the Project, other projects, and external drivers (e.g., climate change).

7.5.4.1 Impacts on Forests

According to Global Forest Watch, impacts to forests in Nepal is a serious issue that has seen a slowing deforestation rate, however total forest loss within the country was 24.5 percent during the fifteen years between 1990 and 2005 (https://www.globalforestwatch.org 2019). This loss was primarily due to anthropogenic factors including: over-harvesting of fuelwood and fodder, forest fires, grazing, slash and burn cultivation, and timber extraction. Some of these impacts have been alleviated through community forest management and protected areas.

Impacts to forested areas by transmission lines are distinct in that they create long linear impacts to forested environments that can induce additional clearing through enabling community access. The construction of the future lines will result in an increase of forest clearing. In terms of the scale of impacts to forests due to the ETP, out of a total length of 314 kilometers, 167.5 kilometers pass through forested areas. The area of forest within the RoW is 777.5 hectares, of which 354.4 hectares will be cleared due to the terrain spanning large areas of forest (resulting in 45.6 percent loss of forest area within the RoW).

As mentioned above, the CCA is considered especially important. The CCA, within the spatial boundary for this CIA, has seven existing transmission lines crossing its area, totaling an estimated 125 kilometers. There are an estimated nine new lines that will be built crossing the PCTMCD, totaling an estimated 329 kilometers. The ETP will cross the PCTMCD in two segments, totaling 32.6 kilometers (see Table 7.5-4). Approximately of 0.8 square kilometers forested land would be cleared for the RoW of ETP and 38 square kilometers would be cleared for future transmission lines. Forested areas within the Chure act as a hydrological regulator and a recharge area for the Terai region. Removal of forested areas will result in a reduction in its groundwater recharge capacity.

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Table 7.5-4: Forest Clearance in the PCTMCD from Project, Existing and Future Transmission Lines

Transmission Line	Total Length (km)	Total Forest Clearance (ha)	Length in PCTMCD (km)	Forest Clearance in PCTMCD (ha)
ETP Transmission Lines	**313.9**	**354.4**	**32.6**	**81.5**
New Butwal to New Damauli Substation	89.5	114.5	18.0	161
Ratmate to New Hetauda Substation	57.5	95.2	18.5	104
Ratmate to Lapsphedi Substation	59.0	50.3	-	-
New Damauli to Ratmate Substation	89.7	80.3	-	-
India Border to New Butwal Substation	18.1	9.0	-	-
Existing Transmission Lines	**379.1**	**931**	**124.5**	**630**
E1: Hetauda–Amlekhgunj	20.2	36	17.5	35
E2: Hetauda–Kulekhani I	15.1	27	10.2	15
E3: Garjyang Grang S/S-Trishuli HPP	18.0	32	-	-
E4: Trishuli HPP-Devighat HEP	4.7	8	-	-
E5: Devighat HEP-New Chabel	24.9	45	-	-
E6: Trishuli HPP-Balaju	16.4	29	-	-
E7: Lower Marsyangdi-Upper Marsyangdi	28.1	76	-	-
E8: Marsyangdi Siuchatar	52.7	142	-	-
E9: Hetauda–Kulekhani II	8.2	22	8.5	7
E10: Bharatpur–Hetauda	70.9	191	78.7	558
E11: Hetauda–Kamane	6.5	17	6.4	4
E12: Bharatpur–Marsyangdi	25.5	69	1.5	4

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Transmission Line	Total Length (km)	Total Forest Clearance (ha)	Length in PCTMCD (km)	Forest Clearance in PCTMCD (ha)
E14: Damauli–Bharatpur	8.6	23	1.7	7
E15: Butwal-Bardghat	43.6	118	-	-
E16: Lower Marsyangdi-New Marsyangdi	35.7	96	-	-
Future Transmission Lines	**1,171**	**4,874**	**329**	**3,746**
F1: Hetauda–New Hetauda	3.1	8	3.1	1
F2: Damauli-Dumre	14.7	40	-	-
F3: Damauli-Marshyangdi	25.6	69	-	-
F4: Marshyangdi-New Marshyangdi	6.5	18	-	-
F5: Mulpani-Lapsiphedi	15.0	41	-	-
F6: New Marshyangdi-Trishuli Galchhi	52.2	141	-	-
F7: Tap-Third Trishuli Nadi (Marshyangdi)-Third Trishuli Nadi	0.4	1	-	-
F8: New Hetauda–New Dalkhebar	108.0	561	64.0	691
F9: New Kolhapur–New Butwal	221.4	1,151	84.0	1,859
F10: Lapsiphedi-Barhabise	44.6	232	-	-
F11: New Hetauda–Parwanipur	40.8	212	17.1	70
F12: India Border (New Butwal)-Gorakhpur (PG)	96.8	503	-	-
F13: Trishuli 3A-Matatirtha	37.1	130	-	-
F14: New Butwal–New Bharatpur	76.3	267	63.8	487
F15: New Damauli–New Bharatpur	31.1	109	7.4	23
F16: New Marsyangdi–New Bharatpur	28.0	98	8.0	22

Transmission Line	Total Length (km)	Total Forest Clearance (ha)	Length in PCTMCD (km)	Forest Clearance in PCTMCD (ha)
F17: New Hetauda–New Bharatpur	70.3	246	70.3	494
F18: Kusma HUB–New Butwal	87.6	307	11.3	99
F19: New Damauli-Lekhnath	42.0	147	-	-
F20: New Butwal-Bardaghat	11.5	40	-	-
F21: Tanahu Seti HEP-New Damauli	23.7	83	-	-
F22: Marshyangdi-Bad Bhaniyan (Matatirtha)	82.0	287	-	-
F23: New Marshyangdi-Super Trishuli Galchhi	18.8	66	-	-
F24: Trishuli 3B HIB-Naubise	33.5	117	-	-
Total	**1,864**	**6,154**	**490**	**4,641**

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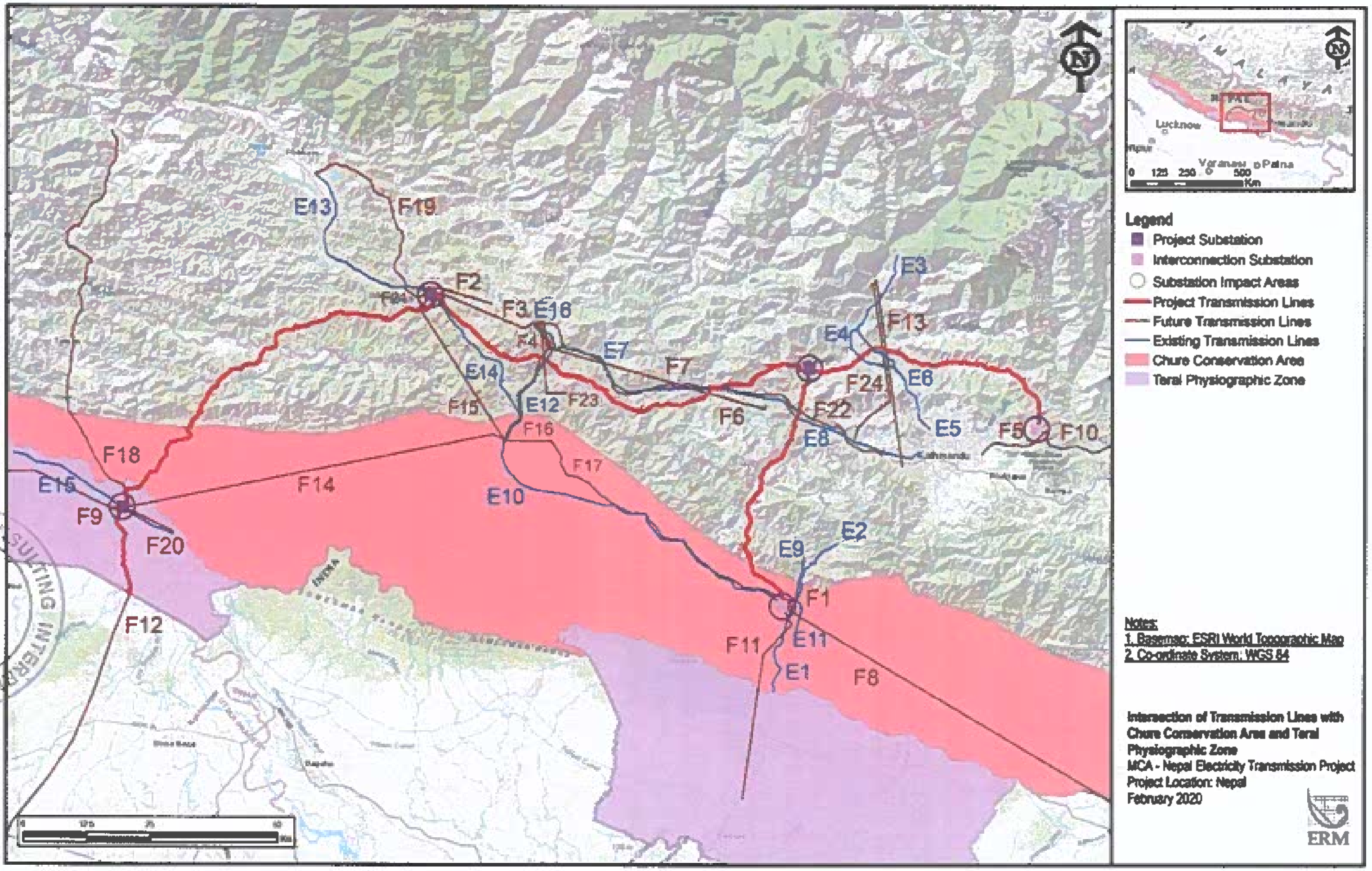

Figure 7.5-1: Intersection of Transmission Lines with Chure Conservation Area and Terai Physiographic Zone

Most rural households in the Project area have some dependence on CF while users of Leasehold Forests (LHF) are almost entirely dependent on these forests for their livelihoods, as noted in the baseline (see Section 5.3). User households, while taking on the responsibility of forest management (in CF and LHF) also have rights to collect firewood, fodder, insulation materials like grasses and leaves, and other NTFP like medicinal herbs and vegetables. Most of these are for household consumption but some may be sold to add to household incomes, especially in the case of LHF user groups. This Project is likely to require 185 hectare of forest clearing within 112 CFs and 8 LHFs, potentially affecting (to a greater or lesser degree) about 20,700 user households (discussed in Section 7.4). The construction of future infrastructure projects, including transmission lines that pass through/near forests, are likely to result in more forest areas being cleared (as summarized in Table 7.5-4), affecting the resource base of dependent communities who manage these forests.

7.5.4.2 Impacts on Bird Species with Special Conservation Status

Transmission lines can have impacts to birds due to the loss of forest and habitats used for breeding and foraging as well as collision/electrocution risk associated with collisions with electricity lines. In Nepal, there are a number of CR and EN listed forest dwelling bird species that are likely to be impacted by vegetation clearance due to loss of habitat. Vegetation clearance could also result in the loss of nesting trees for CR, EN and protected species, such as White-Rumped Vultures, which nest on Bombax ceiba trees in Nepal (Baral et al. 2005) (CR,CR); Red-Headed Vulture (CR,EN), which nest in Pinus roxburghii trees (BCN unpublished data, Bhusal 2014); Great Hornbill which is seriously threatened by deforestation, especially loss of mature fruiting trees as food sources and nest sites (Inskipp et al 2016); and Great Slaty Woodpecker, which inhabits climax Sal and broadleaved forests of the lowlands and is dependent on the presence of mature trees.

These bird species with conservation status can be impacted by transmission lines through electrocution on or collision with energy infrastructure. Collision with wires has been reported to be a threat due to soaring birds diving towards the ground and colliding with strung wires. Electrocution can occur when the gaps between the two conductors is less than the bird's wingspan. Although the ETP has eliminated the risk of electrocution through its tower design, other transmission projects that are not similarly designed do pose this risk.

The construction of the future transmission lines will increase risks of injury or death for these birds. In terms of the scale of the potential impact from the ETP, this is difficult to quantify without ongoing monitoring.

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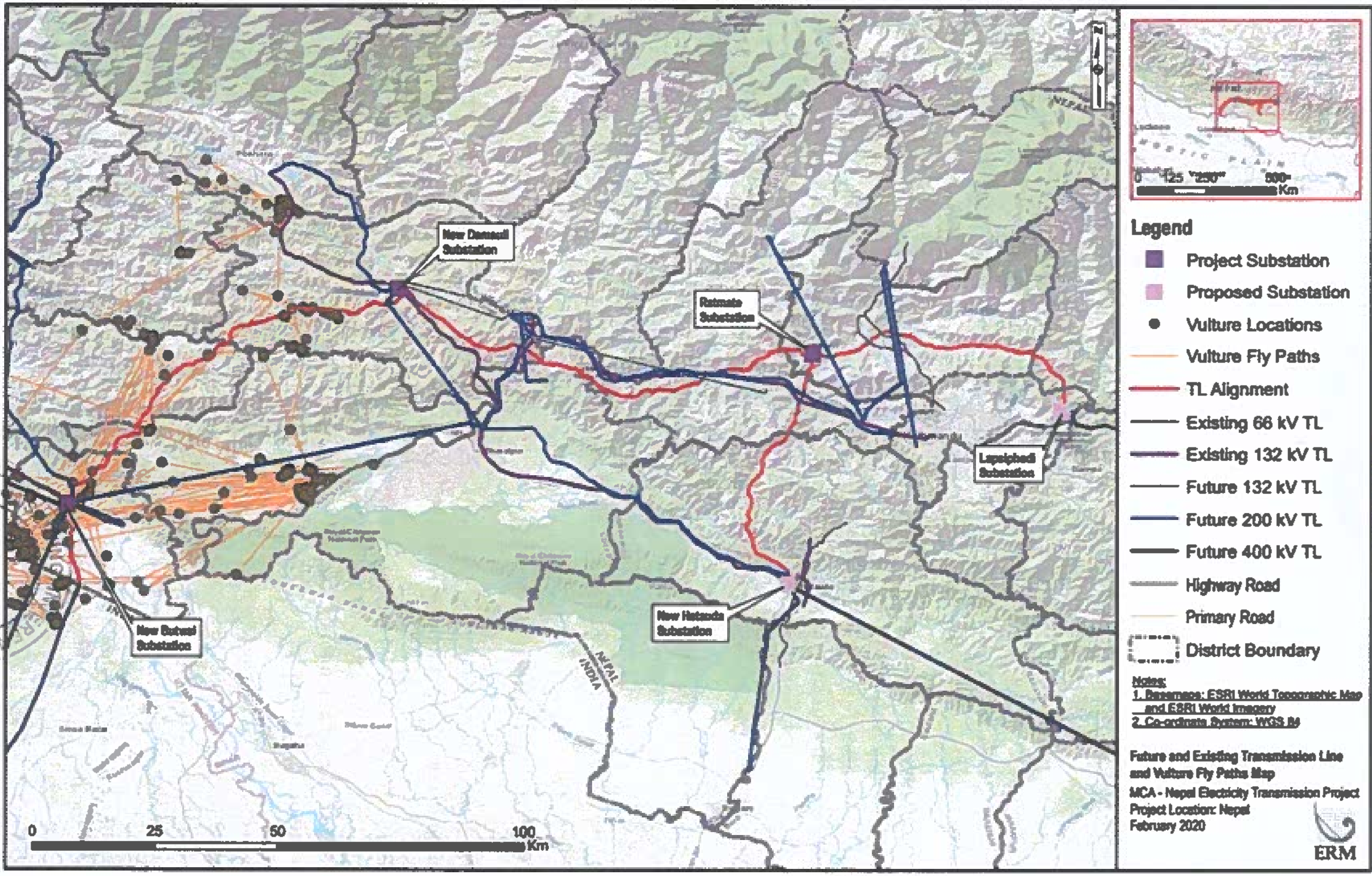

Figure 7.5-2: Project, Future and Existing Transmission Lines, and Vulture Fly Paths

7.5.4.3 Impacts on Communities near Substations

Effects on communities near substations will result from the substation construction itself, as well as the multiple transmission lines connecting to each of these substations. These communities are subject to physical and economic displacement for each transmission line. The magnitude of these impacts can result in disruption of community social structure as communities are fragmented by transmission lines and their neighbors may be physically displaced. Further, as these various transmission lines may be built over the next 10 years or more, these communities are subjected to nearly continuous construction activity and the associated noise, fugitive dust, traffic, increased risk for trafficking in people, labor influx, intrusion of foreign workers, and exposure to communicable and vector borne diseases. Further, these substations have permanent staff and need to have access to good roads, so tend to be located in higher population density areas.

Cumulatively, such impacts have the potential of fundamentally altering community structure, over time. This may result in a change in the population composition, rapid (even unplanned) urbanization, increased stress on infrastructure and resources, largescale change in land use (from lower intensity uses like agriculture to increased commerce, or in cases, land alienation in cases where agriculture becomes unfeasible to sustain as an activity/occupation).

7.5.5 Cumulative Impact Management Framework

Cumulative impacts by definition are as a result of the actions of multiple project sponsors and natural stressors, so management of cumulative impacts typically requires actions by multiple parties. We identify below the measures MCA-Nepal will be taking to mitigate its contribution to these cumulative impacts, and suggest actions that others could take to help manage these impacts.

7.5.5.1 MCA-Nepal Mitigation Actions

MCA-Nepal has already adopted several mitigation measures that mitigate the ETP's contribution to cumulative impacts, including:

- Forests – minimize forest clearing by careful routing of the transmission lines, prohibiting the construction of new tower access roads, using high towers to span over trees, potentially using helicopters and drones to string conductors, and providing afforestation at a ratio of 10 saplings for each tree cleared.
- Birds with Special Conservation Status – eliminate the risk of bird electrocution by ensuring the conductors are separated by more than the wingspan of the largest bird in Nepal (Himalayan Griffon) and reduce the risk of collision by placing marker balls and bird diverters on the shield wires to visually alert birds.
- Communities near Substations – adopt and implement a Resettlement Action Plan and a Resettlement Policy Framework, which includes provisions for compensating those who have occupied land or buildings, are non-registered tenants, or who have other informal arrangements for use of buildings or land. This includes payment of compensation for the

loss of land and assets at replacement cost, and provide other allowances to cover the transition period and temporary livelihoods restoration support for the more vulnerable persons or groups.

7.5.5.2 Suggested Mitigation Actions by Others

The effectiveness of MCA-Nepal's efforts to mitigate its cumulative impacts depends on other project developers taking similar actions. Some actions that the Department of Electricity Development may consider taking include:

- Cumulative Impacts on Forest
  - Adopt and implement transmission line routing guidelines for transmission line project developer to promote forest conservation and minimize forest clearing.
  - Promote conservation initiatives of forested areas, including existing national protected and conservation areas.
  - Provide funding support to affected Community Forest User Groups.
  - Target afforestation within the project area.
- Cumulative Impacts on Birds of Special Conservation Status
  - Use the ETP as a case study to develop a bird protection protocol for other projects to adopt including the use of visual markers to minimize collision risks and taking measures to avoid or minimize electrocution risk.
  - Provide support to Bird Conservation Nepal's Vulture Conservation Program.
- Cumulative Impacts on Communities near Substation
  - Adopt and implement substation siting guidelines that promotes taking into consideration the potential impacts on nearby communities not just from the substation land acquisition and construction itself, but also considering the impacts of future transmission lines.
  - Include provisions for additional resettlement support for households that have been previously displaced (physically or economically) by earlier projects.
  - Ensure affected communities and households receive livelihood restoration support.

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CHAPTER EIGHT
ENHANCEMENT AND MITIGATION MEASURES

The MoFE Hydropower EIA Manual (MoFE 2018) indicates that Projects should manage their effects by both enhancing benefits and mitigating impacts (MoFE 2018). This chapter identifies the enhancement (Section 8.1) and mitigation (Section 8.2) measures proposed by MCA-Nepal, as well as the residual significance of Project impacts, taking into consideration the proposed enhancement and mitigation measures. MCA-Nepal will be responsible for ensuring the mitigation measures proposed in this chapter are implemented.

8.1 ENHANCEMENT MEASURES

Enhancement measures involve identifying opportunities to maximize the Project's beneficial impacts. The enhancement measures that MCA-Nepal proposes are described below.

- Improved National Electricity System Reliability: the ETP's fundamental purpose is to improve the reliability and efficiency of the Nepal electricity grid. MCA-Nepal is including measures as part of the Project's design that go beyond the Project's specific needs and requirements, which will further contribute to system reliability and efficiency. These include providing space for future transmission line bays in substations and providing technical assistance to National Electricity Regulatory Commission (NERC) and NEA to improve transmission system efficiency.
- Increased Local Employment Opportunities: MCA-Nepal will include language within the D&B Contractor Bid Documents and ultimate contract encouraging the D&B Contractors and any subcontractors (collectively referred to herein as the "Contractors") to encourage local hiring, as well as hiring of women, Adivasi Janajati, and Dalits, to the extent possible. For monitoring purposes, the Contractors will be required to track their workforce in terms of nationality, gender, and social group (e.g., Adivasi Janajati, Dalit).
- Increased Local Business Opportunities: MCA-Nepal will include language within the Bid Documents and ultimate contract encouraging the Contractors to maximize the purchasing of local goods and services. The Contractors will be encouraged to advertise requirements for goods and services and post advertisements on local message-boards to increase local businesses participation in bidding.
- MCA Partnership program: MCA-Nepal will set aside at least 0.75 percent of the Project cost (NPR 345 million) for improving access, reliability, and productive use of electricity in Project-affected municipalities.

8.2 MITIGATION MEASURES

Proposed mitigation measures for each Physical, Biological, and Social Environment impact identified in Chapter 7 (Environmental Impacts) are described below. These mitigation measures are also included in the Environmental, Social, Health and Safety Management Plan (ESHSMP) for implementation by the Contractors. An overall residual significance rating for each impact, taking into consideration the predicted effectiveness of the proposed mitigation measures, is provided in the tables at the end of each section (i.e., Physical, Biological, and Socioeconomic and Cultural). Each table identifies the residual (post-mitigation) impact significance rating after taking into account how the proposed mitigation measures may modify the magnitude, extent, and duration of the impacts identified in Chapter 7. Impacts assigned a Negligible Pre-mitigation significance rating in Chapter 7 may not be listed below because no mitigation measures may be warranted or appropriate.

MCA-Nepal will require the Project's Contractors, via the terms of their contract, to implement good international industry practices and mitigation measures, which should be adequate to properly manage construction-phase impacts. MCA-Nepal and the future facility operator (a Government of Nepal entity) will comply with the requirements of the construction and operation phase ESHSMPs.

8.2.1 Physical Environment

This section identifies the proposed mitigation measures for each Physical Environment impact identified in Section 7.2. An overall residual significance rating for each impact, taking into consideration the predicted effectiveness of the proposed mitigation measures, is provided in Table 8.2-1 at the end of this section.

8.2.1.1 Topography, Geology and Soil

Potential mitigation measures for impacts to topography, geology, and soils from erosion are described below.

Construction Phase—Erosion and Landslides

- Undertake erosion and sediment control measures as required in the ESHSMP—the Contractors will be required to implement these during construction to reduce erosion and minimize impacts to streams and other waterbodies (see Chapter 9—ESHSMP).
- Limit clearing within the RoW—only clear those trees approved by the Government of Nepal (GoN) as necessary to construct the line and trees that pose safety risks to the operation of the transmission line. The tree stump and root system, smaller understory trees, shrubs, and the herbaceous layer will be left intact to protect and stabilize the soil from erosion.
- Restrict construction of new tower access roads—MCA-Nepal does not propose to construct any new tower access roads and will use existing trails or establish new narrow trails, which will not require any tree clearing, to minimize soil disturbance and forest clearing.
- Limit use of mechanized construction equipment—excavation of tower foundations will primarily be conducted via hand labor to minimize disturbance of the surrounding ground.

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- Prior to any major excavation, remove and stockpile top soil in a designated stable area for future use in land restoration or provided to local farmers.
- In equipment storage areas (e.g., where tower steel is stored), lime the soil to prevent any effects on soil buffering capacity from potential metal contamination.
- Manage excavated soils—the soils excavated for tower foundation construction will be stockpiled during construction and then backfilled around the foundation, carefully graded and stabilized, using bio-engineering techniques (e.g., use of plant materials to naturally stabilize steep or eroding slopes). Management will be in such a way that it does not result in the discharge or erode into the natural environment that causes or may cause an adverse effect. Bioengineering techniques would be emphasized in landslide prone areas.
- Provide storm drainage—surface drainage will be provided to direct surface water away from the tower foundation, avoiding steep slopes or other erodible areas, to natural drainage ways.
- Prohibit side casting and discharge to streams—No excavated spoil material shall be thrown down slopes (side cast) or discharged into streams.
- Stabilize disturbed areas as soon as possible—as soon as construction is completed, all disturbed areas will be stabilized and restored, either for agricultural reuse, or planted with fast growing native vegetation (see ESHSMP for species list), and properly maintained in order to establish a vegetative cover.
- Provide robust monitoring—the Contractors will be required to carefully monitor their work areas to manage erosion and sedimentation. Further, MCA-Nepal will provide independent environmental monitoring through their Project Engineer, who will conduct construction inspections and require the Contractors to correct any areas of substantive erosion or sedimentation. MCA-Nepal will conduct a post-construction completion audit (see Chapter 11) to confirm that all disturbed areas have been properly stabilized before making the final disbursement to the Contractors.
- Implement the Community Grievance Redress Mechanism (GRM)—the existing Community GRM will enable local landowners or other concerned stakeholders to inform MCA-Nepal and the Contractors of any erosion and sedimentation issues.

Operation Phase—Erosion and Landslides

During the operation phase there will be no new ground-disturbing activities that would result in erosion and sedimentation. Maintenance activities will include:

- Inspect the tower sites and transmission line RoW at least twice a year (once before and once after the monsoon season) for any evidence of erosion or landslides and to take appropriate corrective action necessary to stabilize eroding areas.
- Avoid any ground-disturbing maintenance activities.

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Table 8.2-1 summarizes locations of towers near landslide-prone areas, their impacts, and mitigation measures.

Table 8.2-1 Towers near Landslide prone areas, impacts and mitigation measures

TL Segment	Tower Numbers	Landscape Position of Landslide	Mitigation Measures
India Border to New Butwal	none		• Undertake erosion and sediment control measures as required • Limit clearing within the RoW • Restrict construction of new tower access roads • Limit use of mechanized construction equipment • Prior to any major excavation, remove and stockpile top soil • Manage excavated soils • Provide storm drainage • Prohibit side casting and discharge to streams • Stabilize disturbed areas as soon as possible • Provide robust monitoring • Inspect the tower sites and transmission line RoW at least twice a year • Avoid any ground-disturbing maintenance activities
New Butwal to New Damauli	Towers 41 – 45 Towers 130 – 133 Towers 234 - 235	Within the RoW Upslope/Within RoW Downslope of RoW	
New Damauli to Ratmate	Towers 60- 62 Towers 67 – 68 Towers 77 – 86 Towers 91 – 92 Towers 100 – 102 Towers 115 - 116	Upslope of RoW Upslope of RoW Downslope of RoW Downslope of RoW Upslope of RoW Within RoW	
Ratmate to New Hetauda	Towers 20 – 21 Towers 86 – 88 Towers 90 – 91 Towers 130 - 132	Upslope of RoW Within RoW Downslope of RoW Downslope of RoW	
Ratmate to Lapsiphedi	Towers 37 – 39 Towers 105 – 106 Towers 112 - 113	Upslope of RoW Upslope of RoW Upslope/Within RoW	

8.2.1.2 Land Use and Land Cover

Construction and Operation Phases

Proposed mitigation measures for construction and operation phase changes in land use/land cover are primarily related to impacts to forest and agricultural land.

8.2.1.3 Climate Change

Combined Construction and Operation Phases

- Properly maintain vehicles to ensure that emissions are minimized.

- Transport and install the gas insulated switchgear according to strict management protocols, to avoid any leakages of sulphur hexafluoride, which is a potent greenhouse gas.

- Provide manufacturer-specified maintenance and monitoring for any leakage of Sulphur hexafluoride.

8.2.1.4 Air Quality

Construction Phase
Fugitive Dust Emissions

- Limit clearing within the RoW—only clear those trees approved by the GoN as necessary to construct the line and trees that pose safety risks to the operation of the transmission line. The tree stump and root system, smaller understory trees, shrubs, and the herbaceous layer will be left intact to minimize the generation of fugitive dust.

- Stabilize disturbed areas as soon as possible—as soon as construction is completed, all disturbed areas will be stabilized and restored, either for agricultural reuse, or planted with fast growing vegetation and properly maintained in order to establish a vegetative cover.

- Cover excavated material—stockpiled excavated soil from tower foundation and substation construction will be temporarily covered with leaf litter or cleared vegetation or other appropriate cover such that soil will not be eroded until construction is completed and the site is permanently stabilized.

- Spray disturbed areas if substantive off-site impacts occur and/or in response to grievances—spraying water to moisten the soil is a common dust management practice. In the case of the ETP, however, most tower sites will not be vehicular accessible and water will need to be either carried in or withdrawn from local streams. This limits the applicability of this management practice to extreme cases of fugitive dust along the RoW. Spraying is feasible at the substation sites.

- Prohibit burning and open fires—the Contractors will be prohibited from burning cleared vegetation and solid waste, as well using as wood as cooking fuel in the camps.

- Use existing access trails—use local trails to transport construction equipment and materials to the tower sites as far as possible to minimize soil disturbance and vegetation clearance. No tree clearing will be permitted for new trails required to access tower sites.

- Properly maintain vehicles—the Contractors will be required to properly maintain construction vehicles in accordance with manufacturer's specifications to minimize emissions.

- Limit vehicle speed—vehicles traveling on earthen road will have a speed limit of 20 kilometers per hour to minimize the dust emissions.

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Tower Site Diesel Generator Emissions

- Provide manufacturer-specified maintenance of portable diesel generators.

Substation Construction Emissions

- Provide manufacturer-specified maintenance of portable diesel generators and construction vehicles.

Operation Phase—Substation Operation Emissions

The only operation phase air impacts are associated with substation emergency diesel generators.

- Provide manufacturer-specified maintenance of diesel generators.

8.2.1.5 Water Resources

Construction Phase
Water Sourcing

- Limit sourcing water from small springs or streams so as to not interfere with downstream community use.
- No trees are to be cleared within 50 meters of a water course for water sourcing purposes, and no riparian vegetation is to be cleared without written permission from the GoN.

Aggregate Sourcing

- Obtain required aggregate from already permitted sources such as district approved river aggregate suppliers and appropriate permitted quarries.
- All aggregate sources must be checked by the Engineer's Environmental Specialist. Locations, volumes, extraction methods and rehabilitation measures must be specified and implemented.

River Crossings and Floodplain

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Table 8.2-2 presents towers near floodplain areas and measures to be adopted for mitigating the impact of floods.

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Table 8.2-2 Towers near floodplain areas and mitigation (protection) measures

Segment	River Name	Adjoining Towers	Distance from Nearest Tower to River Bank (m)	Crossing Width	Mitigation Measures
India border to New Butwal Substation	Jharai River	9-10	85	36	• The Design and Build Contractor will examine floodplain conditions and ensure that the tower foundations are designed and constructed such that: (a) special towers or foundation designs are used to ensure the maximum protection from flood damage (which may be either undercutting or overtopping); (b) the invert level (i.e. base) of the foundations is piled or built on firm substrate below the deepest possible scour depth; (c) that the foundations are fully protected to a height of at least one meter above the maximum flood elevation; and crucially (d) such foundations are fully protected from side scour by the river. • Provide riprap (large stone) or gabion works around the base of the foundation for towers located within a floodplain to prevent scour from undermining the foundation. • Avoid construction activity within floodplains during the monsoon season. • Immediately stabilize and revegetate any disturbed areas within floodplains to remove the risk of erosion and sedimentation into the nearby river.
		14-15	90	34	
		18 - 19	50	34	
		19 - 20	30	36	
		20 - 21	14	25	
		28-29	36	34	
		41-42	61	44	
		43-44	54	45	
		44-45	66	42	
New Butwal to New Damauli Substation	Tributary of Jharai	1-2	115	27	
		3-4	67	18	
		7-8	32	21	
		8-9	10	26	
		9-10	85	30	
		10-11	365	21	
		11-12	24	37	
		AP 14 81 – AP 80/5-15	25	39	
		W18-17	115	27	
		17-18	450	27	
		24-25	60	24	
		44-45	132	30	
Ratmatae to New Hetauda Substation	Tributary of East Rapti	108-109	25	12	

Sedimentation

- Undertake erosion and sediment control measures as required in the ESHSMP—the Contractors will be required to implement these during construction to reduce erosion and minimize impacts to streams and other waterbodies (see Chapter 9—ESHSMP).

- Limit clearing within the RoW—only clear those trees approved by the GoN as necessary to construct the line and trees that pose safety risks to the operation of the transmission line. The tree stump and root system, smaller understory trees, shrubs, and the herbaceous layer will be left intact to protect and stabilize the soil from erosion.
- Restrict construction of new tower access roads—MCA-Nepal does not propose to construct any new tower access roads and will use existing trails or establish new narrow trails, which will not require any tree clearing, to minimize soil disturbance and forest clearing.
- Limit mechanized construction equipment—excavation of tower foundations will primarily be conducted via hand labor to minimize disturbance of the surrounding ground.
- Manage excavated soils—the soils excavated for tower foundation construction will be stockpiled during construction and then backfilled around the foundation, carefully graded and stabilized using soil bio-engineering engineering (e.g., use of plant materials to naturally stabilize steep or eroding slopes).
- Provide storm drainage—surface drainage will be provided to direct surface water away from the tower foundation, avoiding steep slopes or other erodible areas, to natural drainage ways.
- Prohibit side casting and discharge to streams—No excavated spoil material shall be thrown down slopes (side cast) or discharged to streams.
- Stabilize disturbed areas as soon as possible—as soon as construction is completed, all disturbed areas will be stabilized and restored, either for agricultural reuse, or planted with fast growing vegetation, and properly maintained in order to establish a vegetative cover.
- Provide robust monitoring—the Contractors will be required to carefully monitor their work areas to manage erosion and sedimentation. Further, MCA-Nepal will provide independent environmental monitoring, who will conduct construction inspections and require the Contractors to correct any areas of substantive erosion or sedimentation. MCA-Nepal will conduct a post-construction completion audit (see Chapter 11) to confirm that all disturbed areas have been properly stabilized before making the final disbursement to the Contractors.
- Implement grievance mechanism—there will be a grievance mechanism in place that will enable local landowners or other concerned stakeholders to inform MCA-Nepal and the Contractors of any erosion and sedimentation issues.

Sewage and Wastewater Discharges

- Tower Sites—at each tower site, the Contractors will provide a pit toilet.
- New Substation Sites—at the three new substation sites (i.e., New Butwal, New Damauli, and Ratmate), the Contractors will install a septic system or a package wastewater treatment plant and provide sanitation/toilet facilities.

- Existing Substation Sites—at the two existing substation sites (i.e., New Hetauda and Lapsiphedi), the construction workers will use existing sanitation/toilet facilities.
- Prohibit open defecation—construction workers will be required to use provided sanitation/toilet facilities. Open defecation will be prohibited by the Worker Code of Conduct (see Chapter 9—ESHSMP). and
- Prohibit untreated wastewater discharges—no untreated wastewater discharges will be allowed to streams or other waterbodies.

Hazardous Material Spills

- Ensure proper care, handling, storage, transport, and disposal of hazardous materials and wastes by providing training for staff using hazardous materials regarding. This one-day training will be provided to 108 staff (two staff from each substation work site and laydown area (28), one staff from each tower field crew (60), and drivers transporting hazardous materials (e.g., bulk quantity of diesel fuel) (20) .
- Prepare and implement a Spill Control Management Plan, which will identify required preventative measures, roles and responsibilities in the event of a spill, the required spill control materials to have at the three new substation sites, and spill control procedures, and notification requirements (see Chapter 9—ESHSMP).
- Provide appropriate containment for any fuel or hazardous materials, including secondary containment (e.g., bund) around any diesel storage tanks.
- Prohibit any hazardous material storage and vehicle refueling within 100 meters of any streams.
- Provide manufacturer-recommended maintenance for all equipment and vehicles.
- Provide bunding around vehicle servicing areas, and stores of both new and used lubricants.
- Provide spill kits at all facilities using hazardous materials, and on all transporting vehicles.
- Check storage tanks and vehicles for leaks on a regular basis.
- Store hazardous materials in a designated location in accordance with their hazard category and maintain an inventory of the hazardous materials with detailed records of use and disposal of any waste. This half-day training will be provided to 28 staff (two from each substation and laydown area location).

Improper Solid Waste Disposal

- Minimize waste generation, through strict control on the good housekeeping and operating practices, including inventory control.

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- Collect all the solid waste generated at every construction site and segregate the waste according to its characteristics for reuse, recycling, disposal.

The 3R's (reduce, reuse and recycle) principle will be applied as far as possible for the proper management of wastes, including scraps. Any scraps (e.g., metal, empty cement bags, containers, rejected materials, plastic) found at the towers, laydown areas, and substations will be collected and reused to the extent possible. The remaining recyclable materials will be transported to nearby recycling centers or scrap dealers. Remove all residual solid wastes for proper disposal at an approved municipal solid waste disposal facility. Prohibit random disposal of solid waste.

- Prohibit burning of solid waste.
- Train employees towards proactive use of designated areas and bins for waste disposal.

Operation Phase

Sewage Wastewater Discharges

- Properly maintain septic systems and/or package wastewater treatment plants for use at the three new substation sites.
- Prohibit any untreated wastewater discharges.

Hazardous Materials Spills

- Store fuel, lubricants, oils, grease, paints and other chemicals in designated areas with impervious liners and a secondary containment system.
- Follow good housekeeping procedures to store hazardous materials in accordance with their hazard category.
- Hazardous waste (e.g., used oil, transformer oil, and oil-soaked cloths) will be properly labelled, stored onsite at a location provided with impervious surface, roof and secondary containment system, and ultimately transported offsite to an approved disposal facility.
- Ensure proper handling of hazardous materials by providing training for all workers with this responsible. This half-day training will be provided to 28 staff (two from each substation and laydown area location)
- Ensure effective chemical transport, handling, and storage to reduce the risk of a spill or leak event by providing training for vehicle drivers and equipment operators. This half-day training will be provided to 33 staff (20 drivers and 13 equipment operators)
- Detail the maintenance and monitoring requirements for storage tanks to check for leaks on a regular basis.
- Carry out maintenance of vehicles, machineries and equipment only in designated areas with appropriate oil and grease traps, and at least 100 meters from any streams or other waterbodies.

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Improper Solid Waste Disposal

- Minimize waste generation, through strict control on the good housekeeping and operating practices, including inventory control.
- Collect all the solid waste generated at the substation and segregate the waste according to its characteristics for reuse, recycling, disposal.
- Prohibit random disposal of solid waste.
- Prohibit burning of solid waste.
- Train employees towards proactive use of designated areas and bins for waste disposal.
- Properly dispose of solid waste at an approved waste disposal facility as described in the ESHSMP.

8.2.1.6 Acoustic Environment

Construction Phase

- Only conduct noise generating construction activities between 6 am and 10 pm. Nighttime construction activities are generally prohibited. There may be some limited circumstances when nighttime construction will be necessary. In these cases, the Contractors shall comply with the following requirements:
  - Obtain MCA-Nepal approval for the need for night-time construction.
  - The Contractors shall notify local residents in areas that would be exposed to noise levels over 55 dBA of proposed nighttime construction and its duration. The Contractors shall inform local residents on why the night construction is necessary and on the proposed mitigation measures.
  - Temporary noise barriers at the appropriate locations may be needed to reduce the noise impacts at night.
  - The Contractors shall arrange temporary accommodations away from the impacted area for vulnerable people such as persons with illness and the elderly if they would be exposed to nighttime noise over 55 dBA.
- Maintain all construction-related traffic and on-site vehicles at or below 20 kilometers per hour on roads within residential areas and within substation sites and tower laydown areas.
- Use properly designed silencers, mufflers, acoustically dampened panels/noise barriers and acoustic sheds or shields. Mufflers and other noise control devices shall be repaired or replaced if defective.
- Locate and orient noise emitting equipment away from noise sensitive receptors.

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- Install substation diesel generators in conformance with the statutory requirement of acoustic enclosures, to achieve the required norm of 75 dBA when measured at workstations.

- Provide rubber paddings and/or noise isolators at equipment/machinery for construction to reduce noise and vibration.

Noise Impacts from Use of Helicopters, Explosives, and Implosives

- Notify nearby households of expected helicopter activity and the use of explosives and implosives and provide compensation if livestock or other farm animals near to be moved.

- Assess structures with potential for damage from vibration prior to any blasting in order to properly document any damage and provide appropriate compensation.

- Limit helicopter, explosives, and implosives use to daylight hours.

- Use of explosives by the ETP will be undertaken by or in close collaboration with the Nepal Army.

- Communities shall be fully informed of the blast at least 48 hours in advance.

- Blasting will not be done on Saturdays, national public holidays, and at night (6 pm to 7 am).

- The Blast Operator will sound a loud double siren 1 hour, 15 minutes and 5 minutes before the blasting are fired.

- Details on the management and use of explosives by the ETP is provided in Annex M.5.12.

Operation Phase

Noise Impacts from Transmission Line Operation

The only noise generated from transmission line operation is the corona effect. The best way to minimize corona effect is to limit the conductor's exposure to dust and dirt during construction, which can clog the conductor and increase the corona discharge.

- Store the conductors in an area free of dust and keep them covered during construction.

- Avoid laying conductors on barren ground or unpaved roads during stringing.

Noise Impacts from Substation Operation

- Restrict loud noise generating maintenance activities to between 6 am and 6 pm.

- Maintain equipment in accordance with manufacturer's specifications.

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8.2.1.7 Landscape Values and Visual Amenity Impact

Construction and Operation Phase
Degradation of Viewsheds

MCA-Nepal has already taken efforts to avoid impacts to scenic viewsheds as part of the route selection process. Other than the measures already taken relative to transmission line and tower siting, there are few other viable mitigation measures. In some locations, the height of the towers and lines could be lowered so they would be screened more by the adjoining forest, but this would increase forest clearing, which will itself contribute to degradation of the viewshed. No additional mitigation measures are proposed.

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8.2.1.8 Physical Environment Mitigation Summary

Table 8.2-3 summarizes the residual significance rating for each of the identified impacts taking into consideration the predicted effectiveness of the proposed mitigation measures.

Table 8.2-3: Physical Impacts, Mitigation, and Residual Significance Summary

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Residual Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Construction Phase								
Topography, Geology, and Soils	Erosion and Landslides	• Implement strict erosion and sediment control measures • Limit clearing • Prohibit construction of new tower access roads • Limit mechanized construction equipment • Prior to any major excavation, remove and stockpile top soil in a designated stable area for future use • Lime the soil in equipment storage areas • Provide storm drainage • Prohibit discharges to streams • Stabilize disturbed areas	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Air Quality	Fugitive Dust Emissions	• Limit clearing within the RoW • Stabilize disturbed areas within the same season • Cover excavated material with cut vegetation or other coverings • Spray water on earth tracks wherever dust is generated • Prohibit wood burning • Use existing access trails • Properly maintain vehicles • Limit vehicular speeds in dirt roads	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
	Transmission Line Emissions	• Properly maintain diesel generators and construction vehicles	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
	Substation Emissions	• Properly maintain diesel generators and construction vehicles	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Residual Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Water Resources	Water Sourcing	• Limit water sourcing from small springs or streams so as to not interfere with downstream community use • Avoid disturbance to riparian vegetation and streambanks	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
	Aggregate Sourcing	• Use permitted sources • Prohibit aggregate sourcing within the Chure Conservation Area	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
	River Crossings and Floodplains	• Locate tower foundations outside of the river channel. • Provide riprap (large stone) or gabion works around the base of tower foundations • Use special towers and design tower foundation to be above the floodplain elevation. • Avoid construction during monsoon season.	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Water Resources	Sedimentation	• Prepare E&S Control Plan • Limit clearing • Restrict new construction tower access roads • Limit mechanized construction equipment • Manage excavated soils • Provide storm drainage • Prohibit discharges to streams • Stabilize disturbed areas • Implement grievance mechanism	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
	Wastewater Discharges	• Provide sanitation facilities • Prohibit open defecation • Prohibit wastewater discharges	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)

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Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Residual Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Water Resources	Hazardous Material Spills	• Ensure proper handling and use of hazardous materials by providing staff training • Put in place strict spill control measures through enforced safe handling procedures • Provide secondary containment • Prohibit refueling within 100 m of any waterbody • Provide manufacturer-recommended maintenance for equipment and vehicles • Check for leaks in storage containers • Maintain inventory of hazardous materials use and disposal	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
	Improper Disposal of Solid Waste	• Minimize waste generation • Collect and segregate waste • Reduce, reuse, and recycle wastes • Transport as needed and provide recyclable solid waste to local scrap vendors. • Remove all solid wastes from construction sites and dispose at approved municipal solid waste disposal facilities	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Acoustics	Transmission Line and New Substation Construction Noise	• Only conduct noise generating construction activities between 6 am and 10 pm. Nighttime construction activities are generally prohibited • Maintain all construction-related traffic and on-site vehicles at or below 15 km/hr • Use properly designed silencers, mufflers, acoustically dampened panels and acoustic sheds or shields. • Located and orient noise emitting equipment away from noise sensitive receptors. • Install substation diesel generators within acoustic enclosures • Provide rubber paddings/ noise isolators at equipment/machinery to reduce noise and vibration.	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)

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Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Residual Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
	Use of Helicopters	• Limit helicopter use to daylight hours • Notify nearby households of planned use of helicopters	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
	Use of Explosives and Implosives	• Limit explosives/implosives use to daylight hours • Assess structures with potential for damage from vibration prior to any blasting in order to properly document any damage and provide appropriate compensation • Notify nearby households of planned use of explosives and implosives	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Landscape Values	Degradation of Viewsheds	• None identified	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
Operation and Maintenance Phase								
Topography, Geology, and Soils	Erosion and Landslides	• Inspect the tower sites and RoW for evidence of erosion or landslides and take appropriate corrective action. • Avoid any ground-disturbing maintenance activities	Adverse	Direct	Low (10)	Site-specific (10)	Long-term (20)	Minor (40)
Water Resources	River Crossings and Floodplain	• Ensure tower locations are located outside the river channel • Maintain rip rap around base of foundation to prevent scour • Design tower foundation to be above floodplain elevation	Adverse	Direct	Low (10)	Site-specific (10)	Medium-term (10)	Negligible (30)
Water Resources	Wastewater Discharges	• Provide septic system or package wastewater treatment plant with appropriate maintenance	Adverse	Direct	Low (10)	Site-specific (10)	Medium-term (10)	Negligible (30)
Water Resources	Hazardous Material Spills	• Same as above for construction phase	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Water Resources	Improper Solid Waste Disposal	• Same as above for construction phase	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
Acoustic Environment	Transmission Line Noise	• During construction, store the conductors in an area free of dust and keep them covered to the extent possible • During stringing, avoid laying conductors on the ground	Adverse	Direct	Low (10)	Site-specific (10)	Medium-term (10)	Negligible (30)

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Residual Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
	Substation Operations	• Same as above for construction phase	Adverse	Direct	Low (10)	Site-specific (10)	Medium-term (10)	Negligible (30)
Landscape Values	Degradation of Viewsheds	• None identified	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
Combined Construction and Operation Phases								
Climate Change	GHG Emissions (combined C&O)	• Properly Maintain vehicles • Transport, store and install switchgear containing SF6 using strict protocols to avoid any damage or leakage • Provide manufacturer-specified maintenance and monitoring for the switchgear insulating gas. • Indirectly reduce domestic diesel generator use • Indirectly displace fossil fuel-generated power in India	Beneficial	Indirect	NA	NA	NA	Positive

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8.2.2 Biological Environment

This section proposes mitigation measures for each Biological Environment impact identified in Section 7.3. An overall residual significance rating for each impact, taking into consideration the predicted effectiveness of the proposed mitigation measures, is provided in Table 8.2-2 at the end of this section. The proposed mitigation measures modify the impacts identified in Section 7.3, and this is reflected in the residual (post-mitigation) significance rating for each impact.

8.2.2.1 Protected Areas and Internationally Recognized Areas for Biodiversity

Construction and Operation Phases

Chure Conservation Area

MCA-Nepal will comply with the conditions of the letter from President Chure-Terai Madesh Conservation Development Board (PCTMCDB) and, in addition, implement the following measures:

- Prohibit sourcing of aggregate within the Chure Conservation Area.
- Prioritize Chure area for compensatory plantation, if the lands are available.
- Implement and enforce a Worker Code of Conduct that prohibits hunting, fishing, poaching, logging, collection of firewood, open fires, burning waste, clearing of vegetation, collection of or trade in plants, animals, or non-timber forest products.

Nawalparasi IBA

- See mitigation measures for bird collisions in Section 8.2.2.3.
- Implement and enforce a Worker Code of Conduct as described above.

8.2.2.2 Forests and Vegetation

Forest Clearing

Construction Phase

- Provide compensatory plantation measure for the clearing of 202,018 trees on a 1:10 basis (i.e., plant 10 saplings for each tree cleared) in accordance with the Working Procedure with Standards for the Use of Forest Lands for National Priority Infrastructure Projects in Nepal 2076 BS (2019 AD), which would result in planting 2,020,180 saplings. as follows:
  - Compensatory plantation for clearing of 71,741 trees within Community Forests of 717,410 saplings;
  - Compensatory plantation for clearing of 12,906 trees within Leasehold Forests of 129,060 saplings; and

- Compensatory plantation for clearing of 117,370 trees within government forests and other areas of 1,173,710"

- Priority will be given to affected community forests, districts, and provinces for afforestation. Indigenous species of trees removed during forest clearance will be promoted, as long as the DOFSC can allocate suitable areas in the right biophysical zones; if not, then the highest biodiversity value species will be used in the reforestation sites. Contracts for nursery development will be made soon after the identification of forest land, and seedlings produced while the site preparation and long term management arrangements are put in place. Saplings used for afforestation will usually be 1 year old. MCA-Nepal will insist on the selected sites being conditional on it being possible to establish a credible management system for the forest that will see it grow to maturity; our funding agencies MCC and GoN make it clear that forest compensation must be made fully sustainable."

- Prohibit forest clearing for all Tower Laydown Areas, tower worker camps, and tower access trails.

- Replant disturbed areas with native species.

Operation Phase

- Limit tree clearing to those required to meet safety standards between the conductors and trees.

Introduction of Invasive Species—Construction and Operation Phases

- Monitor for and remove any invasive species found in areas disturbed by ETP construction.

- Ensure that that all equipment is cleaned and maintained prior to transport to and from each work site. Revegetate disturbed areas using native/non-invasive species

Increase in Fire Hazard
Construction and Operation Phases

- Implement the Fire Management Plan to reduce the risk of fire during construction and operation.

- Prohibit open fires at transmission tower work camps.

Edge Effects
Construction and Operation Phases

- Implement the Invasive Species mitigation measures as outlined earlier.

- Maintain the natural development of a shrub layer within the cleared RoW.

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Induced Clearing and NTFP Collection Construction and Operation Phases

- Notify Division Forest Offices when noticing illegal logging or clearing. This can be either directly by Project Personnel or through established grievance mechanisms.

8.2.2.3 Wildlife Impacts

Disturbance and Displacement of Fauna—Construction and Operation Phases

- Conduct pre-clearance survey for Critically Endangered (CR), Endangered (EN), and protected bird species prior to any forest clearing, and avoid felling of any trees with active nest sites for these species. Where active nests are identified, the nest should be left in situ until the tree is vacated.

- Implement a Fauna Shepherding Protocol (refer to Annex L8.6b) for less mobile terrestrial species (e.g., pangolins and tortoises) within areas of the RoW and substations to be cleared or disturbed to confirm that any resident species have vacated the area, or to physically relocate individuals who remain prior to any land disturbance/forest clearance work. For Pangolins, follow mitigation measures suggested by Pangolin Conservation Action Plan for Nepal, 2018-2022 (DNPWC and DoF, 2018).

Hunting and Poaching of Fauna—Construction and Operation Phases

- Implement and enforce the Worker Code of Conduct that prohibits hunting, poaching, and the collection of/trade in plants or animals.

- Implement a worker environmental awareness program as part of worker induction to inform personnel about the prohibition of collecting timber and non-timber forest products and the importance of natural habitat for the conservation of significant species.

- Establish a community program with adjacent landowners to socialize the restrictions on access to reduce the hunting of fauna and collection of non-timber forest products within the RoW or by ETP workers.

Mortality from Vehicles—Construction and Operation Phases

- Maintain a maximum vehicular speed of 20 kilometers per hour for vehicle use associated with the Project other than on designated Nepal highways to reduce the risk of fauna strikes.

Enhanced Risk of Wildlife-Human Conflict—Construction and Operation Phases

- Implement a worker environmental awareness program as part of worker induction training to inform field personnel about potential wildlife risks, and appropriate preventative measures and responses in the event of a wildlife encounter. This half-day training will be provided to 224 staff (all tower construction staff except for local unskilled workers).

- Keep all food in secure larders and all domestic refuse is to be stored in a secure container and disposed of appropriately away from the camp to avoid attracting fauna.
- Provide lighting at all tower work camps and latrines at night and locate latrines within close walking distance to the camp. All latrines are to be covered and limed upon use.

Increased Habitat Fragmentation—Construction and Operation Phases

- Rehabilitate disturbed areas with native perennial grasses and other plant species approved by MCA-Nepal in the ESHSMP. Site rehabilitation can involve community members to provide employment opportunities.

Bird Collision Risks—Operation Phase

- Implement the requirements of the Avian Power Line Interaction Committee—Reducing Avian Collisions with Power Lines (APLIC 2012).
- Install visibility enhancement objects such as marker balls, bird deterrents, bird flight diverters, ultra-violet emitters, and/or suspended devices on the earth wire to increase line visibility to birds and reduce bird-line collisions, in the areas shown in Figure 8.2-1 and Exhibit E.
- Based on the literature, it is recommended that bird diverters are used in the first instance as these devices have been used successfully in multiple environments, including in deterring vulture interactions with transmission lines in Bulgaria and South Africa (EU, 2015; Phipps WL, 2013). Trials have been extensively undertaken in the USA on the use of bird diverters and appear to be efficient at deterring collision during flight (Yee, M 2008; Ventana Wildlife Society (2009).
- Trials are to be used if bird diverters prove to be inefficient in deterring birds or difficult to maintain. The trial is to be undertaken by the Operator (assumed to be NEA or another Government of Nepal agency) in circumstances where monitoring indicates significant mortality of birds due to ETP collision, especially for species considered to be of high conservation value. The trial is to be conducted with advice from a suitably qualified person(s) with experience in bird collision risk with transmission lines. The trial is to consider the main causal factors that have led to the mortality and result in recommendations on amendments to bird collision risks and methods to reduce those risks along the ETP. Where required, these recommendations are to be implemented by the Operator.
- Table 8.2-4 outlines the minimum distances between visibility enhancement objects that can be used in trials.

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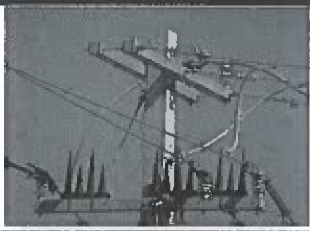
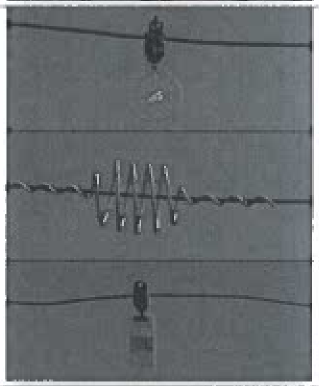
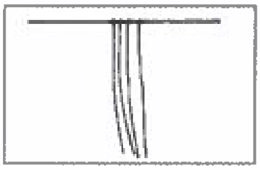
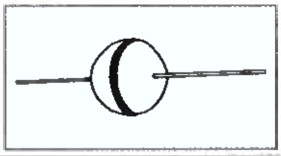
Table 8.2-4: Minimum distances on lines between visibility enhancement objects

S/N	Visibility Enhancement Object Type	Example	Recommended Line placement Location	Minimum distance between Objects
1.	Bird deterrents		Cross arm	On each cross arm
2.	Bird diverters		Overhead wire/ earth wire/ conductors	Every 5 - 10 meters
3.	Ultra-violet emitters		Transmission line towers/cross arm	Each transmission line towers /cross arm
4.	Suspended devices	 	Overhead wire/ earth wire/ conductors	3 strips every meters

S/N	Visibility Enhancement Object Type	Example	Recommended Line placement Location	Minimum distance between Objects
5.	Marker balls	 	Overhead wire/ earth wire/ conductors	Every 75 - 100 meters

The length of line and number of towers where the visibility enhancement objects are to be installed is shown in Table 8.2-5. The location of these crossing points is shown in Figure 8.2-1 and are counted from the western end of the ETP alignment.

Table 8.2-5: Tower numbers and length of line required to install visibility enhancement objects

S/N	Segment	Tower Numbers	Length of Line	Object Type	Max Length Between spans (m)[1]	Total Number of Objects[1]
1.	NB to IB	1–52	6,286	Bird diverters	7.5	838
2.	NB to ND	1–54	15,095	Bird diverters	7.5	2,012
3.	NB to ND	62–90	8,970	Bird diverters	7.5	1,196
4.	NB to ND	125–129	1,619	Bird diverters	7.5	215
5.	NB to ND	160–162	796	Bird diverters	7.5	106
6.	NB to ND	173–201	8,968	Bird diverters	7.5	1,195
7.	ND to RT	93–96	814	Bird diverters	7.5	108
8.	ND to RT	176–186	1,791	Bird diverters	7.5	238
9.	RT to NH	69–80	10,569	Bird diverters	7.5	1,409
10.	RT to LP	145–161	7,220	Bird diverters	7.5	962
					Total	**8,279**

[1] Recommended frequency every 5-7 meters. 7.5 meters was used to calculate the total number of objects.

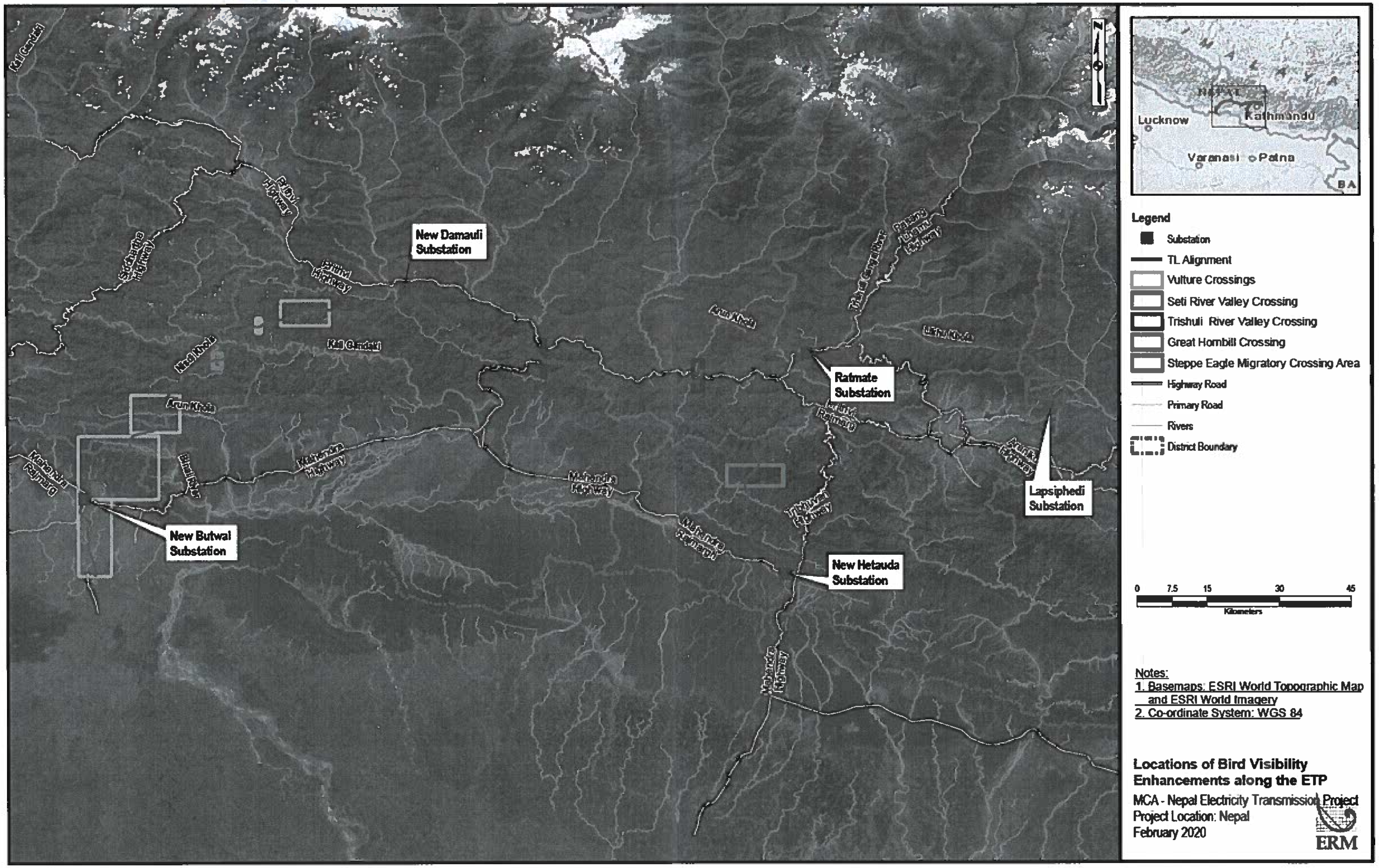


Figure 8.2-1: Locations of Bird Visibility Enhancements along the ETP

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8.2.2.4 Biological Environment Mitigation Summary

Table 8.2-6: Biological Impacts, Mitigation, and Residual Significance Summary

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Construction Phase								
Protected Areas and Internationally Recognized Areas for Biodiversity Conservation	Chure Conservation Area - Vegetation clearance, loss of soil stability and impacts to riparian systems through collection of aggregates etc.	• Comply with the requirements of the PCTMCDB letter. • Prohibit sourcing of aggregate from within the Chure Conservation Area. • Implement and enforce a Worker Code of Conduct	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (40)
	Nawalparasi Forest IBA - Disturbance of birds and risk of bird collision within the IBA	• See mitigation measures recommended for species below.	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Forest and Vegetation	Impacts to Forests	• Provide compensatory plantation on a 1:10 basis (i.e. plant 10 saplings for each tree cleared) • Prepare an afforestation plan for the compensatory plantation • Prohibit forest clearing for all Tower Laydown Areas, tower worker camps, and tower access trails. • Replant disturbed areas with native species. • Coordinate with Division Forest Offices and CFUGs/LFUGs in selecting area for compensatory plantation as per Working Procedure with Standards for the Use of Forest Lands for National Priority Infrastructures in Nepal, 2076.	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
	Introduction of Invasive Species	• Monitor for and remove any invasive species found in areas disturbed by ETP construction. • Implement the Invasive Species Management Plan • Revegetate disturbed areas using native/non-invasive species	Adverse	Direct	Low (10)	Site-specific (10)	Long-term (20)	Minor (40)
	Increase in Fire Hazard	• Implement the Fire Management Plan • Prohibit open fires at transmission tower work camps.	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
	Edge Effects	• Implement weed control	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
	Induced Clearing and NTFP Collection	• Notify Division Forest Offices when illegal logging or clearing are observed	Adverse	Direct	Low (10)	Site-specific (10)	Long-term (20)	Minor (40)

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Wildlife Species	Fauna Disturbance and Displacement	• Conduct pre-clearance surveys and delay felling of trees with any CR, EN and protected bird species nesting • Implement fauna shepherding protocol for less mobile species (e.g., Pangolins and tortoises)	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
	Hunting and Poaching of Fauna	• Implement a worker environmental awareness program as part of worker induction training • Establish a community awareness program with adjacent landowners • Implement a Worker Code of Conduct	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
	Increased Mortality from Vehicles	• Maintain a maximum vehicular speed of 20 kilometers per hour within the Project Area to reduce the risk of fauna strikes.	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
	Enhanced Risk of Wildlife-Human Conflict	• Implement a worker environmental awareness program related to potential human/wildlife conflict. • Keep all food and refuse in secure container and dispose of waste appropriately away from the camp • Provide lighting at all tower work camps and latrines at night and locate latrines within close walking distance to the camp.	Adverse	Direct	Low (10)	Site-specific (10)	Short-term (5)	Negligible (25)
	Increased Habitat Fragmentation	• Rehabilitate disturbed areas with native perennial grasses and other indigenous species	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
Operation Phase								
Habitats	Increased Habitat Fragmentation	• Limit tree clearing required to meet safety clearance requirements	Adverse	Direct	Low (10)	Site-specific (10)	Medium-term (10)	Negligible (30)
Bird Species	Bird Collision Risks	• Implement the requirements of the Avian Power Line Interaction Committee—Reducing Avian Collisions with Power Lines (APLIC 2012) • Install and maintain visibility enhancement objects to reduce bird collisions	Adverse	Direct	Low (10)	Regional (60)	Long-term (20)	Moderate (90)

As Table 8.2-4 indicates, all of the Project's residual biodiversity impacts are considered negligible or of minor residual significance with the exception of the risk of increased mortality for critically endangered and endangered birds (e.g., Himalayan griffon, several species of vultures, steppe eagle, and Sarus crane) from colliding with the transmission lines. MCA-Nepal is proposing additional mitigation measures to reduce other threats to these species to offset this unavoidable moderate residual impact.

To compensate for estimated residual impacts on birds associated with the construction and operation of the ETP alignment, a small biodiversity offset is recommended for the Project. The recommended program will consist of management interventions to help safeguard bird species identified along the New Butwal to New Damauli Segment of the ETP, which crosses part of the Nawalparasi Important Bird Area. The target species will include some of the following species:

- Himalayan Griffon *Gyps himalayensis* [IUCN NT; Nepal Red List VU]
- Egyptian Vulture *Neophron percnopterus* [IUCN EN; Nepal Red List VU]
- Red-Headed Vulture *Sarcogyps calvus* [IUCN CR; Nepal Red List EN]
- White-Rumped Vulture *Gyps bengalensis* [IUCN CR; Nepal Red List CR]
- Slender-Billed Vulture *Gyps tenuirostris* [IUCN CR; Nepal Red List CR]
- Cinereous Vulture *Aegypius monachus* [IUCN NT; Nepal Red List EN]
- Steppe Eagle *Aquila nipalensis* [IUCN EN; Nepal Red List VU]
- Sarus Crane *Antigone Antigone* [IUCN VU; Nepal Red List VU]

The biodiversity offset will be developed in conjunction with key stakeholders and will consist of the following:

1. Review of current threats to the target species within the segment and review of current programs undertaken in Nepal, to develop appropriate threat reduction management actions for the species that can be supported by the program, in line with the continuation of management actions described in the *Department of National Parks and Wildlife Conservation (DNPWC), Nepal 2015 Vulture Conservation Action Plan for Nepal (2015—2019).*
2. Implementation of focussed threat reduction management actions for the target species, as determined by the review; and
3. Implementation of a limited monitoring and evaluation program.

The biodiversity offset will be implemented over a period of five years.

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8.2.3 Socioeconomic and Cultural Environment

This section identifies the proposed mitigation measures for each Social Environment impact identified in Section 7.4. An overall residual significance rating for each impact, taking into consideration the predicted effectiveness of the proposed mitigation measures, is provided in Table 8.2-3 at the end of this section.

8.2.3.1 Overarching Mitigation Measures

There are several mitigation measures that apply across the various social impacts, including those plans discussed below. MCA-Nepal will review and approve each of these Contractor-developed plans prior to implementation.

Resettlement Action Plan and Resettlement Policy Framework (RPF)

MCA-Nepal will prepare and implement four Resettlement Action Plans (RAPs) linked to the various construction bid packages, which will be based on the following standards:

- *Land Acquisition Act* (1977), rules and regulations of the Government of Nepal on land acquisition, compensation and resettlement for permanent land acquisition and rights of way;
- National Policy on Land Acquisition, Compensation and Resettlement in Development Projects in Nepal (formal cabinet approval given in July 2016);
- IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement (and IFC Performance Standard 7 on Indigenous Peoples as appropriate); and
- Guidelines applicable for MCA-Nepal (i.e. MCC Environmental Guidelines 2010 and MCC Gender Policy 2011).

The RAPs will be based on the policy guidelines contained in the Resettlement Policy Framework (RPF). MCA-Nepal has already prepared a RPF and had it approved by MCA-Nepal Board (Annex I). The RPF provides an overview of entitlements and an approach to integrate resettlement-planning safeguards into the land acquisition process to be implemented by MCA-Nepal and the GoN. The RPF includes an overview of the Project's affected communities, screening of involuntary resettlement and livelihood impacts, guidelines for the RAP survey process to document affected land assets and entities (individual and group), the proposed entitlement matrix, institutional arrangements (including principles for market valuation and a budget) along with a monitoring and evaluation framework (see Annex I).

All households that are physically displaced (including informal users, occupants, squatters, and/or encroachers) will be surveyed and their land and assets documented as part of the RAP survey. In addition to compensation for land and assets at replacement cost, affected households will also be offered options for assisted relocation or self-relocation, with adequate support to ensure equal if not better living conditions among physically displaced households, including through the provision of adequate housing with security of tenure at resettlement sites, as applicable.

Livelihood Restoration Plan

Livelihood Restoration Plans (LRP) are required under IFC Performance Standard 5 for all those affected households whose economic or physical displacement threatens their economic security and future livelihoods. The LRP developed for each RAP focuses on:

- Replacing agricultural land and livelihoods;
- Enhancing agricultural productivity, yields, knowledge and advice;
- Skills-based vocational training with entrepreneurial support; and
- Life and financial skills to support the change process.

The LRP will be developed as part of the RAP and implemented at the same time as compensation is paid for losses, and replacement land and structures made available. The intention is to hire third party organizations to implement the LRP. The LRP for each Project-affected person has to be in process before sign-off for the completion of resettlement can take place and land access agreed for the Contractor.

Workforce Management Plan.

Each Contractor will develop a Workforce Management Plan that aligns with the workforce management requirements defined by MCA-Nepal for the Project. This plan will set out the expectations that apply during the hiring process, and ongoing management of staff. This will align with local regulatory requirements as well as relevant international standards, including expectations regarding anti-discrimination.

- Provide an induction that is tailored to the type and duration of employment for all employees. Each induction will outline expected worker behaviors, including health and safety standards and requirements, an introduction to local customs and practices, TIP risks, Anti-sexual Harassment Policy, and Worker Code of Conduct.
- Maintain records on the workforce, by age, gender and ethnic groups, based on identification documents presented (e.g., National Identity Card or a Voter ID card).
- Provision of accommodation, in line with the requirements of the Worker Accommodation Guidelines (IFC and EBRD 2009).
- Encourage local employment, especially of women and other disadvantaged and marginalized people, where qualified labor is available. Work to meet goal of women representing 33 percent of the contractor's workforce.
- Establish and implement a Worker GRM.

Temporary Land Access Process

The Project will occupy and use land for storage, labor camps, laydown areas, helipads, and as work areas around each tower of the TL. Some areas will be needed for less than six months—others such as laydown, helipads and storage, may be taken on a voluntarily agreed long lease/rental and arranged between the Contractors and the Owners for periods longer than six months. If left unmitigated, such temporary access could potentially have a major adverse impact on local communities and the environment.

The following general principles will apply to all temporary access sites throughout all Project activities:

- The procedure covers all land use for less than six months, land needed longer than six months, even if intermittently will require a long-term lease.
- Homestead areas, cultural sites and forest areas will be avoided to the extent feasible;
- Temporary land access will minimize the extent and duration of land requirement wherever feasible;
- Where there is more than one option for providing trail access to a tower site, the use of cultivated land will be selected as the last resort;
- The land footprint will include area required for access/entry; laydown areas for equipment; temporary storage needs; and the core work area. This footprint will be physically demarcated and fenced;
- Compensation for the demarcated land area will include a component of rental and replacement cost for crops or assets on the land cleared and/or damaged as agreed with the land owner. The negotiation will use the District rates for valuation of losses as agreed by the CDC as a minimum;
- Given that access for tower construction, erecting and stringing will require temporary land access around the tower pads in several phases, over the construction period, the Contractors will have the option of having a long-term temporary access agreement with each owner/user to compensate them for loss of standing crops or potential crop loss for the period of occupation during Project activities;
- The grievance mechanism put in place at the District Public Information Centre of the district, within which the activity is being carried out, will be explained to the landowner prior to any access. Any inadvertent destruction of property or impacts from site activities will be handled under this grievance mechanism;
- The Contractors will ensure that local authorities and land owners are consulted and their agreement to access the land area has been documented and the rental payment made and received prior to the commencement of activities; and

- The Contractors are obligated to restore the land to its pre-activity status using properly agreed rehabilitation works and standards after the completion of construction phase works whilst within the rental period.

Community Grievance Redress Mechanism

The community GRM covers all phases of the Project and must be used by all contractors throughout the pre-construction and construction phases. The process is coordinated through MCA-Nepal, which will receive and supervise resolution of all grievance notifications through the procedure given in Annex C.4.4. This process must be used by all parties to ensure high standards of grievance resolution and efficient, timely and effective response. This approach is intended to reduce delays in Project implementation, enhance the reputations of all parties and ensure a high quality of grievance resolution.

The Gender and Social Safeguards Manager for each Contractor is required to implement the prescribed process for receiving grievance notifications and participating in their resolution. The Stakeholder Engagement Plan (SEP) sets out the process to:

- Accept and acknowledge receipt of a grievance;
- Document the grievance on the agreed forms;
- Notify the MCA-Nepal Grievance Redress Coordinator (GRC);
- Record and number the grievance as per the MCA-Nepal GRC's instruction;
- Accept delegated responsibility to investigate the grievance;
- Participate in discussions over responses and agreeing the outcome at which ever tier of response is needed;
- Implementing the decision;
- Informing the claimant;
- Documenting the process; and
- Submitting the resolution to the MCA-Nepal GRC.

Worker Access Management Protocol

MCA-Nepal requires all Contractors to prepare a Worker Access Management Protocol, which will apply to all areas where Project activities will be located on acquired private land or in community or leasehold forest areas. The protocol will be applicable for the entire duration of the Project—from preparatory work to closure and site hand over.

The purpose of the worker access management protocol will be to manage and mitigate the risks associated with workers accessing new areas and providing clear guidelines on prohibited and permissible activities in situations where the workers are accessing private or

STATIC CONSULTING INTERNATIONAL LLC 2000 community resources (e.g., Community Forests/Leasehold Forests/Religious Forests, community water sources, recreational areas, cultural sites).

All Contractors will ensure that the following measures are all in place as a minimum.

- A list of permits, approvals, prohibited and restricted access (based on MCA-Nepal's guidance) for each construction site.
- Review and obtain all permits and approvals for accessing every new area for investigative or construction activities, prior to starting mobilization.
- Obtain a Land Access Release Permit against plot identification, map and GPS coordinates showing what land is open to which sort of activity: this must follow the Land Access Release Protocol (Annex C.5.1a), and indicates completion of resettlement and release for construction.
- Provide each worker with an induction prior to the initiation of work at each new site. As part of this, an understanding shall be provided of the local customs and practices in the area, including prohibited and restricted access and use.
- Undertake regular tool box talks at the start of each work day. As part of these tool box talks, a reminder shall be provided of the prohibited activities and any specific access-related instructions including how to gain access to the plot and where access is not permitted.
- Implement and enforce a Worker Code of Conduct, Anti-Sexual Harassment Policy, and Trafficking-In-Persons (TIP) Risk Management Plan.
- Restrict the workforce to their designated work areas, so as not to enter prohibited and restricted areas unless required for Project purposes (when prior notice will be made to the communities by the Contractor, and with the permission of the person in charge).
- Require the use of existing trails and the processes to be followed for establishing new narrow trails to minimize soil disturbance.
- Prohibit unapproved tree clearing.
- Provide designated areas for the discarding of rubbish and remove from site, with random spot checks.
- Ensure adequate provision of cooking fuel, heating, lighting and food, to mitigate the risk of workers needing to access community forests for fuelwood or to buy excessive amounts from local shops.
- Ensure adequate arrangement of recreational activities for workers during non-working hours.
- Provide transportation for workers, from and to the work sites in cases where the camps are not located within the RoW.

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- Put in place robust monitoring and patrolling provisions for the work sites. The possibility of engaging the local community in the monitoring process shall be explored, based on the regional context and risk levels. This must be decided in advance of starting work.
- Implement the Community GRM.
- Provide the community with sufficient advance notice of each phase of construction activities, in keeping with the SEP requirements.

Traffic Management Plan

All Contractors must prepare a Traffic Management Plan specific to their work and site activities. These plans will apply to all vehicle-accessible areas in construction sites, laydown and storage areas, labor camps and public roads. They will be applicable for the entire duration of each Contractor's activities from preparatory work to closure and site handover. The plans will cover motorized, non-motorized and pedestrian movements, and parking.

The purpose of a Traffic Management Plan is to mitigate and manage environmental, health and safety risks and impacts associated with transportation. This includes transportation of construction materials, transportation of waste, and transportation of labor and equipment to laydown areas and construction sites by roads or trails.

A key aspect of a Traffic Management Plan is to ensure community safety, as the roads used for Project construction are also public roads. Road stretches in and around settlements have particularly great potential to cause disturbance and raise accident risks to members of the communities.

Stakeholder Engagement Plan

MCA-Nepal has prepared and commenced implementation of a Project SEP and community consultation process to guide all interactions between Project personnel and the neighboring communities. The SEP and consultation process are to be continued through the pre-construction and construction phases. They must cover all communities where land is being permanently acquired (land under tower pads, substations and substation access roads), and where use restrictions apply within the transmission line rights of way.

This SEP and consultation process must be used to direct, determine, record and monitor all interactions with the communities, whether they are affected by the construction activities or not. The SEP and consultation process is compliant with IFC Performance Standard 5 and must be used to direct all community interactions to ensure international best practice in communicating with stakeholders and communities. Maintaining high standards of communication is vital to reduce Project delays and prevent the generation of additional grievances. Continuity of use of these approaches over the Project life will contribute to the success of the Project through consistent practices, recording and problem-solving mechanisms.

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Trafficking in Persons (TIP) Risk Management Plan

MCA-Nepal will develop a TIP Risk Management Plan, which will be implemented by the Contractors. This Plan will include management strategies to address and reduce the risk of TIP arising out of the Project activities, especially during the construction phase. The mitigation and management measures will be implemented along with other risk mitigation measures described in this section (Worker Code of Conduct, Workforce Access Management Protocol, Anti-sexual Harassment Policy, Stakeholder Engagement, and Grievance Redressal Mechanism) and other gender and social inclusion safeguards and measures. Development and implementation of policies for management of TIP risk will be accompanied with awareness and sensitization campaigns, periodic and focused training, and ongoing monitoring of delivery and performance on this and related issue.

8.2.3.2 Land Ownership and Land Use

Physical Displacement, Economic Displacement, and Livelihood Impacts

- Implement the RAP and associated RPF and Livelihood Restoration Plan.
- Implement the SEP and Community GRM.

Temporary Access Related Impacts

- Implement the Temporary Land Access Process.
- Implement the Worker Access Management Protocol.

8.2.3.3 Community Health, Safety and Security

Construction Phase
Workforce Management

- Implement the Workforce Management Plan to manage risk of employment discrimination.

Nuisance Impacts on Local Communities

- Implement mitigation measures described in Section 8.2.1 to manage noise, fugitive dust, solid waste, and wastewater.

Risk of Communicable and Vector-Borne Diseases

- Implement the mitigation measures regarding storm water drainage as discussed in Section 8.2.1.
- Provide, as part of the induction process, information to the workforce on appropriate hygiene practices/ behaviors. This information should be reinforced through signage at key locations, such as the worker camps and sanitation facilities.

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- Provide accommodation in accordance with the requirements of the Worker Accommodation Guidelines (IFC and EBRD 2009).

Potential Community Conflict

- Apply the criteria for siting of Tower Work Camps.
- Implement a Workforce Management Plan.
- Implement a Worker Code of Conduct, Anti-Sexual Harassment Policy, and TIP Risk Management Plan.

Potential Safety and Security Impacts

- Implement the Workforce Management Plan.
- Implement the Worker Code of Conduct, Anti-Sexual Harassment Policy, and TIP Risk Management Plan.
- Implement the Traffic Management Plan.
- Ensure security personnel are unarmed.
- Implement the Worker Access Management Protocol.
- As part of the stakeholder engagement process, stakeholders will be informed of planned security measures and the risks of an active construction site.
- Physically relocate any existing residences within the RoW to prevent exposure to EMF.
- Implement the Community GRM.
- Anti-climbing measures have been incorporated into the design of each tower.
- Implement the Occupational Health and Safety Management Plan. The plan shall put in place adequate health and safety management measures, including, but not limited to, the following:
  - Provision of PPE based on each worker's role and activities.
  - Ensure staff are aware of health and safety requirements and expectations by providing training as part of the induction process. The extent of training will be dependent on each worker's role, and the risks associated with the specific role, but will be a minimum of one day for the 324 skilled and semi-skilled staff. Unskilled local workers will receive a two hour training for their specific job responsibility at the initiation of their employment and there will be daily safety briefings at the start of each work day.
  - Provision of appropriate sanitation facilities for the workforce, for males and females.

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Operation Phase
EMF

- Prohibit the construction of any residences, schools, health clinics within the RoW in the permanent restrictive use agreement.
- Monitor the RoW to ensure no unauthorized development occurs throughout the operating life of the Project.
- Conduct an education outreach program for affected communities along the RoW to raise their understanding and address their concerns about EMF.

8.2.3.4 Community Resources

Construction Phase
Change in Forest Resources within Community Forests, Leasehold Forests

- Implement the RAP. The RPF Entitlement Matrix provides for a one time, lump sum compensation (valuation to be determined) to be provided to the CF/LHF user group as contribution to their development plan budget.
- CFUG's and LHFUG's will be encouraged to participate in forest clearing activities during construction.
- Cultivation of NTFP/fruit trees will be promoted in forest land within the transmission line RoW
- Work with affected CFUGs and MoFE for sharing of revenue from the sale of timber or other forest resources in accordance with the *Forest Act (2019) and Forest Rules* (1995).
- Implement the Temporary Land Access Process to compensate the CF/LHF User Groups for any unauthorized damage to forest resources.
- Ensure landowner sign-off on land restoration after temporary access on CF/LHF areas is undertaken.
- Implement the Worker Code of Conduct, which prohibits any unauthorized clearing of vegetation or collection of NTFP within Community and Leasehold Forests.

Operation Phase

Although the Project will require access to towers located within CF/LHF areas for regular maintenance, this access will be limited to existing trails, with no additional tree clearance.

- CFUGs and LHFUGs will be involved in the maintenance of RoW during the operation phase.

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8.2.3.5 Community Infrastructure

Stress on Physical Infrastructure

- Implement a Traffic Management Plan, which will include at a minimum the following details:
  - Confirmed routes for transportation of goods and materials. These routes shall be chosen to minimize the potential impacts like traffic congestion, excessive wear and tear on existing roads and dust on narrow or unpaved roads.
  - Likely time of movement where roads pass through settlements to avoid/minimize disturbance to the local population.
  - Prohibit the construction of new tower access roads.
  - Establish driver qualifications (e.g., valid identification card, proof of age, valid driving license).
  - Establish operational requirements (e.g., wearing seat belt, following speed limits, appropriate usage of turn indicators) and require all drivers to be properly trained. This half-day training will be provided to all drivers (estimated at 80).
  - Establish vehicle operational checks and maintenance requirements.
- Update and implement the Project's SEP to keep local communities updated on the schedule of construction activities.
- Implement and enforce the Worker Code of Conduct, Anti-Sexual Harassment Policy, and TIP Risk Management Plan.
- Implement the Community GRM.
- Establish and implement an Emergency Preparedness and Response Plan. The plan shall provide at a minimum the following details:
  - Identify the emergency situations which may occur during Project construction.
  - Develop a response plan for each identified emergency situation in consultation with relevant stakeholders, including applicable government agencies and local service providers. This plan should document emergency contact information and evacuation protocol.
  - Identify the medical infrastructure in the vicinity of the Project that could be utilized.
  - Ensure staff are ready in the event of a disaster or emergency situation by providing appropriate workforce training and periodic drills. This half-day training will be provided to all tower and substation managers and safety specialists (six from each

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new substation, two from the other substations and the laydown areas, and 60 tower work crew chiefs, for a total of 96).

8.2.3.6 Local Economy and Employment

Effects on Local Economy

- Implement the Workforce Management Procedures, which encourage hiring of local labor.
- The Contractors should strive to meet the goal of 33 percent of the workforce being composed of women and hiring marginalize or disadvantaged workers where they are qualified, and adopt the principle of equal pay for equal work.

  These Project effects are considered positive so no other mitigation measures are proposed.

- Ethnic Groups -Indigenous Peoples/Adivasi JanajatiImplement the RAP
- Implement the SEP
- Implement the Community GRM.
- Implement and enforce a Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan.
- Implement a Workforce Management Plan.

8.2.3.7 Gender and Social Inclusion

- Implement the RAP.
- Implement the SEP.
- Implement the Community GRM.
- Implement and enforce the Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan.
- Implement the Workforce Management Plan.

8.2.3.8 Impact on Cultural Resources

- Implement a Chance Find Procedure for the duration of the Project.
- Ensure that access to cultural sites by their users is not restricted during construction activity.

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- If any cultural resources/sites are found along the transmission line RoW during project implementation, attempts will be made not to disturb such sites by making slight changes to alignment.
- Avoid disruption of festivals, community rituals, and gatherings, in consultation with community leaders.
- Locate worker camps away from any major cultural heritage sites.
- Implement and enforce the Worker Code of Conduct.
- Ensure field workers understand the cultural sensitivities of local communities by providing appropriate training during their induction. This one-day training will be provided to 224 staff (all non-local staff)
- Implement the Community GRM.

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8.2.3.9 Socioeconomic and Cultural Environment Mitigation Summary

Table 8.2-7: Socioeconomic and Cultural Impacts, Mitigation, and Residual Significance Summary

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Construction Phase								
Change in Land Ownership and Use	Physical Displacement (due to land acquisition, RoW use restriction, on private land)	• Implement the RAP • Implement the SEP • Implement the Community GRM	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Minor (40)
Change in Land Ownership and Use	Economic Displacement and Livelihood Impacts (due to land acquisition on private land)	• Implement the RAP • Implement the SEP • Implement the Community GRM	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Minor (40)
Change in Land Ownership and Use	Temporary Access Related Impacts	• Follow the Worker Camp siting criteria • Implement the SEP and Community GRM • Implement the Temporary Land Access Process • Implement a Worker Code of Conduct	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Community Health, Safety and Security	Risk of TIP and Employment of Under-Age Children	• Implement a Workforce Management Plan • Prioritize local employment, where appropriate • Implement and enforce the Worker Code of Conduct and TIP Risk Management Plan	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Community Health, Safety and Security	Nuisance Impacts on local communities (associated with Noise, Dust and Traffic)	• Follow the Worker Camp Siting Criteria • Implement a Workforce Management Plan • Prohibit construction of new tower access roads • Use existing access trails to the extent available • Implement dust management strategies • Implement the Worker Code of Conduct • Implement the SEP and Community GRM • Provide appropriate worker accommodations	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Community Health, Safety and Security	Risk of Communicable and Vector Borne Diseases	• Implement the Workforce Management Plan • Provide storm water drainage • Worker induction process • Implement and Enforce the Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan • Provide appropriate worker accommodations	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)

Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Community Health, Safety and Security	Potential Community Conflict	• Follow Worker Camp Siting Criteria for temporary access • Implement the Workforce Management Plan • Prohibit construction of new tower access roads • Use existing access trails to the extent available • Implement and enforce the Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan • Implement the SEP and Community GRM	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Community Health, Safety and Security	Potential Safety and Security Impacts	• Implement the Workforce Management Plan • Unarmed security persons • Worker Access Management Protocol • Implement a Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan • Implement the SEP and Community GRM • Implement a Worker GRM • Implement an Occupational Health and Safety Plan • Provide appropriate accommodation	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Community Resources	Effect on Natural Resources (Forests)	• Implement a RAP • Implement the SEP and Community GRM • Implement the Temporary Land Access Process • Community monitoring by CFUG/LHFG • Implement the Worker Access Management Protocol • Implement a Worker Code of Conduct	Adverse	Direct	Low (10)	Local (20)	Long-term (20)	Minor (50)
Community Resources	Effect on Natural Resources (Water Resources)	• Implement the Worker Code of Conduct • Ensure tanker water supply, where required • Implement the SEP and Community GRM	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Community Resources	Stress on Physical Infrastructure	• Implement the Traffic Management Plan • Implement the Worker Code of Conduct • Implement SEP and Community GRM	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Local Economy and Employment	Effects on Local Economy	• Not applicable	Positive	Direct	NA	NA	NA	Positive
Vulnerable and Indigenous Peoples	Impacts on Indigenous People and Vulnerable Groups	• Implement the RAP • Implement the SEP and Community GRM • Implement the Worker Code of Conduct, Anti-sexual Harassment Policy, and TIP Risk Management Plan	Adverse	Direct	Medium (20)	Local (20)	Short-term (10)	Minor (45)

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Resource	Environmental Impact	Proposed Mitigation	Impact Criteria					Significance Rating
			Nature	Type	Magnitude	Extent	Duration	
Gender and Social Inclusion	Impacts on women	• Implement the RAP • Implement the SEP and Community GRM • Implement the Worker Code of Conduct, Anti-sexual Harassment Policy and TIP Risk Management Plan	Adverse	Direct	Medium (20)	Local (20)	Short-term (5)	Minor (45)
Cultural Heritage Resources	Impacts on Tangible Resources	• Implement the Chance Find Procedure • Do not restrict access to cultural sites by regular users • Locate work camps away from cultural heritage sites	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Cultural Heritage	Impacts on Intangible Resources	• Avoid festivals, community rituals and gatherings when possible • Implement and Enforce the Worker Code of Conduct • Implement the Community GRM	Adverse	Direct	Low (10)	Local (20)	Short-term (5)	Negligible (35)
Operation and Maintenance Phase								
Change in Land Ownership and Use	Temporary Access Related Impacts on private land	• Implement the Temporary Land Access Process • Implement the SEP and Community GRM	Adverse	Direct	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Community Health, Safety and Security	Electromagnetic Fields Effects	• Implement the SEP • Implement the Occupational Health and Safety Plan • Implement a Worker GRM • Conduct an education outreach program for nearby communities	Adverse	Direct	Low (10)	Site-specific (10)	Long-term (20)	Negligible (40)
Community Resources	Impact of natural resources	• Community monitoring by CFUG/LHFG	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Negligible (40)
Community Resources	Stress on Physical Infrastructure	• Implement the Worker Code of Conduct • Prepare the Emergency Management and Response Plan • Implement SEP and Community GRM	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Negligible (40)
Vulnerable and Indigenous Peoples	Impacts on Indigenous People and Vulnerable Groups	• Implement the Workforce Management Plan • Implement the SEP and Community GRM	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Negligible (40)
Gender	Impacts on women	• Implement the Workforce Management Plan • Implement the SEP and Community GRM • Implement Anti-sexual Harassment Policy and TIP Risk Management Plan	Adverse	Direct	Low (10)	Local (20)	Medium-term (10)	Negligible (40)

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8.2.4 Cumulative Impacts

The measures below address the Project's contribution to identified cumulative impacts.

8.2.4.1 Cumulative Impacts to Forests

- Minimize forest clearing by careful routing of the transmission lines, prohibiting the construction of new tower access roads, using high towers to span over trees, using special towers to allow for long spans over stream valleys, using helicopters and drones to string conductors, and providing compensatory plantation at a ratio of 25 samplings for each tree cleared.

8.2.4.2 Cumulative Impacts to Birds

- Eliminate the risk of bird electrocution by ensuring the conductors are separated by more than the wingspan of the largest bird in Nepal (Himalayan Griffon) and reduce the risk of collision by placing marker balls and bird diverters on the shield wires to visually alert birds.

8.2.4.3 Cumulative Impacts to Communities near Substations

- Adopt and implement a Resettlement Action Plan and a Resettlement Policy Framework, which includes provisions for compensating those who have occupied land or buildings, are non-registered tenants, or who have other informal arrangements for use of buildings or land. This includes payment of compensation for the loss of land and assets at replacement cost, and provide other allowances to cover the transition period and temporary livelihoods restoration support for the more vulnerable persons or groups.

8.2.4.4 Suggested Mitigation Actions by Others

The effectiveness of MCA-Nepal's efforts to mitigate its cumulative impacts depends on other project developers taking similar actions. Some actions that the Department of Electricity Development may consider taking include:

- Cumulative Impacts to Forests
  - Adopt and implement transmission line routing guidelines for transmission line project developer to promote forest conservation and minimize forest clearing.
  - Promote conservation initiatives of forested areas, including existing national protected and conservation areas.
  - Provide funding support to affected Community Forest User Groups.
  - Target compensatory plantation within the project area.
- Cumulative Impacts to Birds of Special Conservation Status

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- Use the ETP as a case study to develop a bird protection protocol for other projects to adopt including the use of visual markers to minimize collision risks and taking measures to avoid or minimize electrocution risk.
- Provide support to Bird Conservation Nepal's Vulture Conservation Program.

- Cumulative Impacts to Communities near Substation
  - Adopt and implement substation siting guidelines that promotes taking into consideration the potential impacts on nearby communities not just from the substation land acquisition and construction itself, but also considering the impacts of future transmission lines.
  - Include provisions for additional resettlement support for households that have been previously displaced (physically or economically) by earlier projects.
  - Ensure affected communities and households receive livelihood restoration support.

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8.3 ENHANCEMENT AND MITIGATION COSTS

Table 8.3-1 provides an estimate of the costs for the proposed enhancement and mitigation measures.

Table 8.3-1: Estimated Costs of Enhancement and Mitigation Measures

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
	Enhancement Measures			
1	Provide space for future transmission lines at New Butwal, New Damauli, and Ratmate substations	-		Included in D&B bid
2	Provide technical assistance to the NERC and NEA to improve transmission system efficiency	-		Provided by MCA/MCC
3	Include language in D&B Contractors bid documents to encourage hiring of women, Adivasi Janajati, and Dalits	-		Provided by MCA
4	Include language in D&B Contractors bid documents to encourage local purchasing of goods and services	-		Provided by MCA
5	Capacity building and trainings	11,000,000	100,000	Included in D&B Contractors bid
6	Budget for MCA Partnership program as CSP	1,320,000,000	12,000,000	Provided by MCA
	Subtotal	1,331,000,000	12,100,000	
	General Mitigation Measures			
1	Develop a detailed Environmental, Social, Health, and Safety (ESHS) Management Plan	16,500,000	150,000	Included in D&B Contractors bid
2	Develop, provide training in, and enforce a Worker Code of Conduct	6,600,000	60,000	Included in D&B Contractors bid
3	Conduct Employee Induction Training on H&S and environmental/cultural sensitivity	6,600,000	60,000	Included in D&B Contractors bid
4	Implement Community Grievance Mechanism	6,600,000	60,000	

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
	Subtotal	36,300,000	330,000	
	Physical Environment Mitigation Measures			
1	Implement an Erosion and Sediment Control Plan	48,235,000	438,500	Included in D&B Contractors bid
2	Limit clearing within the RoW			Condition of D&B Contractors contract
3	Restrict construction of new access roads			Condition of D&B Contractors contract
4	Limit use of mechanized construction equipment			Condition of D&B Contractors contract
5	Manage excavated soils			Included in D&B Contractors bid
6	Provide appropriate stormwater drainage at tower and substation sites	19,294,000	175,400	Included in D&B Contractors bid
7	Prohibit discharge to streams			Condition of D&B Contractors contract
8	Stabilize disturbed areas with native grasses and flora	13,750,000	125,000	Included in D&B Contractors bid
9	Prohibit burning of cleared vegetation and open fires			Condition of D&B Contractors contract
10	Properly maintain vehicles			Included in D&B Contractors bid
11	Spray disturbed areas with water if substantive off-site fugitive dust impacts occur	9,482,000	86,200	Included in D&B Contractors bid
12	Provide manufacturer-specified maintenance of diesel generators			Included in D&B Contractors bid

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
13	Limit sourcing of water from small springs and streams to no more than 20% of flow			Condition of D&B Contractors contract
14	Avoid clearing of trees and limit impacts to riparian vegetation to the extent possible			Condition of D&B Contractors contract
15	Obtain aggregate to the extent possible from already permitted sources			Condition of D&B Contractors contract
16	Prohibit sourcing of aggregate from streams within the Chure Conservation Area			Condition of D&B Contractors contract
17	Prohibit substation construction from obtaining aggregate from local sources			Condition of D&B Contractors contract
18	Provide a pit toilet and bury all organic wastes at tower construction sites	46,585,000	423,500	Included in D&B Contractors bid
19	Install septic systems/package wastewater treatment plants for substation workers	33,000,000	300,000	Included in D&B Contractors bid
20	Prohibit open defecation			Condition of D&B Contractors contract
21	Prohibit wastewater discharges to streams			Condition of D&B Contractors contract
22	Provide hazardous material training to appropriate staff	2,090,000	19,000	Included in D&B Contractors bid
23	Stockpile materials for use in controlling spills/fires at each substation/Tower Laydown Area	4,620,000	42,000	Included in D&B Contractors bid
24	Provide secondary containment for any fuel or hazardous materials	1,320,000	12,000	Included in D&B Contractors bid
25	Prohibit hazardous material storage or vehicle refueling within a 100 m of any stream			Condition of D&B Contractors contract

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
26	Monitor liquid storage tanks and vehicles for leaks on a regular basis			Included in D&B Contractors bid
27	Practice good housekeeping in storing hazardous materials			Condition of D&B Contractors contract
28	Minimize solid waste generation			Condition of D&B Contractors contract
29	Collect and segregate all waste for reuse, recycle, or disposal	308,000	2,800	Included in D&B Contractors bid
30	Prohibit random disposal of solid waste			Condition of D&B Contractors contract
31	Prohibit burning of solid waste			Condition of D&B Contractors contract
32	Train employees to use designated waste disposal areas/bins			Included in D&B Contractors bid
33	Dispose of solid waste at approved waste disposal facilities	4,823,500	43,850	Included in D&B Contractors bid
34	Locate tower foundations outside the river channel			Condition of D&B Contractors contract
35	Provide riprap around the foundation base for towers located within a floodplain	-		Included in D&B Contractors bid
36	Design the tower foundation such that the top of concrete is above the flood elevation			Condition of D&B Contractors contract
37	Limit noise generating construction activities to between 6am to 10pm			Condition of D&B Contractors contract
38	Limit vehicular speeds to 15 km/hr when in residential areas or near substations			Condition of D&B Contractors contract

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
39	Orient noise generating equipment to direct noise away from noise sensitive receptors			Condition of D&B Contractors contract
40	Provide acoustic enclosures for substation diesel generators	-		Condition of D&B Contractors contract
41	Provide rubber padding/noise isolators for equipment that may cause loud noise or vibration	-		Condition of D&B Contractors contract
42	Notify households within 400 m of expected helicopter deliveries			Condition of D&B Contractors contract
43	Limit helicopter use to daylight hours			Condition of D&B Contractors contract
44	Store conductors in an area free of dust and keep them covered			Included in D&B Contractors bid
45	Avoid laying conductors on barren ground or unpaved roads during stringing	-		Condition of D&B Contractors contract
	Subtotal	183,507,500	1,668,250	
Biological Environmental Mitigation Measures				
1	Conduct Pre-clearance surveys	7,260,000	66,000	
2	Implement wildlife shepherding protocol	14,520,000	132,000	
4	Compensatory plantation cost (based on working procedure for the use of forest lands for national priority infrastructures in Nepal 2076, 17(2)(3) 1:10)) and Government Forest Land Transfer Protocol for Electricity Transmission Project (ETP) approved by MoFE (Minister Level Decision) on Poush 03, 2077(December 18, 2020).	55,65,91,132	4,068,818	4a+4b+4c+4d
4a	Seedlings production (@ Rs. 30.42/Seedling; total 29,06,837 seedlings including survival rate of plantation up to two years; total 29,06,837 seedlings will require)	8,84,25,982	50,59,919	

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S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
4b	Site preparation and plantation (@ Rs 145,000/ha; total 1817 ha of land require to plant 29,06,837 trees)	26,34,65,000	2,395,136	3,156.53 ha forest land
4c	Plantation establishment costs for 5 years - weeding (@ Rs 43,300/ha for 2 years)	15,73,52,200	14,30,475	
4d	Plantation establishment costs for 5 years - protection of the plantation Plantation Watcher (Ban Heralu) (@ Rs 26,058/ha)	4,73,47,950	430,436	
5	**Permanently used forest land cost**	684,146,932	6,219,518	5a+5b
5a	Forest Land Compensation (based on Working procedure for the use of forest lands for National priority infrastructures in Nepal 2076- 8(3) 10)	586,089,000	5,328,082	Land cost for 354.4 hectare of forest land GoN cost
5b	Compensatory plantation in forest land permanently used by ETP Project	9,80,57,932	891,436	Plantation expenses for 354.4 ha for forest land @1600 seedlings for ha
6	Prohibit forest clearing for all Tower Laydown Areas, construction camps, and access trails			Condition of D&B Contractors contract
7	Implement invasive alien species management	8,712,000	79,200	
8	Implement fire management strategy	1,980,000	18,000	
9	Implement community program to reduce poaching and collection of non-timber forest products	5,500,000	50,000	
10	Notify Division of Forestry of any illegal logging or clearing			Condition of D&B Contractors contract
11	Restrict Project vehicles speed to authorized speed limits			Condition of D&B Contractors contract
12	Keep food and domestic refuse in secure containers to avoid attracting fauna			Condition of D&B Contractors contract
13	Install bird diverters on transmission lines in designated areas	11,000,000	100,000	

S/N	Mitigation Measures	Total Cost (NRs.)	Total Cost (US$)	Comments
14	Establish a biodiversity offset plan for bird collision risk	22,000,000	200,000	
	Subtotal	2,552,448,128	26,469,020	
	Socioeconomic and Cultural Environment Mitigation Measures			
1	Implement Workforce Management Plan	1,320,000	12,000	
2	Implement Temporary Land Access Process	1,114,364,000	10,130,579	
3	Implement Worker Access Management Protocol	750,000	10,000	
4	Implement Occupational H&S Plan			Condition of D&B Contractors contract
5	Implement Traffic Management Plan	3,300,000	30,000	
6	Implement Stakeholder Engagement Plan			
7	Implement Cultural Heritage Management Plan	300,000	10,000	
8	Implement Resettlement Action Plan (and LRP), including land acquisition/compensation	8,503,734,000	75,588,747	
9	Implement Worker Grievance Redressal Mechanism	3,300,000	30,000	
11	Provide housing consistent with Worker Accommodation Guidelines			Included in D&B Contractors bid
12	Conduct community training on EMF risks	2,750,000	25,000	MCA cost
13	Ensure security personnel are unarmed			Condition of D&B Contractors contract
	Subtotal	9,629,818,000	85,836,326	
	Grand Total	**13,733,073,628**	**126,403,596**	

नेपाल सरकार
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सिंहदरबार काठमाडौं

CHAPTER NINE
ENVIRONMENTAL MANAGEMENT PLAN

9.1 INTRODUCTION TO THE ENVIRONMENTAL MANAGEMENT PLAN

EPA (2019) requires project proponent to prepare Environment Management Plan (EMP). This section explains the objectives and structure, and rationale of the EMP, which is also referred as Environmental, Social, Health, and Safety Management Plan (ESHSMP), in relation to the Project activities, organization and approach to Environmental, Social, Health and Safety (ESHS) mitigation. In accordance with Article 10(5) of the EPA (2019), the EMP will be implemented through project affected local communities as far as possible.

9.1.1 Objectives and Structure

This ESHSMP is the key safeguard document to ensure that the Electricity Transmission Project (ETP) is implemented in ways that:

- Are safe for its workers and the communities affected;
- Minimize and compensate for disruption to society; and
- Minimize and repair damage to the environment.

The ESHSMP applies to every person and organization involved in the implementation of the Electricity Transmission Project. This means it applies to all MCA-Nepal staff, and the staff and workers of all consultants and contractors, and their sub-consultants, subcontractors, and suppliers.

The ESHSMP is a "living" document. It will be subjected to ongoing review and development to ensure that it remains appropriate for all Project activities. It also includes the approaches for continuous monitoring and periodic auditing with the aim of tracking the effectiveness of the management measures that are being implemented. This element is critical to any effective management plan, as there is little value in continuing to implement management measures that do not achieve the desired objectives of good performance in environmental, social and public health issues. Outcomes from the monitoring and audit programs will be used to assess mitigation performance, to document measurable improvements and to determine if further adaptive management is needed.

The ESHSMP follows a structure that is based on the following order of coverage:

- The well-being of people;
- The protection of society; and

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- The protection of the environment.

This is a continuous cycle, since the well-being of people depends on the protection of the environment. However, although the broad topics covered under the heading of ESHS fall logically into this sequence, there is no implication of any having higher priority than others. Individuals, society, biodiversity and the physical environment are all of equal importance.

In some forms of management planning, a number of sub-plans are referred to. In the ESHSMP Framework, all of the sub-plans are incorporated into this single structure. Hence there are no sub-plans (such as for health and safety, construction site management, erosion control, etc.). All of these aspects are covered in the relevant sections of this all-encompassing ESHSMP. This approach has been adopted to ensure that no sub-plan is ignored in the management of the Project.

Sections 9.2 through 9.10 cover the pre-construction and construction phases of the ETP. Section 9.11 covers the operational phase.

9.1.2 How to Use the ESHSMP

The ESHSMP provides the information required to ensure that the pre-construction and construction phases of the Project are managed in accordance with all the safeguards required by the EIA for safety, health, society and the environment. Different sections explain these as follows:

- The permitted Project activities are described. Other construction activities are not to be used, as they have not been approved through the EIA process.
- The responsibilities of all Project staff and workers are explained. These cover every organization involved in the Project, be it government, donor, client, consultant or contractor.
- The supporting parallel plans (such as those for relationships with stakeholders and for resettlement) are described, along with their relationships with the ESHSMP.
- Details are given of the main construction site management issues.
- Safeguards for the safety and health of workers and neighboring communities are described.
- Social safeguards are explained, including gender and social inclusion, to show how the communities can be protected from negative Project impacts.
- Environmental safeguards are also listed, focusing on the physical environment (particularly the protection of soil and water resources) and the biological environment (particularly animals and the forests that are their habitats).
- Waste management is covered in a separate section, since pollution can potentially affect all aspects of ESHS.

- The mitigation measures, monitoring, reporting and enforcement systems are described in detail.
- The document provides all the supporting details needed to implement the plan effectively. These include procedures and guidelines that provide the practical steps to be followed to implement the mitigation measures to the standard required under the environmental permit issued by the Government of Nepal.

9.1.3 Project Activity Sequence

The Contractor will follow the steps in Table 9.1-1 in sequence and cannot start the next step until completing all prior steps.

Table 9.1-1: Project Activity Sequence

Step	Activity	Responsibility	Condition
1	Ensure permitting is in place	Contractor	To be verified by MCA-Nepal
2	Fulfil permanent land access procedures	RAP Consultant	To be verified by MCA-Nepal
	Fulfil temporary land access procedures	Contractor	To be verified by Project Engineer
	Undertake forest clearance process	MCA-Nepal	Permit issued by MOFE
3	Vegetation clearance	Contractor	To be verified by Project Engineer
	Laydown area and camp establishment	Contractor	To be verified by Project Engineer
	Waste management system establishment	Contractor	To be verified by Project Engineer
	Materials acquisition arrangements	Contractor	To be verified by Project Engineer
	Workforce mobilization and camps	Contractor	To be verified by Project Engineer
4	Construction	Contractor	To be verified by Project Engineer
5	Site restoration and revegetation	Contractor	To be verified by Project Engineer
6	Handing back of temporarily used land	Project Engineer	To be approved by MCA-Nepal

9.1.4 Project Organization for ESHS Management

The management of ESHS compliance is the responsibility of MCA-Nepal, which is the Project proponent and contractual employer. However, all Contractors are given responsibility for ensuring that all of their actions are compliant with the conditions of the environmental permit issued by the MoFE: contracts are clear on this point. Damage to any part of the environment or disruption to society by a Contractor is usually also an infringement of the law. A failure to comply with the environmental and social mitigation measures may therefore subject a Contractor both to corrective actions and penalties under the contract with MCA-Nepal, and to legal action by the civil authorities. While MCA-Nepal retains ultimate responsibility for monitoring Contractor compliance with the ESHSMP and will use its own Environmental and Social Performance (ESP) personnel, they will be supported by the Project

Engineer, who will provide independent third party monitoring of project construction, including compliance with the requirements of the ESHSMP

The organization for ESHS management is summarized in the table below. In the environmental management and monitoring matrix, these responsibilities are clearly stated against each set of mitigation. The process of resettlement and compensation is managed by a separate implementation consultant. Detailed responsibilities for each organization are given in Section 10.2.

Table 9.1-2: ESHS Management Organization

Organization	ESHS Management Responsibility	Reports to	Personnel Requirements	Personnel Roles
MCA-Nepal	The Client or Employer in contractual terms. Will let contracts for engineering design, procurement and construction of the ETP, all to be completed in line with ESP safeguards. Participates in continuous monitoring and periodic auditing.	Government of Nepal (GoN)	Executive Director	Approves and submits reports to GoN and MCC, as appropriate
			Deputy Executive Director (Project Delivery)	Reviews and rejects or approves the Engineer's and Contractors' reports. Approves corrective action plans for the Contractors. Communicates on ESP issues with MCA-Nepal ESP and MCC-ESP.
			Environmental Specialist	Participates in monitoring physical and biological environmental aspects, health and safety issues.
			Land Acquisition Specialist	Participates in monitoring social aspects, including compensation and stakeholder engagement.
			Gender and Social Inclusion Specialist	Participates in monitoring of gender and social inclusion provisions.
			Quality Assurance Manager - Environment, Health and Safety	Monitors the level of achievement on all environmental aspects of the Project, and health and safety issues.
			Quality Assurance Manager -Social Inclusion and Resettlement	Monitors the level of achievement on all resettlement/compensatory and gender and social inclusion aspects of the Project

Organization	ESHS Management Responsibility	Reports to	Personnel Requirements	Personnel Roles
Project Engineer	The Project Engineer will provide oversight of all construction contracts and activities. Carries out monitoring as required by the ESHSMP. Reviews and approves Contractors' monthly monitoring reports. Performs completion audits.	MCA-Nepal	Project Manager	Reviews and rejects or approves the Contractors' reports. Approves ESHS monitoring reports. Develops corrective action plans for the Contractors.
			Site Managers	Supervises and monitors the Contractors' technical works.
			Health and Safety Specialist	Monitors the Contractors' health and safety performance.
			Social Specialist	Carries out monitoring of social aspects, including stakeholder engagement.
			Gender and Social Inclusion (GSI) Specialist	Monitors and reviews Engineer's and Contractors' performance, undertakes GSI awareness training for both Engineer and Contractors.
			Environmental Specialist	Carries out monitoring of physical and biological environmental aspects of Project activities.
			Geomorphologist/ Soil Conservation Specialist	Responsible for checking the conditions around aggregate sources and completed work sites.
Contractors	The design and build Contractors. Carry out internal monitoring to ensure compliance with the ESHSMP and any Contractor's plans approved by the Engineer and MCA-Nepal.	MCA-Nepal, usually via the Engineer.	Project Managers	Ensure that their companies achieve all of the ESHS requirements. Submit monitoring reports to MCA-Nepal via the Engineer. Devise and implement corrective measures as necessary.
			Site Managers	Ensure that all of the ESHS requirements are achieved on their allocated sites.
			ESHS Manager	Approves and submits reports to MCA-Nepal. Ensures that corrective measures are completed.

Organization	ESHS Management Responsibility	Reports to	Personnel Requirements	Personnel Roles
			Health and Safety Managers	Support their companies in achieving all of the health and safety requirements. Prepare monitoring reports to MCA-Nepal. Ensure that corrective measures are completed.
			Gender and Social Inclusion Managers	Support their companies in achieving all of the social requirements. Prepare monitoring reports to MCA-Nepal. Ensure that corrective measures are completed.
			Environmental Managers	Support their companies in achieving all of the environmental requirements. Prepare monitoring reports to MCA-Nepal. Ensure that corrective measures are completed.
RAP implementation consultant	Implements RAP on behalf of MCA-Nepal.	MCA-Nepal	RAP Implementation Manager	Oversees and coordinates all RAP implementation-related activities. Carries out required monitoring. Produces monthly reports.
MCC	Donor. Disburses funding for the Project.	U.S. Government	MCC-Nepal Country Director	Primary contact between GoN and MCC. Reviews and rejects or approves progress and monitoring reports.
			MCC-ESP Staff (Washington, D.C.)	Review Reports, provides feedback to MCA-Nepal on MCC requirements
MoFE	Regulator. Responsible for checking compliance with environmental permit conditions. Also administers forest clearing and compensation.	GoN	Environmental and Social Safeguards Specialists	Carries out external monitoring activities. Issues instructions to MCA-Nepal for any corrective actions considered necessary.

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Organization	ESHS Management Responsibility	Reports to	Personnel Requirements	Personnel Roles
DoED	Host government entity. Responsible for ensuring that the Project complies with the conditions in the environmental permit.	GoN	Environmental and Social Safeguards Specialists	Carries out external monitoring activities. Provides feedback to MCA-Nepal on issues of concern for action to be taken.
PCTMCDB	Agency responsible for conservation controls in some Project areas.	GoN	Environmental Specialists and Foresters	May carry out external monitoring and provide feedback to MCA-Nepal on issues of concern in its area of interest (i.e. the Chure and Terai).
CAAN	Agency responsible for administering aviation hazards.	GoN	Technical Specialists	Carry out external monitoring activities. Provides feedback to MCA-Nepal on issues of concern so that MCA-Nepal can take action.
Local Governments	Responsible for monitoring and grievance resolution	GoN	Local government officials	Carry out external monitoring activities and provide feedback to MCA-Nepal. Help to address local grievances.

9.1.5 Impacts and Mitigation

Construction of the ETP will have various impacts on the physical, biological, and social environment. MCA-Nepal has worked to avoid and minimize many potential impacts through careful routing and design of the transmission line.

The sections below briefly describe the most significant Project impacts and mitigation measures.

9.1.5.1 Physical Environment

The Project will have relatively minor impacts on most physical environment as described below, along with the mitigation measures required to ensure that the residual impacts are not significant.

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Table 9.1-3: Physical Environment Mitigation Measures

Issue / impact	Mitigation Measures
Erosion and landslides	• Implement site-specific erosion and sediment control measures as described in the ESHSMP. • Minimize ground disturbing activities during the monsoon season. • Limit clearing within the RoW by simply topping trees, leaving tree stumps, root systems, shrubs and the herbaceous layer intact, to stabilize the soil. • Prohibit construction of new access roads to minimize forest clearing. • Carefully segregate soils excavated for tower foundation construction, stockpile them and replace them once construction is complete. • Provide appropriate storm drainage and direct drainage away from steep slopes and erodible areas.
Impacts on air quality	• Limit clearing in the RoW to the extent possible. • Stabilize disturbed areas as soon as possible after construction is completed. • Cover excavated soils. • Spray water on disturbed areas.
Impacts on water resources	• Water sourcing: water may be withdrawn from local streams for the production of concrete for the tower foundations. Contractors are limited to withdrawing no more than 20 percent of the flow of small streams and springs; • Aggregate sourcing: construction aggregate is needed for concrete production and will be obtained from already permitted sources such as permitted quarries and district approved sand miners. Because of its environmental sensitivity and conservation status, sourcing of aggregates is prohibited in the Chure Conservation Area. • Sewage and wastewater discharges: every Contractor will manage sewage and wastewater by providing pit toilets at all tower construction sites and septic systems at camps, laydown areas and at the three new substation sites. Wastewater discharges to streams are prohibited. • Hazardous materials: the Project will use hazardous materials such as diesel fuel for vehicles and generators, oils and lubricants, paint and cement. Contractor staff will be trained in the proper care, handling, storage, transport, and disposal of hazardous materials. Diesel storage tanks will be located at least 100 meters from any streams and will have secondary containment to contain any spills.
Noise	• Noise-generating activities will be prohibited between 10 pm and 6 am. To the extent helicopters will be used, the contractor will pre-notify nearby households and helicopter use will be limited to daylight hours, and with no flying on public and religious holidays.

9.1.5.2 Biological Environment

Important biological environment resources affected by Project construction and operation will include forests and other important habitats, and some species of conservation significance. These effects are summarized below, with the corresponding mitigation measures.

Table 9.1-4: Biological Environment Mitigation Measures

Issue / impact	Mitigation Measures
Impacts to Protected Areas and Internationally Recognized Areas for Biodiversity	• Comply with the requirements as outlined below for forests and vegetation • Comply with the requirements of the GoN in relation to operating within conservation landscapes
Impacts on forests and vegetation	• Minimize forest clearing to tower construction sites and areas of the RoW where cable clearance above trees would not meet standards. • Develop a new large tower type to allow the transmission lines to span longer distances over valleys, which again reduces the need to clear underlying forests. • In remote or difficult to access areas, a helicopter will be used to deliver construction equipment and materials to minimize forest clearing for access. • Compensatory forest plantation on a 1:10 basis (plant 10 saplings for each tree cleared). • Minimize impacts to several critically endangered and endangered bird species found in some areas along the alignment.
Impactss due to invasive species	• Manage invasive species in areas of natural habitat. Ensure that that all equipment is cleaned and maintained prior to transport to and from each work site • Inspect areas of natural habitat for invasive species once construction is complete and control these species as necessary
Impacts due to fires	• Manage the use of fire at workers camps to reduce fire risk, particularly during the dry season
Impacts on important terrestrial habitats and species (edge effects, NTFP collection and hunting/poaching of fauna)	• Shepherding protocols to be used to relocate less mobile fauna (e.g. pangolins, elongated tortoise) before clearing activities begin. • Replanting disturbed areas with native species, employing sediment and erosion control measures, especially around rivers and steep slopes, and avoiding the introduction of invasive species. • Worker education and enforcement of the Worker Code of Conduct will reduce the risk of hunting and poaching.
Impacts on birds	• Transmission towers designed such that the lines are spaced further apart than the wingspan of the largest bird in Nepal (the Himalayan griffon), which effectively eliminates the risk of electrocution. • Install bird diverters and marker balls on the transmission lines in areas where these birds are known to fly or migrate through.

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9.1.5.3 Socioeconomic Environment

Project activities, during the construction and operation phases, are likely to have both beneficial and adverse impacts on the socioeconomic environment.

Beneficial impacts are as follows.

- Construction of the ETP will create over 7,300 full-time jobs over the 3.5-year construction period.
- It is estimated that Nepalese workers would fill about 60 percent of these jobs.
- Goods and services requirements through the Project lifecycle will provide opportunities for local businesses in areas such as construction equipment, food for the worker camps, and support services.

Adverse impacts and the appropriate mitigation measures are listed below:

Table 9.1-5: Socioeconomic Environment Mitigation Measures

Issue/impact	Mitigation Measures
Land acquisition and restrictions	• Acquire land for the substation and tower pads in accordance with the provisions of the Land Acquisition Act 2034. • Create and secure the easement for the land within the RoW subject to permanent restrictions in accordance with the provisions of the Electricity Act, in coordination with the District Compensation Determination Committees (CDC).
Physical and economic displacement	• Pay compensation as per the RPF and RAP. • Implement a Livelihood Restoration Plan for displaced families or workers, as applicable • Follow the Temporary Land Access Process and mitigate, compensate for temporary access on private or used land.
Impacts on Community and Leasehold Forests	• Implement the Workforce Management Plan • Mitigate impacts through entitlements included in the RAP and livelihood support for vulnerable households. • Apply the Worker Access Management Protocol
Impacts on community health, safety, and security	• Require proof of age for all employees. • Implement a Workers Code of Conduct • Implement the Anti-sexual Harassment Policy. • Implement a Traffic Management Plan. • Explain development restrictions on land within the RoW (e.g., prohibition on the construction of any houses) • Implement the Trafficking in Person (TIP) Risk Management Plan.
Impacts on indigenous, vulnerable, and disadvantaged people	• Provide trainings to staff and workers to raise awareness of the criminal nature of gender-based violence, trafficking in persons and other civil offences. • Prohibit unfair hiring and payment practices. • Implement a Gender and Social Integration (GSI) Plan.

The Workers' Code of Conduct requires respect for local customs and practices. It is also used to prohibit certain activities and emphasize the importance of non-involvement in a number of illegal activities. These include:

- Hunting;
- Collection of firewood;
- Unauthorized clearing of vegetation;
- The collection of or trade in plants and animals;
- Possession of illegal substances;
- Abuse of drugs and alcohol;
- Gambling;
- Carrying of firearms;
- Trafficking in persons;
- Involvement with prostitutes; and
- Sexual harassment and abuse.

In addition, the Project will implement a Grievance Redress Mechanism (GRM) that allows stakeholders to raise concerns about MCA-Nepal's, the Engineer's and the contractors' environmental and social performances.

9.2 RESPONSIBILITIES FOR IMPLEMENTING THE ESHSMP

The sections below summarize the main responsibilities of the organizations responsible for implementing and overseeing the ESHSMP.

9.2.1 Permitting and Regulations

MCA-Nepal is the proponent of the Project and will obtain the environmental permit for the overall Project. This permit is based on the designs, locations, construction methods, activities and materials described in the Environmental Impact Assessment. Any change to any aspect of these may lead to a need for the EIA and environmental permit to be revised. The environmental permit does not include the right to enter any area of land, to clear any forest or to ignore any law or regulation.

The forest clearance permit is separate from the environmental permit. This will also be obtained by MCA-Nepal for the whole Project. It will cover only specified areas of forest at certain tower sites and in certain sections of the right of way where conductors will not be able to span trees with adequate clearance. Any change to these areas will require the forest clearance permit to be revised.

Every Contractor is responsible for determining what further permits are required and for obtaining them. These may include permits relating to aspects such as vehicles, waste and the sources of building aggregates. Permits may be needed from federal, provincial, district and municipality governments.

It is expected that sand and aggregates for construction will be obtained from a number of sources. It is each Contractor's responsibility to arrange these. Every material source will be covered by a valid environmental permit, a copy of which will be submitted to the Engineer with a request for approval of the use of that source. The Engineer will in turn obtain the approval of MCA-Nepal's ESP Specialist (Environment) for each source, and additional ESHS mitigation measures are likely to be required by MCA-Nepal before approval can be given.

No Contractor will apply for further permits from the MOFE without first defining a need and obtaining the written approval of MCA-Nepal to initiate the permit request procedure. All parties will closely coordinate with the central, provincial and local governments as required.

9.2.2 Contractors

This ESHSMP specifies the minimum requirements for the safeguarding of all ESHS aspects of the Project during the pre-construction and construction phases.

Each Contractor will prepare a detailed Contractor's Environmental, Social, Health and Safety Management Plan (CESHSMP) that will state in detail how the provisions of this ESHSMP Framework will be implemented by that Contractor on its specific parts of the Project site, given that Contractor's actual tasks and methods. It is expected that every CESHSMP will incorporate sections of this document to avoid duplication and ensure alignment. Each CESHSMP will be reviewed and changes required if necessary before approval by both the Engineer and MCA-Nepal. Full approval will be obtained at least one month before the Contractor starts any site activities, including any access to land or preparations for the establishment of ancillary facilities such as camps and laydown areas.

Every CESHSMP will contain, in addition to all relevant components of the ESHSMP, Contractor-specific plans that cover:

- Spill response and clean-up; and
- Emergency response.

The general development and approval process for each CESHSMP is as follows:

- The Contractor will develop a detailed draft CESHSMP, using this ESHSMP Framework to establish the minimum MCA-Nepal requirements.
- The Contractor will provide the draft CESHSMP to the Engineer for its review.
- The Engineer will review the draft and provide comments to the Contractor.

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- The Contractor will address all comments provided by the Engineer and provide a revised draft CESHSMP which the Engineer will check and send with its recommendation to MCA-Nepal for its review.
- MCA-Nepal will review and, if acceptable, approve the CESHSMP, with further comments and revisions if necessary.
- Hard and soft signed copies of the final CESHSMP will be distributed among MCA-Nepal, the Engineer and the Contractor for use.

The ESHSMP-related responsibilities of the Contractor are as follows:

- Develop a draft CESHSMP, which addresses all applicable construction phase ESHS commitments based on the compliance register of MCA-Nepal that will be part of its Environmental and Social Management System (ESMS).
- Maintain copies of the current approved CESHSMP at all central and site offices at all times.
- Follow the management of change process described in Section 9.2.10 for any changes to the CESHSMP;
- Include language requiring full compliance with this ESHSMP Framework and the relevant CESHSMP in all subcontracts related to the Project. If a subcontractor proposes any changes to the current approved CESHSMP, those changes will go through the management of change process.
- Provide appropriate training at all levels of management, staff and workforce to assure that its personnel understand the requirements of the CESHSMP.
- Ensure all new Project personnel receive ESHS training as part of their induction process as described in Section 9.5.2.
- Provide written verification (induction sign-off) that all new personnel have completed the Project induction, understand their ESHS obligations and commit to comply with them.
- Employ staff qualified in all topics of ESHS to oversee the Project's ESHS measures.
- Ensure that ESHS staffing and resources are adequate, commensurate with the magnitude and timing of work and potential ESHS risks.
- Construct the Project in accordance with the EIA, ESHSMP and the CESHSMP.
- Comply with the MCA-Nepal's GRM.
- Erect notification boards at all construction sites providing information for the local communities about the Project, and instructions on how to lodge any grievances or make suggestions, along with contact information for the site managers and ESHS staff.

- Establish an employees' grievance mechanism that complies with International Finance Council (IFC) Performance Standard 2, to provide a way for workers to file grievances or make suggestions.
- Notify the Engineer and MCA-Nepal of all incidents and accidents in accordance with the requirements of the ESHSMP.
- Monitor and report on the ESHS performance of the Project during construction as described in Section 9.10.1.
- Participate in regular ESHS performance meetings with the Engineer and MCA-Nepal, as required, to review ESHS performance.
- Proactively implement corrective actions to address any situations where the requirements of the ESHSMP are not being met.
- Retain documentation of Project compliance to facilitate ESHS compliance audits.
- Cooperate fully with all compliance audits conducted by or on behalf of the engineer, MCA-Nepal, MCC or a government regulatory agency.
- Cooperate fully and implement any corrective actions required by the Engineer or MCA-Nepal, to address all situations where the requirements of the ESHSMP or the laws of Nepal are not being met.

The required minimum numbers of Contractors' ESHS staff to be provided from pre-construction to site handover, according to activity, are as shown in the table below.

Table 9.2-1: Contractor ESHS Staffing Requirements

Supplier	Senior specialism	Number	Mid-level specialism	Number
Contractors	Health and Safety Managers	1 per contract	Health and Safety Superintendents	Substations: 1 per substation Tower foundations: 5 per 100 kilometers (assuming 1 person will supervise 5 foundations every day) Tower erection (with helicopter): 3 per 100 kilometers Tower erection (no helicopter: 15 per 100 kilometers [1 for each tower + 1 additional for laydown areas]) Conductor stringing: 7 per 100 kilometers
	Gender and Social Safeguard Managers (will	1 per contract	Gender and Social Safeguards	1 of each per substation 1 of each per TL segment, covering tower sites, laydown areas, etc.

Supplier	Senior specialism	Number	Mid-level specialism	Number
	include GSI specialist skills)		Superintendents and Assistants	
	Environmental Managers	1 per contract	Environmental Superintendents	1 per substation 1 per 50 kilometers of TL, covering tower sites, laydown areas, etc.

The minimum qualifications for the various categories of staff are as given below.

Table 9.2-2: Minimum Staff Qualifications

Sector	Required managers' qualifications	Required superintendents' qualifications
Health and safety	• Bachelor degree in engineering / environmental science (or equivalent) • Minimum of 8 years site experience as Safety Officer /Site Engineer in any Transmission Line construction work (132 kV and above) • Certificate / training in health and safety • Working knowledge in Nepali, Hindi and English.	• Bachelor degree in engineering / environmental science (or equivalent) / or diploma in engineering • Minimum of 2 years site experience as Safety Officer /Site Engineer in any Transmission Line construction work (132 kV and above) • Certificate / training in health and safety is preferred. • Working knowledge in Nepali, Hindi and English.
Social safeguards	• Master or Bachelor degree in social science / human geography (or equivalent) • Minimum of 8 years site experience in any Transmission Line construction work • Working knowledge in Nepali, Hindi and English.	• Master or Bachelor degree or diploma in social science / human geography (or equivalent) • Minimum of 10 years experience and 3 years site experience in any Transmission Line construction work • Working knowledge in Nepali, Hindi and English.
Environmental safeguards	• Master or Bachelor degree in physical geography / natural science / environmental science / environmental management • Minimum of 8 years site experience in any Transmission Line construction work • Working knowledge in Nepali, Hindi and English.	• Master or Bachelor degree or diploma in physical geography / natural science / environmental science / environmental management • Minimum of 2 years site experience in any Transmission Line construction work • Working knowledge in Nepali, Hindi and English.

The frequency and duration for the presence of the Contractor's ESHS staff on site, and for which activities they will be present, will be agreed with the Engineer. This site attendance protocol will be submitted to MCA-Nepal for approval. The extent to which it is achieved will be included in Monthly ESHS Reports.

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9.2.3 Project Engineer

The Project Engineer is the consultant engineering company tasked with supervising the quality of design and construction on behalf of MCA-Nepal. The Project Engineer will have a technical team responsible for overseeing the actual engineering and construction, and an ESHS team responsible for overseeing the implementation of the mitigation measures for all ESHS aspects as described in this ESHSMP Framework.

- Provide information to MCA-Nepal to maintain its ESHS compliance register as part of its ESMS, which includes all Project commitments in response to government approvals, MCC standards, MCA-Nepal requirements and agreements with local communities.
- Review, request changes as necessary and recommend MCA-Nepal to approve every CESHSMP.
- Comply with the management of change process described in Section 9.2.10 for any changes required to the ESHSMP.
- Provide appropriate training at all levels of management, staff and workforce to assure that its personnel understand the requirements of the CESHSMP.
- Ensure all new Project personnel receive ESHS training as part of their induction process as described in Section 9.5.2.
- Provide written verification (induction sign-off) that all new personnel have completed the Project induction, understand their ESHS obligations and commit to comply with them.
- Employ staff qualified in all topics of ESHS to oversee the Contractors' ESHS measures.
- Ensure that ESHS staffing and resources are adequate, commensurate with the magnitude and timing of work and potential ESHS risks.
- Supervise the construction of the Project in accordance with the EIA, ESHSMP and the CESHSMP.
- Comply with the MCA-Nepal's GRM.
- Monitor Contractors' ESHS performance and ensure they monitor their own and all subcontractors' ESHS performance throughout construction, including mobilization and site closure.
- Report on the ESHS performance of the Project during construction as described in Section 9.10.2.
- Hold regular meetings with all Contractors to review ESHS performance.
- Proactively instruct corrective actions to address any situations where the requirements of the ESHSMP are not being met. Issue non-compliance and corrective action orders, including stop work and stop task orders according to the provisions in Section 9.10.4.

- Notify MCA-Nepal of all instructions relating to non-compliance.
- Retain documentation of Project compliance to facilitate ESHS compliance audits.
- Co-operate fully with all compliance audits conducted by or on behalf of MCA-Nepal, government regulatory agencies and the MCC.

The required minimum numbers of the Project Engineer's ESHS staff to be provided from pre-construction to site handover are as shown in the table below. The qualifications should be similar to those defined for contractors in Section 9.2.2.

Table 9.2-3: Minimum Numbers of Project Engineer's ESHS Staff

Supplier	Senior Specialism	Number	Mid-level Specialism	Number
Project Engineer	Health and Safety Specialist	1 overall	Health and Safety Officers	5, allocated between SS and TL according to activities
	Social Safeguards Specialist	1 overall	Social Safeguards Officers	5, allocated between SS and TL according to activities
	Environmental Specialist	1 overall	Environmental Officers, different technical areas (physical, biological, etc.)	5, allocated between SS and TL according to activities

The frequency and duration for the presence of the Project Engineer's and the Contractors' ESHS staff on site, and for which activities they will be present, will be agreed between the Project Engineer and each Contractor. These site attendance protocols will be submitted to MCA-Nepal for approval. The extent to which they are achieved will be included in Monthly ESHS Reports.

9.2.4 Millennium Challenge Account Nepal

MCA-Nepal is the client, employer and proponent of the Project. Under the environmental permit issued by the MoFE, it is to be obligated to uphold the ESHS standards defined in this ESHSMP Framework, for the activities described in the EIA.

- Include language in all contracts that requires the Contractor to comply with the latest approved ESHSMP, RAP and RAP-ISP.
- Prepare and maintain an ESHS compliance register as part of the ESMS, which includes all Project commitments in response to government approvals, MCC standards, MCA-Nepal requirements and agreements with local communities.
- Review, request changes as necessary and approve every Contractor's CESHSMP.
- Operate the management of change process described in Section 9.2.10 for any changes required to the ESHSMP.

- Monitor Contractors' ESHS performance and ensure they monitor their own and all subcontractors' ESHS performance throughout construction, including mobilization and site closure.
- Hold regular meetings with the Project Engineer and all Contractors to review ESHS performance.
- Notify the Project Engineer of the need for any corrective actions by the Contractors.
- Instruct the Project Engineer to issue non-compliance and corrective action orders, including stop work and stop task orders, according to the provisions in Section 9.10.4.
- Co-operate fully with all compliance audits conducted by or on behalf of government regulatory agencies and the MCC.

9.2.5 RAP Implementation Consultant

The Resettlement Policy Framework (RPF) specifies the Resettlement Action Plans (RAP) for all aspects of the resettlement process, which are required to be implemented before and complied with during the pre- construction and construction phases of the Project. This Section describes the process for implementing the RAP and for approving, and where needed, modifying the RAP, and each party's responsibilities relating to the RAP.

The general development and approval process is as follows:

- The RAP Implementation Consultant will develop a detailed draft RAP Implementation Schedule Plan (RAP-ISP), using the agreed RAPs which establish the minimum MCA-Nepal requirements;
- The RAP Implementation Consultant will provide the draft RAP-ISP to MCA-Nepal for its review;
- MCA-Nepal will provide comments to the RAP Implementation Consultant;
- The RAP Implementation Consultant will address all comments provided by MCA-Nepal and provide a final RAP-ISP to MCA-Nepal for its review;
- MCA-Nepal will review and, if acceptable, approve the final RAP-ISP; and
- Hard and soft signed copies of the final RAP-ISP will be distributed by the RAP Implementation Consultant to all relevant Project offices including the District Public Information Offices.

The list below indicates the RAP-related responsibilities of the Resettlement Implementation Consultant.

- Develop a draft RAP-ISP, which addresses all applicable pre-construction and construction phase RAP commitments, and revise it as needed in order to obtain MCA-Nepal approval.

- Maintain a copy of the current approved RAP and RAP-ISP at the construction site management office at all times.
- Follow the management of change process described in Section 9.2.10 for any changes to the RAP-ISP.
- Provide appropriate training so as to assure that the workforce understands the requirements of the RAP and RAP-ISP.
- Implement the RAP in accordance with the RAP-ISP and the ESHSMP.
- Comply with the MCA-Nepal's GRM, ensuring that all resettlement-related grievances are addressed by the system.
- Provide material at regularly updated times and take responsibility for placing on the notification boards at all construction sites, information for the local communities about the Project, as well as instructions on how to log any grievances or make suggestions along with contact information for the site managers, and ESHS staff. Record all such actions.
- Participate in regular performance meetings with the MCA-Nepal to review RAP-ISP performance.
- Retain documentation of Project compliance with the RAP, RAP-ISP and related sections of the ESHSMP to facilitate MCA-Nepal compliance audits.
- Cooperate fully with all compliance audits conducted by or on behalf of MCA-Nepal, MCC and government regulatory agencies.

9.2.6 Millennium Challenge Corporation

As a public sector donor, the MCC will ensure that the Project meets the standards that underlie its policies. Its Environmental and Social Protection staff are obliged to monitor the ETP and ensure that it complies with all aspects of the ESHSMP.

9.2.7 Ministry of Forests and Environment

MoFE is the national regulator for environmental and social compliance by all industries and development activities on behalf of the government and as defined in the environmental protection legislation. For monitoring, its main source of information is from the reports that are specified in management plans such as the ESHSMP. However, it may also either undertake its own monitoring of the Project or might commission an independent review.

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9.2.8 Department of Electricity Development

The government agency responsible for the industrial context of the ETP is the DOED. Although the MCA-Nepal reports to the Ministry of Finance, for technical regulation it is answerable to DOED. This department has its own environmental and social unit, and may monitor the Project's compliance with the ESHSMP and adherence to the conditions of its environmental permit.

9.2.9 Capacity Building and Training

Several capacity and occupational enhancement trainings may be demanded by the Project affected communities. The Project proponent or Contractors are responsible for implementation of such need-based trainings according to the nature of the topic and the community demand. Some of the trainings are likely to be along the following lines:

- Trainings and awareness campaigns on HIV/AIDS, STD, TIP, sexual harassment, nutrition, and sanitation;
- Conservation of wildlife and forests;
- Agricultural assistance and modern farming;
- Skill enhancement trainings on animal husbandry, carpentry, eco-tourism, house-wiring, home-stays, etc., as per locals' opportunities, and occupations;
- Capacity building on income generating programs as mushroom farming, fisheries, pig farming, etc.;
- Trainings on control of forest fires;
- Nursery establishment and the rational use of Community Forest products; Capacity building for emergency preparedness on natural calamities such as landslides, floods, earthquakes, etc.;
- Employment and livelihood restoration opportunities for women and marginalized groups
- Capacity building in financial literacy and targeting individuals with low levels of literacy, especially women and marginalized groups; and
- Supportive programs for nature conservation to CFUGs and LFUGs.

9.2.10 Management of Change

A need may arise to modify the ESHSMP. This section establishes the change management requirements for all such changes.

It is anticipated that most of the proposed changes to the ESHSMP will be initiated by the Contractors. However, the system also allows for the Project Engineer and MCA-Nepal to propose changes when it is reasonably likely that the current ESHSMP is not sufficient to prevent:

- Serious health and safety incidents;
- Impacts above those disclosed in the EIA;
- New impacts not disclosed in the EIA;
- Violation of Nepal law; and
- Non-compliance with MCA-Nepal requirements.

The list below defines three categories of potential changes to the ESHSMP.

- Changes that have the potential to, or are reasonably likely to, result in decreased Contractors' ESHS performance, or are likely to result in an increase in ESHS impacts above those disclosed in the EIA, result in new impacts not disclosed in the EIA, require the acquisition of rights to use additional lands, or require additional permits or approvals from the government.
- Changes which have the potential to, or are reasonably likely to result in, decreased Contractors' ESHS performance, but are unlikely to result in any increase in ESHS impacts above those described in the EIA, or result in new impacts not described in the EIA, or require the acquisition of rights to use additional lands.
- Changes that are expected to result in similar or improved ESHS performance and are unlikely to result in any increase in environmental or social impacts above those described in the EIA.

The review and approval process is given below.

1. The Contractor will notify the Project Engineer in a formal written submission of the proposed change and provide the rationale and justification for the change.
2. The Project Engineer will review the submission, add comments and participants the request with a recommendation to MCA-Nepal.
3. MCA-Nepal will consider and consult on the matter, and take action accordingly.
4. If MCA-Nepal agrees with the request, it will modify the ESHSMP and issue an updated version.
5. Some changes may require MCA-Nepal to seek the approval of the MoFE, where they are affected by the conclusions of the EIA or the conditions of the environmental permit. In this event, MCA-Nepal will obtain formal approval from MoFE before modifying and re-issuing the ESHSMP.

Contractors are required to maintain a copy of the current version of the ESHSMP at their central and construction site offices at all times. Every Contractor is to understand that MCA-

Nepal and the Project Engineer will use the current version of the ESHSMP as the basis for conducting their monitoring inspections.

The flow chart given below gives an indication of the time implications of changes in design and approach.

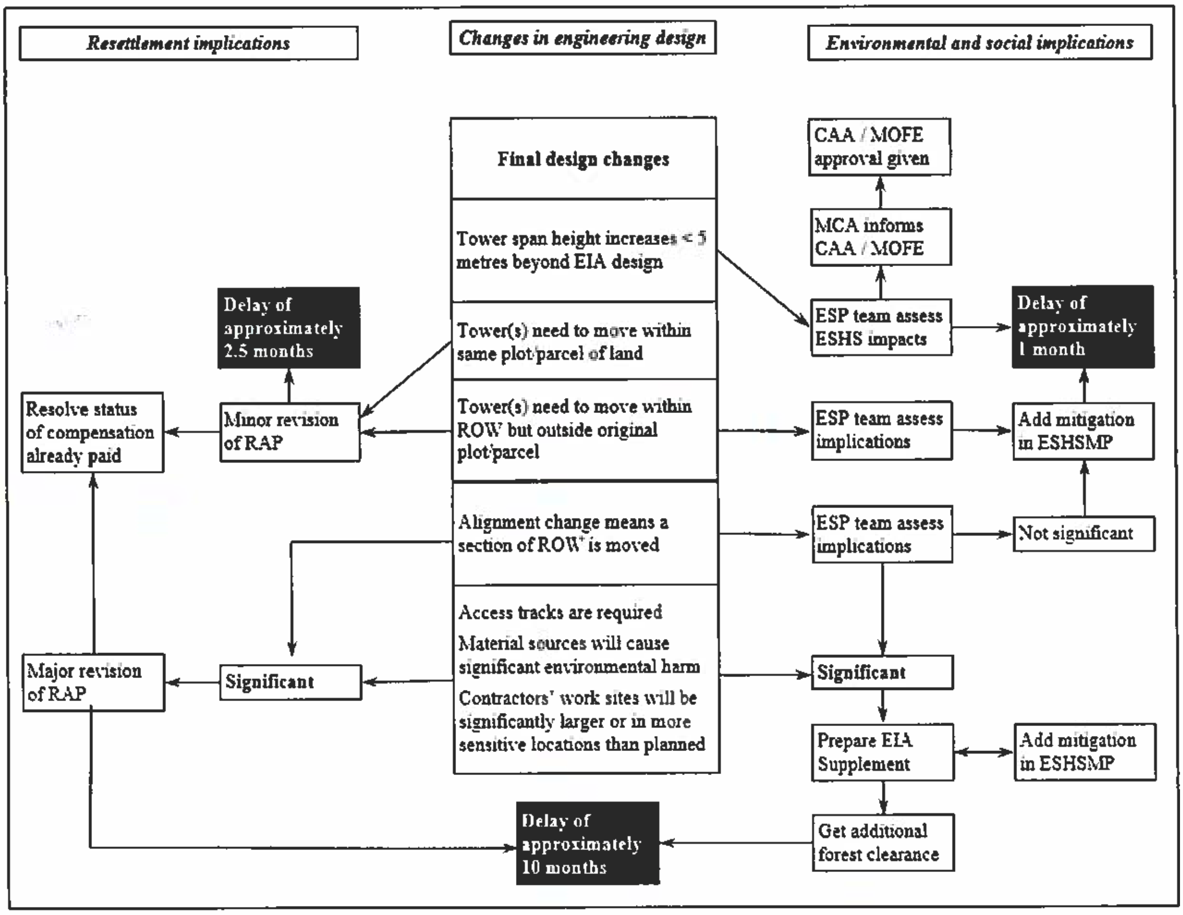

Figure 9.2-1: Flow Chart of Implications of Engineering Design

9.3 KEY SOCIAL SAFEGUARDS SUPPORTING THE ESHSMP

This section provides a brief overview of the separate safeguard plans that the Project will implement in parallel with the ESHSMP.

9.3.1 Stakeholder Engagement and Community Consultation

MCA-Nepal has prepared and commenced implementation of a Project Stakeholder Engagement Plan (SEP) and community consultation process to guide all interactions between Project personnel and the neighboring communities. The SEP and consultation process are to be continued through the pre-construction and construction phases. They will cover all communities where land is being permanently acquired (land under tower pads, substations and substation access roads), and where use restrictions apply within the transmission line rights of way.

This SEP and consultation process will be used to direct, determine, record and monitor all interactions with the communities, whether they are affected by the construction activities or not. They are compliant with IFC Performance Standard 5 and will be used to direct all community interactions to ensure international best practice in communicating with stakeholders and communities. Maintaining high standards of communication is vital to reduce Project delays and prevent the generation of additional grievances. Continuity of use of these approaches over the Project life will contribute to the success of the Project through consistent practices, recording and problem-solving mechanisms.

The SEP and community consultation process are based on the following:

- Applicable local and national gender and social safeguards and regulations of the GoN on land acquisition, compensation, and resettlement for permanent land acquisition and rights of way;
- National Policy on Land Acquisition, Compensation and Resettlement in Development Projects in Nepal (formal cabinet approval given in July 2016);
- IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement (and IFC Performance Standard 7 on Indigenous Peoples as appropriate);
- Guidelines applicable for MCA-Nepal (i.e. MCC Environmental Guidelines 2010 and MCC Gender Policy 2011); and
- MCA-Nepal's Social and Gender Integration Plan (SGIP) and Resettlement Policy Framework (RPF).

The implementation of the SEP and community consultation process are described in procedures in Annexes L.4.1a, 4.1b and 4.1c.

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9.3.2 Resettlement and Compensation

9.3.2.1 General

MCA-Nepal is to prepare Resettlement Action Plans (RAP) covering all areas where land is being permanently acquired under tower pads, substations and substation access roads, and where land use restrictions apply within the transmission line rights of way. All RAP will be based on the Project's approved Resettlement Policy Framework (RPF), and will include Livelihoods Restoration Plans (LRP), as applicable.

Four RAP will be prepared, as follows:

- RAP Package 1: Ratmate Substation
- RAP Package 2: Segment from India Border to New Damauli
- RAP Package 3: Segment from New Damauli to Ratmate
- RAP Package 4: Segment from New Hetauda (via Ratmate) to Lapsiphedi

The purpose of implementing a Resettlement Action Plan is to mitigate and manage the adverse impacts of physical and economic displacement on people that result from permanent land acquisition and restrictions of land use within the transmission line RoW. It applies to all land that is privately owned and used.

All RAP prepared for the Project will be guided by the RPF. This policy document was developed for the Project and is based on the following standards:

- *Land Acquisition Act* (1977), rules and regulations of the GoN on land acquisition, compensation and resettlement for permanent land acquisition and rights of way;
- National Policy on Land Acquisition, Compensation and Resettlement in Development Projects in Nepal (formal cabinet approval given in July 2016);
- IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement (and IFC Performance Standard 7 on Indigenous Peoples as appropriate); and
- Guidelines applicable for MCA-Nepal (i.e., MCC Environmental Guidelines 2010 and MCC Gender Policy 2011).

9.3.2.2 Key Elements

MCA-Nepal will implement resettlement planning and implementation in line with international standards as outlined in the RPF. Key aspects include the following:

- Payment of compensation to replace land, assets thereon, incomes and livelihoods linked to the Project's impacts on, or use of land and natural resources, irrespective of the legal recognition of land tenure and based on full replacement cost;

- Restoration (at a minimum) or improvement of the livelihoods and standards of living of affected people, families, and communities; and
- Improvements in living conditions among physically displaced households through the provision of adequate housing with security of tenure at resettlement sites, as applicable.

The RPF provides an overview of entitlements and an approach to integrate resettlement-planning safeguards into the land acquisition process to be implemented by MCA-Nepal and the GON. The document also includes an overview of the Project's affected communities, screening of involuntary resettlement and livelihood impacts, the proposed entitlement matrix, institutional arrangements (including principles for market valuation to arrive at a fair 'replacement cost' of affected land and asset categories) along with a monitoring and evaluation framework.

The RPF mandates the use of the Project wide GRM, described in Section 9.3.5. The Project wide approach is needed to ensure all grievances are addressed in an integrated, international best practice standard to ensure quick and efficient response, full recording and reporting.

9.3.2.3 RAP (and LRP) Implementation Preparation

Each of the four RAP will include rehabilitation measures, a Livelihood Restoration Plan (LRP), and gender and social inclusion safeguards specific to their particular local context. Each RAP will include an implementation schedule covering resettlement activities, dates for the legal process, suggested land access timelines and provision of compensation, and the clearing of the right of way.

MCA-Nepal will coordinate the resettlement planning (in terms of development of the RAP and Household Entitlement Plans for each RAP Package) with the land acquisition process and notifications that are required in accordance to the *Land Acquisition Act* 1977. MCA-Nepal will also assist the GoN to document the process, and will minimize the involvement of any intermediaries, aggregators and land consolidators during the land access process.

All Contractors will follow MCA-Nepal's commitment that no physical or economic displacement of the Project affected households will occur until:

- Compensation has been paid at full replacement cost; and
- There is a formal agreement with each household on the timelines and disbursement of all other entitlements as per their eligibility.

If additional land or a variation in land acquisition is needed beyond that obtained under the RAP, the official GoN Procedure described in Annex L.5.1a for land acquisition will be followed. Contractors will be aware that additional acquisition can take between 2.5 and 12 months to complete, depending on whether the land is already covered by the EIA for the Project, how many plots are required and the complexities of resolving compensation entitlement, valuation of assets, ownership, loans and mortgage encumbrances for each plot.

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A formal sign-off process is required to indicate the completion of resettlement and allow access to the plot. This is discussed in Section 9.4.15.

9.3.3 Livelihoods Restoration Plans

Livelihood Restoration Plans (LRP) are required under IFC Performance Standard 5 for all those affected households whose economic or physical displacement threatens their economic security and future livelihoods. The LRP developed for each RAP will focus on some or all of the aspects below (as relevant):

- Replacing agricultural land and livelihoods;
- Enhancing agricultural productivity, yields, knowledge and advice;
- Skills-based vocational training with entrepreneurial support; and
- Life and financial skills to support the change process.

The LRP will be developed further during the pre-construction phase and implemented at the same time as compensation is paid for losses, and replacement land and structures made available, as applicable. The intention is to hire third party organizations to implement the LRP. The LRP for each Project-affected person has to be in process before sign-off for the completion of resettlement can take place and land access agreed for the Contractor.

9.3.4 Indigenous Peoples

Indigenous peoples may be particularly vulnerable to the adverse impacts associated with Project development, including risk of impoverishment and loss of identity, culture, and natural resource-based livelihoods. MCC policy requires adherence to IFC Performance Standard 7, which seeks to ensure that business activities minimize negative impacts, foster respect for human rights, dignity and culture of indigenous populations, and promote development benefits in culturally appropriate ways. Informed consultation and participation (ICP) with indigenous peoples throughout the Project process is a core requirement of the standard, and may include Free, Prior and Informed Consent (FPIC) under certain circumstances. Such circumstances have not been noted for this Project yet.

In Nepal the definition of indigenous peoples is generally broader than that used internationally, but some groups fall under both definitions. To avoid confusion and future disputes, the approach used by MCA-Nepal is to follow a community consultation process that is compliant with Performance standard 7 as a matter of routine throughout the Project.

The RAP and LRP will ensure due consideration is given to cultural sensitivities and vulnerabilities created by social marginalization of social groups (Indigenous Peoples/Adivasi Janajati) in particular contexts, and accordingly, include processes or other measures to address such issues.

9.3.5 Grievance Redress Mechanism

The GRM that covers all phases of the Project will be used by all Contractors throughout the pre-construction and construction phases. The process is coordinated through MCA-Nepal, which will receive and supervise resolution of all grievance notifications through the procedure given in Annex L.4.4. This process will be used by all parties to ensure high standards of grievance resolution and efficient, timely and effective response. This approach is to reduce delays in Project implementation, enhance the reputations of all parties and ensure a high quality of grievance resolution.

The Gender and Social Inclusion Safeguards Manager for each Contractor is required to implement the prescribed process for receiving grievance notifications and participating in their resolution. The SEP sets out the process to:

- Accept and acknowledge receipt of a grievance;
- Document the grievance on the agreed forms;
- Notify the MCA-Nepal Grievance Redress Coordinator (GRC);
- Record and number the grievance as per the MCA-Nepal GRC's instruction;
- Accept delegated responsibility to investigate the grievance;
- Participate in discussions over responses and agreeing the outcome at which ever tier of response is needed;
- Implementing the decision;
- Informing the claimant;
- Documenting the process; and
- Submitting the resolution to the MCA-Nepal GRC.

9.3.6 Social and Gender Inclusion

All projects and activities supported by MCC will take proactive measures to enhance gender and social inclusion.

MCA-Nepal's Social and Gender Integration Plan (SGIP) is the operational and management document for ensuring the integration of gender and social inclusion in Compact projects and activities, and monitoring performance and results. The SGIP analyses social and gender-based constraints and risks, and identifies opportunities for mitigating risks while enhancing benefits for women, and vulnerable and marginalized groups, including traditionally excluded castes and ethnicities. The findings and recommendations are based on a comprehensive review of national and international reports and available data as well as consultations with key stakeholders, including government agencies, non-governmental organizations, civil society organizations, communities, and Project-affected people.

The SGIP identifies enabling provisions for inclusive stakeholder engagement and benefit-sharing as well as GSI-responsive procedures and approaches to support non-discriminatory outcomes in resettlement, livelihoods restoration, and compensation packages. It also provides guidance on mitigating risks from trafficking in persons (TIP) and sexual exploitation based on MCC's Counter-TIP Policy and Gender Policy as well as key GoN legislation on the protection of women, prevention of child labor and anti-trafficking of persons. The SGIP Action Plan contained within the SGIP is the guiding document for key GSI activities. It outlines objectives and activities as well as monitoring responsibilities and timelines.

The SGIP includes provisions designed to encourage inclusion by Contractors, including:

- Mandating equal pay and benefits for men and women performing the same work;
- Encouraging the employment of women to represent at least 33 percent of the workforce;
- Preventing the employment of minors under the age of 18;
- Prohibiting the preference or exclusion of employment of persons on the basis of gender, ethnicity, status, or gender orientation;
- Ensuring that the MCC Policy on Counter-trafficking in Persons is complied with in terms of employment conditions and in prohibiting the transport of non-employees in Contractors' vehicles;
- Ensuring that cultural sensitivities in work areas are acknowledged and that workers are allowed to attend local festivals, etc.; and
- Mandating and enforcing a Worker Code of Conduct Procedure, as detailed in Annex M.7.2 which requires workers to behave in ways that do not offend local communities or increase negative impacts caused by drinking, gambling, illegal drugs, prostitution, sexual harassment, sex trafficking, soliciting/exploiting minors for sex, and violence to women and minors.

9.3.7 MCA Partnership Program

The MCA Partnership program is the benefit sharing component of ETP. It incorporates the Community Support Programs that are typically undertaken by electricity sector projects in Nepal. The objective of the MCA Partnership program is to build trust, rapport and share Project benefits with the communities affected by Project activities. This is expected to help develop relationships with the Project communities to build trust and rapport that will smooth Project completion because the people affected themselves obtain tangible benefits.

The objectives of MCA Partnership program are the following:

- To ensure that direct Project-related benefits are accrued by the Project communities by increasing access to energy and maximizing the use of energy for productive purposes; and

- To help build relationships with the Project communities for the timely completion of the Project.

Although the electricity transmitted through the lines that the ETP constructs cannot be directly supplied to the Project communities, the MCA Partnership program will work towards providing adequate and reliable electricity through either grid-connected distribution system extensions or improvements, or through off-grid electricity solutions. In addition, the MCA Partnership program will promote productive uses of electricity to enhance the quality of life and livelihoods for communities in and around the Project area.

9.4 CONSTRUCTION SITE MANAGEMENT IN THE ESHSMP

This section provides an overview of ESHS management in relation to the main Project sites.

9.4.1 Permanent Land Access

Land acquired for the Project can only be accessed once the acquisition and resettlement process is complete. The ETP has a formal sign off process to indicate the completing of resettlement and allowing of access to the plot. The dangers of escalating grievances caused by contractors entering and utilizing unauthorized plots represent a Project risk that is easily avoidable by adherence to the RAP process and land access release procedure that is applicable to all contractors entering acquired land.

The Land Access Release Procedure (Annex L.5.1a) states the conditions necessary and the steps to be followed to verify that resettlement has been completed to the required status before any Contractor can be permitted to enter the land for works. These will be coordinated by MCA-Nepal against the construction program and works contracts to ensure a smooth transition and land access for contractors.

These conditions are:

- Payment of all compensation;
- Replacement of land if required: this involves the permanent acquisition of replacement land and the relocation of the Project PAP to be completed;
- Relocation to permanent or temporary buildings if the previous house is to be demolished;
- Enrolment in livelihood programs and the commencement of the programs; and
- Transition and other applicable allowances are paid.

Once the resettlement for Project PAP has reached this stage, MCA-Nepal will hire a third party organization to verify completion of resettlement. On completion of the verification survey, the third party organization and MCA-Nepal will sign the Land Access Release Permit for each affected plot and formally record the transfer of the release forms.

The Permit consists of both an electronic record and a physical paper that contains the plot reference number, a map and boundaries of the acquisition, GPS coordinates, and the names of the former owners, and indicates ways of entering the plot. The Land Access Release Permit forms the basis of the Work Land Access Permit that contractors will use when managing works.

Should any Contractor discover the need for the ETP to acquire additional land, the Contractor will engage with MCA-Nepal and request MCA-Nepal to acquire the area. Depending on the circumstances this may take 2.5 to 12 months and represents the potential for causing considerable delay.

All contractors are required to have a Work Management Plan within which it is mandated that there will be a Work Land Access Permit. This will be issued daily or per task alongside the job card, and will be carried by all work team leaders. It will clearly identify which land the contractor has access to by plot, and the works that may be carried out according to the acquisition rights or lease arrangement. This permit requirement prevents accidental incursion on unacquired land and accidental damage to property and crops as a result of not knowing precisely where movement and activities are allowed. The Work Land Access Permit is given in Annex L.5.1b.

9.4.2 Acquisition of New Land

In contracts where the final design is not complete before land acquisition is needed, the situation arises whereby further land has to be acquired to facilitate the construction of the final design.

All new land has to be acquired by the official GoN land acquisition process as set out in the *Land Acquisition Act* (1977) and as laid out in the Resettlement Policy Framework for the Project. A new Resettlement Action Plan process has to be undertaken incorporating all stages of assessment, valuation, agreement, payment and relocation which can take between 2-12 months to fulfil. The potential for delay is high and so requests to acquire new plots need careful consideration against the design difficulties that have triggered the request.

In the event that new acquisition is required, the contractor will liaise with the Land Acquisition Officer of MCA-Nepal to agree the process whereupon the Land Acquisition Officer will trigger a new acquisition. The land may not be entered prior to acquisition but will await the release of the Land Release Permit for the plot.

9.4.3 Temporary Land Access

Land will be needed temporarily for a range of purposes. Differing requirements exist for rentals of plots for less than six months as against longer periods.

Owned or used land required by a Contractor or which is affected by the stringing of transmission lines (subject to land use restrictions) is subject to stringent rehabilitation requirements once construction is finalized. The Project Engineer and the Contractor will agree the rehabilitation measures that will be required before the Contractor is allowed to sign a lease, and the rehabilitation will form part of the contract. These might typically include waste materials removal, replacement of soil and re-contouring as required (especially for agricultural land) , removal of temporary structures and facilities, and replanting of trees and grasses as required, to remove hazards or contaminants, prevent erosion and rehabilitate the land. The cost of these works is to be borne by the Contractor, and the time to complete them will be included in the period of the lease.

9.4.3.1 Land Needed for Six Months or Less

A Temporary Land Access Procedure that includes environmental and gender/social safeguards was developed and implemented to cover geotechnical investigation-related activities of the Project during its planning phase. This procedure has been updated along the lines required in the Resettlement Policy Framework and will be followed by all Contractors. The procedure is given in Annex L5.2. It applies to all land used or temporarily occupied by any part of the Project, that is owned or used by private or community entities (e.g., CFUG).

Temporary access for Project activities will not exceed a period of six months of continuous occupation of private property, and in every case the Temporary Land Access Procedure will be followed and reported to the Resettlement Implementation Consultant via the Project Engineer and MCA-Nepal, to ensure that all parties are aware and to highlight the potential for grievances to be registered and redressed if necessary.

9.4.3.2 Long-Term Lease for Temporary Land Use

In the event that land is needed temporarily for works for longer than six months (e.g. for a Contractor's laydown area) or that a wayleave is required for the duration of the Project to facilitate construction, but is not needed permanently, a long-term lease may be entered into by the Contractor with the land owner. The lease will include environmental and gender/social safeguards, based on those developed and implemented to cover geotechnical investigation-related activities of the Project during its planning phase. The lease will also ensure a high standard of land restoration at the end of the contract.

The long-term leasing procedure of land for Project access (wayleave) or works for more than six months is prescribed in Annex L.5.2. This procedure requires the lease to be negotiated and paid prior to access and use or works commencement, and includes commitments to the restoration of the land at the end of the lease. Documentation including the payment receipt will be reported to MCA-Nepal and the Resettlement Implementation Consultant prior to the Contractor exercising the access negotiated.

9.4.4 Tower Construction Site Management

9.4.4.1 Site Management

The purpose of the management of tower construction sites is dictated by the procedure in Annex L.5.4. The purpose is to ensure that the many towers are constructed in ways that do not have unnecessary or unacceptable impacts on any aspect of the environment or society. The approach to tower construction site management will address the following topics.

- Demarcation and public notice: the establishment of the site on the ground, and making the public aware of its purpose and their rights in relation to the Project.
- Tower access: the determination of the access routes and methods for the site, for workers, construction materials and supplies.
- Tower work camps, storage areas, and work areas: the management of the different parts of the construction site in an orderly fashion, to make them safe and to avoid damaging the environment or disrupting communities.
- Worker accommodation: the rules to ensure clean, healthy accommodation for workers at temporary sites.
- Wastewater treatment: the ways in which wastewater is to be managed so as to avoid polluting the soil or nearby water bodies.
- Air quality management: the approaches used to minimize air emissions, from dust and exhausts.
- Noise abatement: the approaches used to minimize noise, especially at night (noisy works from 6:00 am to 6:00 pm).
- Hazardous materials and waste management: the rules to be followed to ensure that hazardous chemicals do not pollute the soil, water bodies or the atmosphere.
- Solid waste management: the approaches to the collection, storage and disposal of waste materials in ways that minimize the risks to health and environmental pollution.

9.4.4.2 Access to Tower Sites

No new access tracks or roads may be made to provide vehicle access to tower sites. Access will be only using existing access routes. New foot trails to a maximum width of 1.5 meter may be constructed. These will be earth paths made following the guideline in Annex M.5.4, and which will be removed and the land rehabilitated at the time of site closure.

All-terrain vehicles (ATV) may be used on foot trails where it is safe to do so. Trails may not be widened beyond 1.25 meter for their use, although in steep terrain step-out areas for pedestrians may be built every 50 meters or where the ground allows. For the ETP, an ATV is defined as having the following attributes.

- Four wheels with low ground pressure tires, or twin rubber tracks;
- A single driving position and no passenger capability;
- A maximum width of 1.22 meters; and
- A maximum payload of 250 kg.

The opening of vehicular access on government-owned public land is illegal without an environmental permit. Contractors will not obtain environmental permits for the construction of tracks or roads on public land that are used for access to ETP tower sites without the written consent of MCA-Nepal.

Any works undertaken by contractors at the request of landowners or community members will only be commenced once the written consent of MCA-Nepal has been obtained and an environmental permit issued by the MOFE. Any such tracks or roads will be built to GoN local road specifications and all earthworks and drainage completed in accordance with the guidelines in Annexes M.5.14a to M.5.14f. This will be undertaken irrespective of the agreement between the Contractor and the landowner or community.

9.4.5 Substation Construction Site Management

The management of substation construction sites is dictated by the procedure in Annex L.5.5. The purpose is to ensure that these large facilities are constructed in ways that do not have unnecessary or unacceptable impacts on any aspect of the environment or society. The approach to substation construction site management will address the following topics.

- Demarcation and public notice: the establishment of the site on the ground, and making the public aware of its purpose and their rights in relation to the Project.
- Substation access: the determination of the access routes and methods for the site, for workers, construction materials and supplies.
- Work camps, storage areas, and work areas: the management of the different parts of the construction site in an orderly fashion, to make them safe and to avoid damaging the environment or disrupting communities.
- Worker accommodation: the rules to ensure clean, healthy accommodation for workers at these relatively long-term construction sites.
- Wastewater treatment: the ways in which wastewater is to be managed so as to avoid polluting the soil or nearby water bodies.
- Air quality management: the approaches used to minimize air emissions, from dust and exhausts.
- Noise abatement: the approaches used to minimize noise, especially at night (noisy works from 6:00 am to 6:00 pm).
- Hazardous materials and waste management: the rules to be followed to ensure that hazardous chemicals do not pollute the soil, water bodies or the atmosphere.
- Solid waste management: the approaches to the collection, storage and disposal of waste materials in ways that minimize the risks to health and environmental pollution.

9.4.6 Insulating Gas

The ETP's substations will use the gas Sulphur hexafluoride (SF6) for insulation in its gas-insulated switchgear (GIS). This synthetic gas has a high dielectric strength, a high arc interruption capability, and high heat transfer characteristics; in addition, it is non-toxic, biologically inert, chemically stable, non-corrosive and easy to handle. However, the significant disadvantage of the gas is that it has the highest global warming potential of any known substance: it is 23,500 times more effective as a greenhouse gas than carbon dioxide.

Strict procedures for the transport, storage, handling and use of SF6 will be prepared by the substation Contractors, approved by the Project Engineer and MCA-Nepal, and followed at all times.

Guidance rules for the use of SF6 are provided in Annex M.5.6.

9.4.7 Laydown Area Management

The management of laydown areas is dictated by the rules in the ESHS mitigation matrix in Section 9.9.2. The purpose is to ensure that the laydown areas are selected, managed and rehabilitated in ways that do not have unnecessary or unacceptable impacts on any aspect of the environment or society. The approach to laydown area management will address the following topics.

- Demarcation and public notice: the establishment of the site on the ground, fencing and making the public aware of its purpose and their rights in relation to the Project.
- Site access: the determination of the access routes and methods for the site, for workers, construction materials and supplies.
- Camps, storage areas, and work areas: the management of the different parts of the area in an orderly fashion, to make them safe and to avoid damaging the environment or disrupting communities.
- Wastewater treatment: the ways in which wastewater is to be managed so as to avoid polluting the soil or nearby water bodies.
- Air quality management: the approaches used to minimize air emissions, from dust and exhausts.
- Noise abatement: the approaches used to minimize noise, especially at night.
- Hazardous materials and waste management: the rules to be followed to ensure that hazardous chemicals do not pollute the soil, water bodies or the atmosphere.
- Solid waste management: the approaches to the collection, storage and disposal of waste materials in ways that minimize the risks to health and environmental pollution.

9.4.8 Workers' Camp Site Management

The management of workers' camps is dictated by the rules in the ESHS mitigation matrix in Section 9.9.2. As with laydown areas, the intent is to ensure that the locations are selected, managed and rehabilitated in ways that do not have unnecessary or unacceptable impacts on any aspect of the environment or society. The approach to camp management will address the following topics.

- Demarcation and public notice: the establishment of the site on the ground, and making the public aware of its purpose and their rights in relation to the Project.
- Site access: the determination of the access routes and methods for the site, for workers, construction materials and supplies.
- Parking, storage, sleeping accommodation, cooking and eating areas, recreational facilities and washing and sanitation places: the layout and management of the different parts of the area in an orderly fashion, to make them safe and to avoid damaging the environment or disrupting communities.
- Wastewater treatment: the ways in which wastewater is to be managed so as to avoid polluting the soil or nearby water bodies.
- Solid waste management: the approaches to the collection, storage and disposal of waste materials in ways that minimize the risks to health and environmental pollution.

9.4.9 Clearance of Transmission Line Rights of Way

The vegetation in the rights of way may be cleared only where private land has been acquired or where a forest clearance permit has been obtained for public land. The ETP's approach is to minimize vegetation clearance by spanning cables above trees wherever possible. Cables will be strung using pilot wires rather than by unrolling them along the ground. Hence there will be no clearing of the entire RoW as a standard procedure.

The following main rules apply.

- Only trees individually marked and approved for felling may be cleared.
- Tree felling may only be undertaken using hand saws, axes or chain saws. Trees may not be felled using bulldozers, excavators, winches or other machines (except as a safety aid in conjunction with a saw).
- No stumps or roots are to be disturbed.
- Shrubs, herbs and ground cover vegetation will be maintained to minimize soil erosion.

Further details of this aspect of the Project are given in Section 9.7.6.

9.4.10 Use of Helicopters and Drones

The use of all airborne vehicles, whether manned or unmanned, will comply with the requirements of the CAAN. Any Contractor using helicopters or drones will provide a detailed plan for their use to MCA-Nepal at least one month in advance; such a plan will include copies of all relevant permits, as well as statements of the activities proposed, the frequencies, durations and detailed safety procedures.

Aircraft, including drones, may be used only during the hours of daylight and never on public holidays or religious festivals. They may only be operated by fully qualified and certified individuals.

Helicopter landing sites are restricted to areas that have been designated for the purpose, cleared and marked appropriately. These will normally be laydown areas, and helicopters will not normally land at tower construction sites. Designated landing sites will have identified ground managers who will follow the agreed safety protocols and ensure readiness by trained ground staff. Landing sites will be at least 200 meters from the nearest dwelling and in locations where public access can be controlled. Stores of jet fuel will be managed as for other fuels (i.e., maintained in covered, bunded stores with fire prevention measures in place).

Sky crane helicopters (or equivalent heavy-lift helicopters) may only be landed at airfields certified by CAAN. Their use will be requested to MCA-Nepal at least three months in advance. Any such request will be accompanied by a detailed plan of operations that demonstrates a high degree of safety in all lifting and assembly operations. If used in tower assembly operations, they are not permitted to land at landing sites approved for small helicopter use for Project activities.

9.4.11 Aggregate Sourcing

Aggregates for substation and transmission tower foundation construction will be obtained only from sources that have been formally approved in advance by the Project Engineer. The Contractor will provide a draft aggregate sourcing plan at least three months in advance of starting extraction. The environmental permits for each proposed source will accompany this draft plan. The Project Engineer's materials engineer will then check the quality of each location and the Project Engineer's geomorphologist will review the source locations. The geomorphologist will undertake a full appraisal of the physical environmental consequences of the use of each proposed site and will provide a decision on its suitability: (a) acceptable; (b) acceptable with conditions that will be incorporated in the Contractor's aggregate sourcing plan before it can be approved; or (c) reject it, with reasons. The material transport arrangements will also be considered. All aspects of the plan will comply with the conditions of the ESHSMP. All findings communicated from the Project Engineer's staff will be incorporated in the aggregate sourcing plan before it is resubmitted for approval. The Contractor will be responsible for completing the rehabilitation works before payment can be made for the aggregates.

In creating its aggregate sourcing plan, a Contractor will address all of the following rules:

- Aggregate will be sourced from quarries or river miners that are already approved and with valid environmental permits.
- The exact nature and volume of the aggregates to be obtained will be given, in relation to the quarry's annual output.
- A letter of acceptance will be provided by the chief officer of the municipality.

The sourcing of aggregate from streams and rivers is prohibited within the Chure Conservation Area.

9.4.12 Blasting at Tower Sites

In certain locations, geological conditions may require the use of explosives to create sound foundations for transmission towers. The need for this will not be known until the final geotechnical site investigations are undertaken at each of the tower sites during the pre-construction phase by the transmission line contractors. Blasting is to be minimized and will be used as a last resort. All use of explosives will be managed by the Nepal Army; and so if blasting is required the first step for the Project will be a request by MCA-Nepal to the Nepal Army Headquarters for assistance.

Explosive charges may also be used to connect sections of cable. These are actually configured to be implosive compressive connectors, which have a metallic sleeve wrapped inside a special explosive charge. When that charge is detonated, emitting a noise like a large firecracker, the energy of the explosion compresses the metallic sleeve around the conductor and forms a solid connection between two ends of conductor (in the case of a splice) or between the conductor and dead-end hardware. Implosive connectors do not require large equipment to install. Individual explosive wraps can be handled by one person and other components such as detonators are also portable.

Guidelines on the management and use of explosives are provided in Annex M.5.12.

9.4.13 Construction in the Chure Range

The Chure Range is the most southerly and recently formed of the Himalayan ridge complexes. Its recent geological formation, along with its continuing active uplift and down wasting, means that its slopes are steep and physically fragile. Water tables are mostly deep and water courses ephemeral, so this range supports only a very sparse population. As a result, the area is still relatively well forested and supports high rates of biodiversity. It is also the source of much of the groundwater that makes the Terai so suitable for habitation and agriculture. In recognition of this, the area is designated principally for conservation under the management of the PCTMCDB. The Board sets a range of rules and guidelines that will be followed for all activities in its defined area: this encompasses all parts of the Bhabar (Terai upper piedmont), Chure or Siwaliks and Mahabharat crossed by the ETP transmission lines. The Project Engineer's geomorphologist can advise Contractors on the boundaries of the Bhabar, Chure and Mahabharat, and information on the exceptional landform dynamics of these areas. All Contractors are required to follow the Chure Guidelines related to

Environment Protection. Key aspects identified by the Board during Project preparation are as follows.

- Balance cut and fill in all earthworks.
- Construct drains, siltation tanks and recharge ponds around all earthworks.
- Avoid causing any impacts on wetlands and biodiversity rich areas.
- Design structures to withstand the very high sediment loads of Chure rivers.
- Provide full details of construction materials to be excavated from locations in the Chure.
- The sourcing of aggregate from streams and rivers is prohibited within the Chure Conservation Area.

9.4.14 Physical Site Restoration and Revegetation

All earthworks made bare by Project activities will be protected against erosion. Eroded soil is Nepal's biggest export, and one that it cannot afford. Soil is the growing medium for the plants that provide almost all food, and many medicines, fibers and construction materials. Once it is entrained in rivers, soil becomes a pollutant and sediment. The steep slopes and intense rainfall mean that bare surfaces are particularly susceptible to erosion in Nepal. For these reasons, all Project-disturbed land will be physically restored and revegetated.

Site rehabilitation involves the following main activities.

Table 9.4-1: Main Rehabilitation Activities

Activity	Guidance
Surface grading. All surfaces will be regraded to a smooth, firm condition.	Guideline in Annex M.5.14a.
Soil replacement. Subsoil and topsoil will be replaced on the surface, taken from storage areas made at the time of site clearance.	Guideline in Annex M.5.14b.
Revegetation planning. The newly restored bare surfaces are highly erodible. The optimal bio-engineering (revegetation) techniques will be selected and preparations made for implementation.	Guideline in Annex M.5.14c.
Revegetation implementation. As soon as the soil is moist enough at the start of the monsoon, the revegetation works planned (activity above) will be implemented.	Guidelines in Annexes M.5.14d, 5.14e and 5.14f.
Monitoring of effectiveness. The establishment of the revegetation works will be monitored and either repaired or its success certified before the site can be considered restored.	

9.4.15 Sign-off and Handing Back of Sites

The Contractor will notify the Project Engineer and MCA-Nepal of the timescale to the end of the lease. The MCA-Nepal and the Project Engineer's Environmental Specialists will review the measures in the contract, make a site visit to assess and revise measures in the light of the works actually undertaken and the impact on the site. The revised measures will be agreed and instructed, and the Contractor will carry out the works. The completion of rehabilitation will be monitored and verified by the Project Engineer's Geomorphologist and Environmental Specialist, and approved by the MCA-Nepal Environmental Specialist.

All restored and revegetated sites will be certified as complete by the Project Engineer's Geomorphologist and Environmental Specialist, and the MCA-Nepal Environmental Specialist before the site can be handed back to the owner. Payment of the Contractor for restoration work and completion can be made only after this has been certified.

9.4.16 MCA Partnership Program

As part of the benefit sharing of the Project through the MCA Partnership program, MCA-Nepal would provide services to the communities in three thematic areas:

1. Electricity distribution system extension and upgrading;
2. Off-grid solutions for households and social institutions; and
3. Capacity building for enhanced electricity use.

The construction activities that might have their own environmental impacts will mainly be in thematic area 1, of electricity distribution system extension and upgrading. The grid line extension will mainly follow roads and should have very limited environmental impact on the area. In case of thematic area 2, most of the work will be at the individual level and should not have any significant impact on the surroundings. This theme will also cover some of the solutions for communities such as multiple water use systems, but it may have impacts such as by pumping water from streams to upper distribution tanks. The third thematic area will be focused on building the capacities of the communities and municipalities for improving their livelihoods and planning capabilities.

To ensure that any potential impacts are mitigated, the Project's ESP team will conduct rapid assessments of all MCA Partnership program interventions at the planning stage.

9.5 HEALTH AND SAFETY COMPONENTS OF THE ESHSMP

This section provides an overview of the safety and health obligations for both workers (i.e. as occupational health and safety) and communities. It also specifically covers traffic management (a key risk area) and emergency preparedness.

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9.5.1 Guiding Safety Principles

Every person working on the Electricity Transmission Project takes responsibility for their own safety and that of all others. This message is to underlie all health and safety actions. It is to be delivered in all trainings and safety briefings.

Safety is the single most important factor in all Project activities. The failure of any person to ensure safety is to be a disciplinable offence in all contracts. MCA-Nepal and the Project Engineer have authority to stop work on any site where a Contractor fails to ensure safety according to the provisions of the contract terms and the ESHSMP. All responsibility for delays caused by such work stoppages rests with the Contractor.

All Contractors will comply as a minimum with the MCA-Nepal Safety Absolutes given in Annex N.

9.5.2 Occupational Health and Safety

The Project involves construction activities on a large scale and at over 850 work sites over distances exceeding 300 kilometers. The possibility of serious injuries and fatalities among workers is extreme.

Any serious injury or fatality among the workforce will be considered the fault of the Contractor's Site Manager until proven otherwise. Through this premise, Contractors' Site Managers are obligated to take full responsibility for the management of the health and safety provisions for their workforces. The Site Managers will be supported by Health and Safety Managers, who will lead teams of Health and Safety Superintendents, as listed in Section 9.2.2. These Superintendents will oversee all aspects of health and safety on the tower and substation construction sites.

Every Contractor will develop and implement a site-specific health and safety management plan for every site. All such plans are to be submitted to the Project Engineer for approval by the Project Engineer's Health and Safety Specialist. This plan will include health and safety training in both induction trainings and regular tool-box talks. The OHS Management Plan should be based on a Hazard Identification and Risk Assessment and apply the hierarchical principles of the safety pyramid, which are listed below in descending order of effectiveness:

- Elimination/Substitution – identify opportunities to eliminate the safety risk by preventing exposure to the hazard before it occurs, or to substitute a less hazardous material or process to reduce the risk;
- Engineering Controls – involve changing the structure of the work area to reduce exposure using safety devices or barriers, such as placing a fence around a dangerous locations;
- Administrative and Work Practice Controls – implement procedures that require workers to do things to reduce their exposure to a risk, including placement of warning signs and alarms; and

Personal Protective Equipment (PPE) – ensure all employees wear proper protective clothing and equipment, such as safety goggles, gloves, and fall protection. MCA-Nepal, the Project Engineer and all Contractors will provide the personal protective equipment (PPE) to all of their personnel and visitors on all Project sites, as described in Annex M.6.2.

All personnel working at or visiting will comply with the Safety Absolutes given in Annex N.

9.5.3 Community Health and Safety

The Project is likely to present risks to the health and safety of communities. These may arise from:

1. Importation of diseases to potentially vulnerable local populations.
2. Increased risk of community exploitation through:
    a. Disruption to local market prices and availability of goods and services;
    b. Increased opportunities for gambling, drinking and imported illegal drugs;
    c. Increased potential for gender-based violence and inequalities within households or at work camps;
    d. Increased sexual harassment and exploitation of women, girls and boys, or persons who self-identify as the third gender; and
    e. Potential increased likelihood of trafficking of persons to other areas.

Every Contractor will have a Social Safeguards Manager, who will be responsible to deploy one or more (as appropriate to the site and the construction schedule) community communication team to conduct community health awareness trainings covering the following:

1. The risks to communities of imported diseases and the social impacts of increased gambling, drinking and drug taking in the communities;
2. Trafficking in persons and the threats to communities of increased harassment and exploitation of women, girls and boys, enabling prostitution;
3. Impacts of gender-based violence, exploitation and discrimination, and inequalities in the home or at work camps; and
4. The likely impact of the Project on local goods and services, opportunities and potential for disruption.

The Project Engineer's Social Safeguards Specialist will assist the Contractors' staff to devise the messages and manage these campaigns. This work will require the hiring of specialist trainers or employing in-house trainers to deliver trainings at employee induction programs, and for the reiteration of awareness raising during tool-box talks.

9.5.4 Traffic Management

All Contractors will prepare a Traffic Management Plan specific to their work and site activities. These plans will apply to all vehicle-accessible areas in construction sites, laydown and storage areas, labor camps and public roads. They will be applicable for the entire duration of each Contractor's activities from preparatory work to closure and site handover. The plans will cover motorized, non-motorized and pedestrian movements, and parking.

The purpose of a Traffic Management Plan is to mitigate and manage environmental, health and safety risks and impacts associated with transportation. This includes transportation of construction materials, transportation of waste, and transportation of labor and equipment to laydown areas and construction sites by roads or trails.

A key aspect of a Traffic Management Plan is to ensure community safety, as the roads used for Project construction are also public roads. Road stretches in and around settlements have particularly great potential to cause disturbance and raise accident risks to members of the communities.

Guidance for Traffic Management Plans is provided in Annex M.6.4.

9.5.5 Emergency Preparedness and Response Plan

All organizations operating in Nepal should have an Emergency Preparedness and Response Plan so that staff can react in a controlled and efficient manner in the event of an emergency or disaster. MCA-Nepal has such a plan and all Contractors will also create and maintain them.

The objectives of the Emergency Preparedness and Response Plan include the following:

- Establish the emergency organization and management approach in accordance with a defined incident command system;
- Establish the roles and responsibilities of key personnel during emergency events or potential for an emergency event;
- Provide response guidelines for dealing with specific emergency scenarios to minimize, as far as possible, the impact to the personnel at site and the environment;
- Identify and provide first aid equipment at the work sites, including equipment needed rescues;
- Identify and provide spill response equipment to enable a quick and appropriate response in the event of pollution being caused;

- Establish communications and co-ordination protocols and interfaces between the Contractor and MCA-Nepal; and
- Designate exit routes, evacuation plans, and assembly areas

Guidance on the development of minimum Emergency Preparedness and Response Plans is provided in Annex M.6.5. These plans will cover issues such as earthquakes, floods, fires, epidemics, civil unrest, economic blockades, accidents and spills of hazardous materials, affecting the Contractor or its personnel either at its work sites or in transit.

Every Contractor will submit an Emergency Preparedness and Response Plan for approval by MCA-Nepal at least three months before mobilizing to any site.

9.6 SOCIAL COMPONENTS OF THE ESHSMP

This section provides an overview of the gender and social safeguards required by the Project, for both workers and the communities with context of their reciprocal relationship, in the neighborhoods of the Project work sites.

9.6.1 Labor and Working Conditions

IFC Performance Standard 2 on Labor and Working Conditions will be fully complied with. The requirements of this standard have been guided by a number of international conventions and instruments, including those of the International Labor Organization and the United Nations. The scope of application of this Performance Standard depends on the type of employment relationship between the client and the worker. It applies equally to workers directly engaged by MCA-Nepal, workers engaged through Contractors, and workers engaged by other primary suppliers

Performance Standard 2 requires the adoption and implementation of human resources policies and procedures appropriate to the size and workforce of an organization that set out its approach to managing workers consistent with the requirements of the standard and Nepalese law. Employers will provide workers with documented information that is clear and understandable, regarding their rights under national labor and employment law and any applicable collective agreements, including their rights related to hours of work, wages, overtime, compensation, and benefits upon beginning the working relationship and when any material changes occur.

Employment in Nepal is primarily regulated under the *Labor Act 2074* (2017 AD), the *Child Labor (Prohibition and Regulation) Act 2056* (2000 AD) and the *Labor Rules (or Regulations) 2075* (2018 AD). The *Labor Act 2074* replaced the previous labor law completely (i.e. the *Labor Act 2048* has ceased to be in effect). The *new Labor Act* has been passed for provisions for the rights, interest, facilities and safety of workers and employees working in enterprises of various sectors.

Every Contractor will prepare a Workforce Management Plan. This will be reviewed by the Project Engineer and, when acceptable, submitted to MCA-Nepal. The plan will then be reviewed and approved by MCA-Nepal, be compliant with IFC PS 2, MCC Gender and Anti trafficking Polices and MCA-Nepal SGIP prior to the Contractor commencing works. Each Contractors plan will be monitored and audited as specified in the ESHSMP.

The Workforce Management Plan will apply across the Project area, including all contractors' employees and subcontractors engaged by the Project. Each contractor will prepare a detailed Workforce Management Plan in keeping with the minimum requirements identified here.

The aim of the Workforce Management Plan is to manage the employment of local unskilled labor and impacts of semi- and skilled labor influx due to the Project. The purpose of the plan is to:

- Define a formal and integrated approach to manage workforce presence and movement during the construction and operation phase of the Project; and
- To meet the requirements of the applicable regulations and relevant international standards.

The specific objectives of the Workforce Management Plan are to do the following:

- Prevent employment of minors below the age of 18 years (Procedure in Annex L6.1;
- Enable the employment of local men and women as unskilled labor at each site (Procedure in Annex L6.2);
- Attract and retain a skilled and competent workforce;
- Ensure employees are aware of their rights and entitlements including pay, festivals, sick and bereavement leave, and rest breaks (Procedure in Annex L6.3);
- Ensure contractors comply with MCC counter trafficking in persons policy and guidelines in their employment conditions for employees;
- Deliver a fair and equitable environment that includes an employees' grievance mechanism for responding to and resolving employees' questions and concerns;
- Ensure compliance with relevant regulations, and relevant international standards and
- Ensure employee relations issues are managed in a fair, coordinated and consistent manner.

9.6.2 Employee Induction and Worker Code of Conduct Requirements

Under the Labor Rules 2075, Contractors are obliged to have a Workers' Code of Conduct to lay out their obligations to workers, and also workers' rights and obligations. This code of conduct draws on the Labor Law 2074 to define:

- Conditions of employment: working hours, rates of pay, rest periods;

- Rights of employees to a grievance mechanism, holidays, and cultural and festival access; and
- Conditions for work camps, shelter, water and sanitation, food and security.

All workers, regardless of their role or duration of employment, will be expected to review and acknowledge the Workers' Code of Conduct by signing the code sheet. The signed document will include the requirement to respect local customs and practices. All Contractors are required to undertake a series of employment inductions and employee awareness programs at the commencement of employment and over the employment period. The code of conduct will include provision for a grievance mechanism to be in place throughout the construction period to ensure that any employee-related grievances will be reviewed with the employees on a regular basis to avoid any such further grievances. The Contractor will include expectations of employee behavior in induction packages.

Induction packages will be mandatory for all employees and include:

- Employment rights and conditions as set out under the *Labor Act 2074*;
- Anti-sexual Harassment Policy;
- Anti-trafficking employment rights (see Section 9.6.3);
- Rights to have access to local festivals, etc.;
- Cultural sensitivities, and social norms and practices in each area;
- Expectations on avoiding poor relations between employees and local communities caused by behavior relating to alcohol, gambling, prostitution, illegal drug use, violence and sexual abuse of women and minors;
- Awareness of responsibilities to counter the trafficking of people around the Project area; and
- Awareness of the possibilities of the transmission of HIV/AIDs and communicable illnesses.

The contractor may hire a third party organization to deliver appropriate training and awareness programs.

The Workers' Code of Conduct will set out expectations and responsibilities for all Project employees to ensure they understand cultural sensitivities within each ETP district. It also will list local customs and festivals and their timings, and cultural practices by area and community. It will also specify penalties for contraventions.

9.6.3 Counter Trafficking in Persons

The MCC Counter Trafficking in Persons (TIP) Policy defines "severe forms of non-employment related forms of trafficking in persons" as sex trafficking where a commercial sex act is induced by force, fraud, or coercion, or in which the person induced to perform such act has not attained 18 years of age; or where the person is moved to another area for such exploitation. MCC and MCA-Nepal have a zero tolerance policy regarding TIP. The IFC Performance Standard 2 on Labor and Working Conditions defines trafficking in persons as the recruitment, transportation, transfer, harboring, or receipt of persons, by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation.

A clear potential Project related TIP risk is associated with the actions of contractors and workers through demand for sex workers, particularly where the Project involves an influx of predominantly male workers. It is considered TIP when adults engage in sexual activities through force, fraud or coercion. It is also considered sex trafficking when the person induced to perform such act has not attained 18 years of age. Women and children are particularly vulnerable to trafficking practices.

The MCC is committed to working with partner countries to ensure appropriate steps are taken to prevent, mitigate, and monitor TIP risks in the projects it funds. This policy applies to all MCC-funded projects. MCA-Nepal is required to develop TIP Risk Management Plan, and also to require all Contractors and consultants to implement a TIP Risk Management Plan.

All Contractors will also include the following in the Worker Code of Conduct, with penalties for non-compliance:

1. Prohibition of transportation of non-employees in Project vehicles, except in cases of medical emergencies;
2. Prohibition of the importation of women for provision of sex services for employees into work camps or in local villages;
3. Prohibition of sex with a minor at any point or time; and
4. Participation of facilitation or the procurement of another person of whatever age for trafficking purposes.
5. Targeted education to inform contractors' staff about TIP risks and what constitutes sexual harassment, exploitation, and abuse.

Contractors will also engage a gender and social inclusion specialist or a third party training organization to conduct awareness training on the social ills of trafficking as part of employee induction and reinforcement of the messages in regular tool box talks.

9.6.4 Awareness of HIV/AIDS, STDs, and Communicable Diseases

Project-related health risks are associated with the actions of Contractors and their workers through increased use of sex workers, particularly where the Project involves an influx of

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predominantly male workers. The biggest risk is usually in the increased transfer of HIV/AIDs and other sexually transmitted diseases (STDs). Additionally, increases in other communicable diseases are likely to be facilitated by movements of personnel into and around the Project area.

The Contractor is required to assess the risk of increasing the incidence of HIV/AIDS, STDs and other communicable diseases into the Project areas and plan for the reduction in likely impacts through managing worker behavior and provision of health services for workers, including condoms.

The Contractor will engage a gender and social inclusion specialist or a third party organization to conduct awareness training on the social impacts of all forms of communicable diseases as part of employee induction and reinforcement of the messages in regular tool box talks.

The Contractor will include conditions in the Workers Code of Conduct that require workers to notify the employer of incidences of illness. The Contractor will maintain records of illnesses and treatments among its workforce.

9.6.5 Management of Cultural Heritage

All contractors will manage cultural heritage in relation to all Project activities. The purpose of this provision is to ensure that there are no adverse impacts caused by construction phase activities on tangible cultural heritage, local communities' cultural practices and intangible heritage. Through Project design these impacts have been limited as far as possible through adjustments to the transmission alignments.

The careful management of cultural heritage is needed to comply with the IFC Performance Standard 8 requirement for identification and protection of Cultural heritage in Project-affected areas as the result of chance finds. This international standard defines chance finds as "tangible cultural heritage encountered unexpectedly during Project construction or operation". This may include archaeological deposits, human remains, artefacts of historical importance, etc. This will be more likely in Nawalparasi and Tanahu districts.

Cultural heritage management actions include, as a minimum, the following requirements:

- Regular consultations with the local communities to notify them of construction work;
- Maintenance and updating a central list of tangible cultural heritage around the Project areas for avoidance of heavy transport (to mitigate potential vibration damage); and
- Ensuring that all ancillary Project facilities, including labor camps, are set up away from cultural heritage sites.

All Contractors will follow the Chance Finds Procedure (see Annex L.7.5), which includes the following required actions:

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- Establishment of protection area around the find where no further work can be undertaken;
- Clear criteria for potential temporary work stoppages that could be required for rapid disposition of issues related to the finds;
- Record keeping and expert verification procedures;
- Chain of custody instructions for movable finds including coordination with relevant Department of Archaeology or other GoN agencies;
- An outline of the roles, responsibilities and response times required from Project staff, and any relevant heritage government authority, as well as any agreed consultation procedures; and
- An agreed treatment plan.

9.6.6 Community Support Program

In the Electricity Transmission Project, the Community Support Program is provided by the MCA Partnership program. This is covered by a separate Framework Plan and Implementation Plan. This ESHSMP also makes reference (in Section 9.3.7) to the environmental and gender/social safeguards of the MCA Partnership program.

9.7 ENVIRONMENTAL COMPONENTS OF THE ESHSMP

This section provides an overview of the safeguards for all aspects of the physical and biological environments.

9.7.1 Protection of Soil and Land

In the steep terrain and monsoonal climate of Nepal, special measures are needed during construction works to minimize the erosion of soil. This is not only a direct environmental loss—soil is the source of all food and other crops—but it also leads to the pollution of watercourses. The Project's mitigation strategy in this respect includes both temporary measures that will be implemented during the construction phase, and permanent measures that will remain in place once development is completed. Measures are identified to prevent controllable erosion and minimize adverse effects of sediment transport from on-site to off-site areas. The implementation and effectiveness of these measures can be easily verified by on-site monitoring.

Site activities will be carefully managed in order to avoid soil erosion and sedimentation of downstream waterways that can affect aquatic ecosystems. Erosion and sedimentation will be controlled during the construction of the Project works by implementing the mitigation measures given in the management and monitoring matrix in Section 9.9.2.

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9.7.2 Protection of Water Quality

Protection of water quality during construction is important on account of its value in hosting aquatic biodiversity, as well as its significance as a resource for drinking and irrigation uses.

No pollution will be tolerated of any water course or water body as a result of Project activities. Care will also be taken to avoid activities that damage dry gullies or seasonal water courses, where pollution might be triggered the next time that water flows in that location. Runoff and effluent from construction sites and camps will all be contained on site using standard drainage and sanitation provisions.

The main way that water pollution is controlled is by minimizing the disturbance of soil surfaces and therefore the potential for erosion, and the entrainment of sediment in water courses. Project construction sites are all designed to be at least 50 meters from a water course, but as sediment can be carried considerable distances, it is still important that it is stopped at the source by avoiding ground disturbance in the first place.

9.7.3 Protection of Air Quality

Fugitive dust—fine particulate material suspended in the air—is likely to be the largest threat to air quality as a result of Project activities. Dust is mainly a dry season problem and is generated by vehicles moving on earth tracks and gravel roads, as well as from machines undertaking earthworks, rock crushers and by strong winds on unprotected soil stockpiles. Dust generation will be controlled at all times to avoid impacts on surrounding communities, and especially to vulnerable people (e.g., children and the elderly).

The only large earthworks undertaken by the Project will be at the three new substations, and the site and construction characteristics are such that the usual preventative measure will not be feasible, that of using phased removal of vegetation to prevent large areas from becoming exposed to wind. However, a number of appropriate measures can be adopted instead, including restricting surface clearing to the Project footprint, limiting vehicle speeds, placing dust screens around construction areas close to local communities, spraying water on dirt roads, excavations, soil stockpiles and loose fill material, and covering trucks transporting fine materials.

The other potentially significant threat to air quality is from exhaust emissions from vehicles and machines used during construction. This can be reduced to the greatest extent possible by maintaining strict rules, such as turning engines off when not in use, and ensuring the optimal operating conditions and maintenance regimes for diesel generators, construction machinery and vehicles.

Prevention of the leakage of the insulating gas sulphur hexafluoride from the Project's gas insulated switchgear is of critical importance to ensure that this potent greenhouse gas does not pollute the atmosphere. It is of paramount importance to ensure that this equipment is properly sealed to prevent any leakage, and to take proper precautions to prevent any damage to the switchgear.

9.7.4 Management of Vegetation Clearance

The following minimum requirements need to be followed by the Contractor:

- Construction activities for the ETP alignment will comply with all applicable Nepal laws and other legal requirements governing forest and biodiversity conservation, and will provide proof of such compliance as required.
- Vegetation clearance may only occur in designated areas, agreed in the EIA and the Forest Clearance Permit.
- Vegetation may only be cut by hand. Stumps and roots will be left in the ground. No vegetation may be removed using machines or winches. The use of chemical herbicides is banned. Fire is prohibited for the burning of any vegetation.

The objective of the vegetation clearance process is to reduce impacts to natural habitats, thereby reducing impacts to habitats for species of conservation significance. The minimum requirements are detailed in the procedure in Annex L.8.4.

9.7.5 Forest Compensation

The forest policy of Nepal states that the country will have not less than 44.74 percent of its land area under forest (MFSC 2075). This means that forest cannot be converted for non-forestry uses unless an equivalent area, preferably of similar eco zones, are replaced somewhere else by a Project proponent. If the Project is to be executed in the national forest area, the proponent will take prior approval from the MOFE justifying that there were no other alternatives than to use the forest land. Even if the Cabinet approves the proponent's proposal, the Project will only have the use-right over such land but cannot own it. In addition, the proponent will plant ten times the number of trees that are felled (Working Procedure with Standards for the Use of Forest Lands for National Priority Infrastructure Projects in Nepal 2076 BS (2019 AD)).

MCA-Nepal will undertake a forest compensation strategy in line with current government rules. This strategy will be undertaken separately from the ESHSMP. The details will be discussed and agreed with the MOFE, and also with sectoral stakeholders at Provincial and Division levels. At the FUG level, the loss of trees in community and leasehold forests will be compensated through the Resettlement Action Plan.

9.7.6 Protection of Biodiversity

Nepal's varied climates, dictated by the dramatic topography and its maintenance of 44.74 percent of forest cover and large protected areas, gives rise to a significant biodiversity. The ETP's transmission lines can potentially disrupt this by cutting swathes that disconnect areas of forest and by interrupting the airspace used by migrating birds that cross the Himalayas between the cooler northern steppes and the warmer winter feeding grounds of India. A number of practical measures are therefore required to mitigate these potential impacts.

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In general, the Project will abide by the guidelines of IFC's Performance Standard 6, in that it will not significantly convert or degrade natural habitats or critical habitat unless there are no viable alternatives, consultation has been undertaken and appropriate mitigation measures put in place. To achieve this, the following main provisions are obligatory.

Fire Management.

To prevent the collection of firewood and the spread of fire, the following actions will be carried out:

- A strict no open fire policy will be maintained throughout the RoW and any violation will result in penalties and fines.
- Cleared vegetation will be used for mulching and will not be burned.
- To prevent the use of the local firewood stoves, every Contractor will provide liquid petroleum gas (LPG) canisters for cooking meals at the Project sites.
- Project workers will be continually reminded not to throw lighted cigarette tips into the forest areas and not to use the forest area as picnic spots.
- Contractors will provide firefighting training to an adequate proportion of the construction work force.

Soaring and Perching Birds.

Mitigation of collisions and electrocutions of birds from conductors and earth wires require the following actions:

- Alignments are re-routed to avoid the key identified migration routes and soaring zones, and will not be changed from the design in these areas (as described in the EIA).
- Markers will be placed on the conductors and earth wires to make them visible to birds.
- Conductors will be further apart and further from towers than the extended wingspan of the largest birds. The Himalayan griffon vulture is the largest, with a wingspan up to 3.1 meters.
- Anti-perching spikes will be installed at key positions on cross arms, as per designs.
- Insulation sleeving will be provided as per design, on conductors close to the insulators.
- Nesting platforms will be provided at safe locations as per tower designs.
- Monitoring will be arranged by MCA-Nepal at intervals once the cables are strung and being energized, to assess the effectiveness of these measures. Further mitigation may prove necessary.

Engagement of Communities in the Protection of Biodiversity

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The Project's ESHS staff are responsible for actions to raise awareness among communities close to the Project sites, of the importance and value of protecting biodiversity. A procedure for this is given in Annex L.8.6a.

Project Policy to Counter Illegal Logging.

The purpose of this is to prevent illegal loggers accessing forest areas via Project areas and work sites. The following rules are to be maintained by MCA-Nepal, the Project Engineer, and all Contractors and Subcontractors.

- A "no access" rule is to be applied at all times to prohibit non-authorized personnel, their vehicles and any equipment used for illegal logging in all areas under Project control.
- Personnel are to be briefed that anyone identified to have participated in illegal logging activities will be dismissed from employment and will not be re-employed at any later date.
- Any person associated with the Project found conducting illegal logging will be reported and handed over to relevant authorities for investigation.

Project Policy to Counter Poaching and Hunting.

The purpose of this is to prohibit the collection of wildlife and forest resources by people involved in the Project. The following rules are to be maintained by MCA-Nepal, the Project Engineer, and all Contractors and Subcontractors.

- All personnel will be briefed on the zero tolerance policy for the possession of wildlife and forest resources that will be enforced by management in every organization throughout all Project activities.
- All Project staff and workers are strictly prohibited from the possession, purchase, trade or collection of wildlife or forest resources that are legally protected under Nepalese law, are CITES-listed, or classed as threatened by the IUCN Red List.
- Personnel are to be briefed that anyone identified to be in possession, or having purchased, traded or collected any wildlife or forest resources will be dismissed from employment and will not be re-employed at any later date.
- Any staff member or Contractors identified to be involved in activities related to poaching and hunting will be reported and handed over to relevant authorities for investigation.

Biodiversity Induction.

A component on biodiversity awareness will be created by the Project Engineer's Environmental Specialist and incorporated into all staff and worker induction training programs. A slide deck for biodiversity induction and training will be made available in all languages required. The contents of the biodiversity induction will be regularly updated and improved, and will include the following topics.

- Requirements for the implementation of the Project's anti-illegal logging policy and sanctions for non-compliance.
- Requirements for the implementation of the "no-poaching and no-hunting" policy within the Project area, and sanctions for non-compliance.
- Awareness of biodiversity values that exist in the Project area and surroundings, and potential impacts to these values from construction activities.
- Individual responsibilities to reduce biodiversity impacts relevant to related procedures outlined in the ESHSMP. These include wildlife shepherding (Refer Annex L.8.6b) and the care of injured wildlife (Refer Annex L.8.6c).

Invasive Species.

- Manage invasive species in areas of natural habitat. Ensure that that all equipment is cleaned and maintained prior to transport to and from each work site
- Inspect areas of natural habitat for invasive species once construction is complete and control these species as necessary

9.7.7 Noise Abatement

Construction noise will mainly be localized to work areas, although the communities in areas along roads used for access will have raised noise levels due to increased traffic. Noise will be limited to daytime only, by the prohibition of construction activities between 6 pm and 6 am and never on public holidays and religious festivals, other than in exceptional circumstances when the written permission of MCA-Nepal's Environmental Specialist will be obtained in advance. Noises exceeding the national standards will be mitigated, either by noise abatement measures if they affect communities or using hearing protection if they affect workers.

If helicopters are used to aid construction, separate but similar noise mitigation rules will apply. Helicopters will not be permitted to land or hover within 250 meters of houses or other buildings. If heavy-lift helicopters are used, then the separation distance may need to be increased in order to bring the sound level to acceptable limits at receptor points.

9.7.8 Chure Conservation Area

The Chure Conservation Area (CCA) is the zone defined by the PCTMCDB for particular conservation-focused development. Much of the area, particularly the Churia and Mahabharat ranges that largely fall within it, are characterized by steep slopes, often with unconsolidated geology, and deep water tables: these features make them inhospitable for human settlement and so they remain largely forested and of high biodiversity value. The PCTMCDB's main objectives are to maintain biodiversity habitat by controlling the loss of soil and forest.

The PCTMCDB's Environmental Guidelines which will be followed by any infrastructure Project within the CCA. The content of these guidelines has been incorporated in the mitigation measures adopted in the ESHSMP for all areas, which represent standard good

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practices that ETP activities will follow. This means that all ETP construction should be compliant with the CCA requirements, whether they are in this area or elsewhere.

9.8 WASTE MANAGEMENT COMPONENTS OF THE ESHSMP

This section provides an overview of the safeguards against environmental damage from waste and other hazardous substances.

9.8.1 Spill Prevention and Response

The purpose of the spill prevention and response capability in the ESHSMP is to be able to respond effectively to an accidental leakage or spillage of diesel, lubricants, paints, chemicals or contaminated waste in the quickest and most environmentally safe manner.

All Contractors will be able to undertake the following.

- Establish the management approach and organization to be prepared for and deal with emergency spills, either at any work site or in transit under the Contractor's responsibility.
- Establish the roles and responsibilities of key personnel during an emergency spill event.
- Provide response guidelines for dealing with specific spill scenarios to minimize as far as possible the impact to people and the environment.
- Provide the necessary spill response equipment to enable a quick and appropriate response.
- Establish communication and coordination protocols with MCA-Nepal and local authorities.

The spill prevention and response part of every Contractor's CESHSMP will include the following measures, as a minimum.

- Identify the required preventative measures.
- Identify the roles and responsibilities of personnel in the event of a spill.
- Detail the required spill control materials to be stored at all work sites and in vehicles carrying hazardous substances (particularly fuel tankers).
- Clearly document spill control procedures.
- Describe notification requirements.

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9.8.2 Management of Hazardous Materials

9.8.2.1 Diesel Fuel, Jet Fuel, Lubricants, and other Hydrocarbons

Diesel and engine oil are highly toxic, and are the most common hazardous materials used by most projects. They will be widely used by all Contractors, and will need to be stored at laydown sites for the refueling and maintenance of vehicles and machines. Jet fuel (effectively a refined form of kerosene) will be required if helicopters are used.

The mitigation of hydrocarbon pollution requires all sites where they are stored to have adequate preventative measures in place, and all storage and transfer facilities to have spill response equipment, personnel trained in preventing and cleaning spills, and a practiced spill response plan. These items and plans are contract-specific and will be incorporated in each CESHSMP.

In certain circumstances, hydrocarbons can eventually be degraded in soil treated with the correct bacteria. Spill response plans will therefore have a provision for the bioremediation of soil that has been polluted by hydrocarbons.

9.8.2.2 Paints

Paints will be used mostly at substations, but may also be used for some components at tower sites. Oil-based paints and the solvents used with them are toxic in the environment and therefore need to be managed carefully. Covered stores, fire protection and bunding are all required. Used containers will be disposed of into lined landfill sites and are not disposable by simple burying at remote work sites.

9.8.2.3 Heavy Metals in Coatings of Steel Members

There is a potential for the leaching of heavy metals in laydown areas, prior to delivery of towers at each tower location. This is due to preventive measures usually taken by Contractors against what is known as the white rust problem. Freshly galvanized material normally needs three to six months to "cure" to build-up a protective thin film that guaranties the longevity of its galvanized coating. The reaction is fed by reacting very slowly with carbon dioxide in the air. Once the tower has been erected, the curing process reaches its maturity point and the zinc coating becomes almost insensitive to surrounding moisture.

If, shortly after galvanization, the steel component is exposed to constant moisture, zinc will react with water to develop white zinc oxide. This reaction, if not prevented, may consume entirely the zinc coating within very few months, in the laydown yard; and when there is no more zinc to consume, black staining and then red corrosion starts to appear on steel members, before being used for tower assembly. To prevent this, galvanizers' associations have issued recommendations to store and stack steel components properly in laydown yards, ensuring perfect drainage from rain. However, Contractors quite often ask the galvanizer to add a coating on the steel member that seals it from the surrounding air, but that progressively gets washed out from the steel surface within a few months. This coating is usually based on chromates and other similar chemicals, which are toxic in agricultural soil. There exist

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alternative coating materials that are heavy-metal free, but they are more costly, and not widely known or used in practice.

For this reason, all coatings on steel elements will be recorded and certificates submitted to MCA-Nepal for approval before they are imported to Nepal. No coating that contains a heavy metal or other toxic substance will be permitted under the ETP.

9.8.3 Waste Management

The principles of managing waste to be used as part of the Project's pollution prevention strategy are to minimize the production of waste, reuse materials, use products that can be reused many times, and recycle as much as possible of things that cannot be reused. This type of strategy usually saves money as well as resources. A distinction is to be made between waste materials that have a potential commercial value—which are classed as assets—and those with no value—which are considered non-assets.

All organizations involved in the ETP are therefore required to operate waste management strategies based on reduction, recovery, recycle and reuse. Recycling and waste reduction campaigns will be conducted whenever there is evidence of unnecessary waste generation. In all Project facilities and construction sites, waste materials will be collected and segregated at the source. Full records will be maintained of the types and quantities of waste generation, storage, transfers and disposals.

Detailed guidelines on waste management are provided in Annex M.9.3.

9.8.4 Spoil Disposal

Careless disposal of construction spoil—unwanted soil and rock—is one of the largest environmental problems in the hills of Nepal. It can smother vegetation, give rise to erosion and landslides, damage natural forest and agricultural land and pollute rivers. In all construction projects involving foundation excavations, however much care is taken to minimize quantities of spoil, it cannot be eliminated altogether. It is therefore important to find ways to manage it without causing environmental damage.

Spoil problems can be minimized by taking two steps. The first is to identify those operations that will generate spoil, the places where it will be generated and the quantities involved, no matter how small. The second is to plan for its disposal by designating safe tipping sites. In the ETP, the Contractor is responsible for designating suitable spoil disposal sites and obtaining the Project Engineer's approval for them. The criteria for their selection will avoid all of the problems listed above. The Contractor will ensure that the construction workforce is aware of the restrictions on the disposal of spoil, the location of approved spoil disposal sites and specific requirements for the management of these sites. The Project Engineer will strictly enforce contract specifications regarding spoil disposal.

Detailed guidelines on spoil management are provided in Annex M.9.4.

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9.9 MANAGEMENT OF MITIGATION AND MONITORING

This section gives the full details of the mitigation measures that will be adopted in order to address the identified potential impacts.

9.9.1 Index of Mitigation Measures

Based on the topics covered in the ESHSMP, fifteen topic areas have been used to group the impacts and corresponding mitigation measures. These are as follows:

1. General Environmental Protection
2. Occupational Health and Safety
3. Community Health and Safety
4. Community Impacts Management
5. Traffic Management
6. Cultural Heritage Management
7. Hazardous Materials Management
8. Construction Materials Management
9. Waste Management
10. Soil Erosion Control
11. Water Resources Management
12. Air Emissions Management
13. Biodiversity Management
14. Noise Abatement
15. Office Management

The topic headings above are used to group the mitigation measures in the large table in Section 9.9.1. Section 9.9.1 not only gives the full details of the mitigation measures that will be adopted in order to address the identified potential impacts, but it also states who is responsible to implement them and to what standard. It also states how they will be monitored to ensure effectiveness, who does the monitoring, when they will do it and what they will do with the findings.

9.9.2 Mitigation and Monitoring Matrix

Table 9.9-1: Mitigation and Monitoring Matrix

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
1. General Environmental Protection								
1.1 General environmental damage in the form of degraded land, lowered quality of living, reduced quality of resources, etc. On the communities near the work sites.	• Avoid damage to any part of the environment (soil, plants, animals, human resources and settlements) as far as possible. • If damage cannot be avoided, then mitigate or compensate for the damage. • Avoid any work beyond the agreed boundaries of the work sites. • Agree on mitigation or compensation arrangements before starting any work. • Do not hide any damage or pollution. In the event of an accident, it is better to consult the MOFE and other agency/stakeholders, agree on a mitigation plan than to risk prosecution under the law.	Contractor's Site Manager	Not applicable: these are a statement of professional working standards.	All standards and guidelines	• Before starting work. • Monthly during site operations. • After completion of site operations.	• MCA-Nepal Environment Specialist, for bio-physical matters. • MCA-Nepal Social Safeguards Specialist, for socioeconomic matters. • Local government, CFUGs also involve in coordinating.	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.
1.2 Limited awareness or respect about the importance and value of the environment among labor force leads to excessive damage to resources or disruption of people's livelihoods in the areas around Project work sites, laydown areas, etc.	• Ensure that the site supervisors brief all workers at the start of every job, and at the beginning of each week, on the main environmental messages. • Ensure that all professional and technical staff respect the environment and understand why they will. • Do not allow staff and workers to neglect environmental issues. This may lead to offences under environmental or forest laws. • Do not ignore disregard for environmental and social issues by professional and technical staff.	Contractor's Environment Manager	Not applicable: these are a statement of professional working standards.	All standards and guidelines	• Monthly during site operations.	• MCA-Nepal Environment Specialist	• Interviews with the site-workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
2. Occupational Health and Safety								
2.1 Have an effective OHS Plan	• Conduct a Hazard Identification and Risk Assessment • Apply the hierarchical principles of the safety pyramid	Contractor's H&S Manager	Not applicable: these are a statement of professional working standards.	Safety Pyramid	• Prior to initiation of construction	• Project Engineer's Health and Safety Manager.	• Site observations • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
2.2 Workers are unaware of the dangers from the sites (transmission lines, substations, quarries, etc.) they are working in, leading to high rates of injury.	• Ensure that workers are given safety inductions, toolbox talks and full daily and weekly briefings. • Develop a culture of admonishment for unsafe acts. • Obligate managers to set good examples for respecting safety on site. • Ensure that all management staff from MCA-Nepal, the Project Engineer and Contractors always abide by the Safety Absolutes.	Contractor's Site Manager	Not applicable: these are a statement of professional working standards.	MCA-Nepal Safety Absolutes	• Weekly during site operations	• Project Engineer's Health and Safety Manager.	• Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory
2.3 Injuries due to inadequate provision of safety equipment	• Provide all workers with safety equipment appropriate to the work that they are doing • Do not allow workers on to a site unless they are wearing the appropriate safety gear • Keep first aid kits on all work sites, and ensure they remain stocked and all items are in-date. • Ensure that there are two people on each work site who know what to do if there is an accident and how to use the first aid kit.	Contractor's Site Manager	Bill of quantities (BOQ) items budgeted in all contracts.	MCA-Nepal Safety Absolutes E.6.2	• Weekly during site operations.	• Project Engineer's Health and Safety Manager.	• Visual inspection • Documents • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
2.4 Injuries from traffic accidents.	• Respect all traffic and road transportation rules. • Every passenger in a Project-related vehicle will wear a seat belt. • Every passenger in a Project-related vehicle will be in a proper seat, with no sharing of seats. • Passengers will not travel in the back of pick-ups or trucks). • Report any accident to their manager.	MCA-Nepal, Project Engineer and Contractors' Transport Managers	Not applicable: these are a statement of Project rules.	E.6.4 MCA-Nepal, Project Engineer and Contractors' Traffic Management Plans	• Monthly during site operations.	• Project Engineer's Environment Specialist • MCA-Nepal Environment Specialist.	• Visual inspection • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
3. Community Health and Safety								
3.1 Injuries occur to the public, especially children, during works in the communities near the Project work sites.	• Ensure full separation of the public from working sites. • Fence off working areas so that people cannot be injured by things dropped on them or falling on them when they are in excavations. • Maintain a clean site so that dangerous articles are not left lying around near the work site, especially at night.	Contractor's Site Manager	Not applicable: represents good standard management practices.	C.4.1b C.4.1c	• Before starting work. • Monthly during site operations • After completion of site operations. •	• Project Engineer's Health and Safety Manager.	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory

Potential Impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring: Check Timing	Monitoring: Responsibility to Check	Monitoring: Condition Assessment	Monitoring: Action Required
3.2 Injuries occur to the public from exposure to hazardous substances (e.g. cement, diesel) in the communities near the Project work sites.	• Ensure full separation of the public from storage facilities. • Enforce the exclusion of non-Project personnel from all sites with hazardous substances.	Contractor's Site Manager	Not applicable: represents good standard management practices.	E.9.2a	• Before starting work. • Monthly during site operations. • After completion of site operations.	• Project Engineer's Health and Safety Manager.	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.
3.3 Infectious and contagious diseases are spread amongst the communities near the work sites.	• Ensure that non-local workers are accommodated in sound, dry buildings, with good ventilation and clean water supplies, and with good cleanliness and sanitation arrangements. • Provide awareness trainings to workers and nearby communities, on the prevention of contagion and infection from diseases such as influenza, sexually transmitted diseases and HIV. • Encourage workers to abstain from sex with local people.	Contractor's Site Manager supported by the Community Liaison Manager	BOQ items budgeted in all contracts.	E.7.1 E.7.2	• Before starting work. • Weekly during site operations.	• Project Engineer's Health and Safety Manager.	• Visual inspection • Documents • Interviews with workers • To be completed at each check. • Local's grievance	Complete at check if compliance is not satisfactory.
3.4 Sexual exploitation and gender-based violence increase in communities near large work sites (substations and big laydown areas), due to the influx of temporary laborers.	• Issue policy statements on the Project's adherence to Nepalese law regarding sexual exploitation (including minors and prostitution) and gender-based violence. • Maintain a zero tolerance punitive regime among all Project and Contractors' staff and workers. • Include awareness raising on these issues in trainings and site briefings.	Contractor's Site Manager	Not applicable: represents good standard management practices.	C.6.1 E.7.2 Social and Gender Inclusion Plan Trafficking in Persons Risk Management Plan	• Before starting work. • Monthly during site operations.	• Project Engineer's Health and Safety Manager, supported by Community Liaison Officers and MCA-Nepal GSI Specialist.	• Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
4. Community Impacts Management								
4.1 The Project causes general disruption of the communities near its work sites.	• Use the SEP and communication procedures to inform communities about disruption caused by construction work.	Contractor's Social Safeguards Manager	Not applicable: represents good standard management practices.	C.4.1a C.4.1b C.4.1c C.4.4	• Monthly during site operations.	• Project Engineer's Social Safeguards Specialist.	• Interviews with community leaders and members of the public • To be completed at each check.	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
4.2 Incoming workers do not respect local communities, leading to social disruption, particularly near large work sites (substations and big laydown areas).	• Ensure that the site supervisors brief all workers at the start of every job, and at the beginning of each week, on the main messages regarding respect for the local communities. • Ensure that all professional and technical staff respect the local communities and behave well. • Do not ignore blatant disrespect for communities, including vulnerable households (e.g., *Dalits*, female-headed, disadvantaged social groups) by professional and technical staff.	Contractor's Environment Manager	Not applicable: represents good standard management practices.	E.7.2	• Monthly during site operations.	• Project Engineer's Social Safeguards Specialist.	• Interviews with staff • To be completed at each check. • Local grievances	Complete at check if compliance is not satisfactory.
4.3 Houses are lost in the substation sites and transmission line rights of way.	• Pay the full and fair compensation as agreed following the procedures given in the Resettlement Action Plan. • Assist the affected persons to relocate and re-establish their lives and livelihoods. • Do not allow any work to commence on a site before full resettlement compensation has been completed.	RAP Implementation Manager.	Resettlement Action Plan	Resettlement Action Plan C.5.1a C.5.1b	• Before starting work.	• MCA-Nepal ESP Specialist (Land Acquisition).	• Documents • To be completed at special checks before construction is permitted to start.	Complete at check if compliance is not satisfactory.
4.4 Loss of land use and business sites in the substation sites and transmission line rights of way.	• Pay the full and fair compensation as agreed following the procedures given in the Resettlement Action Plan. • Assist the affected persons to relocate and re-establish their livelihoods. • Do not allow any work to commence on a site before full compensation has been completed.	RAP Implementation Manager.	Resettlement Action Plan Livelihoods Restoration Plan	Resettlement Action Plan Livelihoods Restoration Plan C.5.1a C.5.1b C.5.2	• Before starting work. • Monthly during site operations.	• MCA-Nepal ESP Specialist (Land Acquisition).	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.

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Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
4.5 Cultivated land and crops are disturbed or destroyed, mainly in the rural areas around the substation sites and along the transmission line rights of way	• Avoid the use of cultivated land wherever possible. This includes fallow agricultural land and tree plantations. • Where use of such land is required, check with the Environmental and Social Performance On-site Community Assistant (ESP-CA) at least four weeks prior to commencement of activities (ideally earlier) that mitigation measures have been agreed and implemented. • Do not start using cultivated land before the occupier has fully agreed the compensation strategy, all amounts have been paid and this is confirmed by the ESP-CA. • Avoid damage to crops or land beyond agreed boundaries.	RAP Implementation Manager.	Resettlement Action Plan	Resettlement Action Plan Livelihoods Restoration Plan C.5.1a C.5.1b C.5.2	• Before starting work. • Monthly during site operations.	• MCA-Nepal Environment Specialist assisted by the ESP-CA	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.
4.6 Local people's livelihoods are adversely affected by Project activities.	• Establish an equitable and fair employment strategy. Liaise with the ESP-CA to ensure that it is understood in the local communities (i.e. that it is transparent). • Give priority to local men and women in labor gangs, and those who used to earn livelihoods on land in the RoW. • Pay at least the usual accepted district wage rates. • Do not demand unpaid work by local farmers or others.	Contractor's Site Manager, supported by Community Liaison Manager	Part of Contractors' standard costs	Livelihoods Restoration Plan C.4.4 C.6.2	• Monthly during site operations.	• Project Engineer's Social Safeguards Specialist • MCA-Nepal ESP Specialist (Land Acquisition).	• Interviews with communities • To be completed at each check.	Complete at check if compliance is not satisfactory.
4.7 Cumulative losses are incurred by social groups unable to respond to change.	• Give priority to local men and women in labor gangs, and those who used to earn livelihoods on land in the RoW. • Maintain an active policy to ensure gender equality and opportunities for vulnerable groups. • Ensure equal payment for equal work	Contractor's Site Manager supported by the Community Liaison Manager	Not applicable: represents good equitable management practices.	Livelihoods Restoration Plan C.4.4 C.6.2	• Monthly during site operations.	• MCA-Nepal GSI Specialist.	• Interviews with communities • To be completed at each check.	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
5. Traffic Management								
5.1 Use of public roads by Project vehicles increases the accident rate and generates nuisance levels of dust.	• Minimize vehicle movements. • Obey and enforce transport rules and regulations rigorously. • Conduct driving safety awareness and defensive driving campaigns among staff. • Establish and enforce speed controls • Do not tolerate any poor behavior, dangerous driving or even minor traffic infringements by any staff or workers of any Project-related organization. • Do not allow dust generation to affect the ambient air quality outside the site. • Spray dust suppression water as required, but ensure it is not applied at such rates that it causes erosion and washing out of the roads. • Report all accidents and near misses • Post traffic signs near substation sites and laydown areas.	MCA-Nepal, Project Engineer's and Contractors' Transport Managers	Not applicable: represents good standard management practices.	E.6.4 MCA-Nepal, Project Engineer's and Contractors' Traffic Management Plans	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Specialist • MCA-Nepal Environment Specialist.	• Visual inspection • Documents • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
5.2 Vehicle use gives rise to unnecessary amounts of energy wastage.	• Turn off a vehicle's engine when it is stationery and open the windows for ventilation if necessary. • Walk from one area to another within each work site. • Minimize vehicle movements. • Only use vehicles for journeys that are longer than 500 meters.	MCA-Nepal, Project Engineer's and Contractors' Transport Managers	Not applicable: represents good standard management practices	E.6.4 MCA-Nepal, Project Engineer's and Contractors' Traffic Management Plans	• Monthly during site operations.	• Project Engineer's Environment Specialist • MCA-Nepal Environment Specialist.	• Visual inspection • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
6. Cultural Heritage Management								
6.1 Cultural sites are damaged, anywhere that land is cleared, such as for tower sites.	• Stop work as soon as potential cultural heritage and archaeological finds are discovered. • Put in place the Chance Finds Procedure. • Notify the Department of Archaeology. • Fence the potential site to prevent disturbance before investigation.	• Contractor's Site Manager • Contractor's Community Liaison Manager	Not applicable: represents good standard management practices. RAP contingency if any need to compensate.	C.7.5	Before starting work. As required thereafter.	Project Engineer's Social Safeguards Specialist.	Visual inspection Documents Interviews with communities To be completed at each check.	Complete at check if compliance is not satisfactory.

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Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
7. Hazardous Materials Management								
7.1 Pollution to air, soil or water and danger (illness or injury) from the delivery and handling of hazardous materials (including fuels, lubricants, paints and cement) at Project camps, laydown areas and construction sites.	• Follow the hazardous materials management guidelines fully. • Use the safest available transportation option. On roads, use convoys with accompanying support. • Deliver only to prepared locations. • Maintain supplies of spill kits and granules in all vehicles and at all offloading locations. • Ensure competent drivers and close supervision. • Provide emergency training to all personnel involved in the movement and handling of hazardous materials. • Use both international and Nepali labelling for identifying hazardous substances. • Maintain emergency response / fire-fighting teams trained for a spillage event and appropriate equipment at each substation and major laydown facility.	Contractor's Site Manager and Environment Manager	BOQ for spill kits and fire prevention equipment. Other measures: not applicable: represents good standard management practices.	C.9.1 E.9.1 E.9.2a E.9.2b E.9.2c	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check	Complete at check if compliance is not satisfactory.
7.2 Pollution to air, soil or water and danger (illness or injury) from fuel and oil storage at Project laydown areas.	• Follow the hazardous materials management guidelines fully. • Only use storage facilities located down gradient of public water supply boreholes and at least 100 meters from watercourses. • Only use designated storage areas, with bunding of 150% volume of total capacity. • Ensure that there are retention systems, including walls, bunds and lined drains to contain any spillages. • Ensure that there is hard standing, with a drainage system that includes oil/water separators. • Ensure spill kits and granules are available, and if used, dispose of waste appropriately. • Check facilities, safeguards and procedures for any potential for explosions to occur.	Contractor's Site Manager assisted by Environment Manager	BOQ for storage facilities etc., spill kits and fire prevention equipment. Other measures: not applicable: represents good standard management practices.	C.9.1 E.9.1 E.9.2a E.9.2b E.9.2c	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • Interviews with workers • To be completed at each check • Sampling of surface water, groundwater and/or soil when accidents occur.	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
	• Maintain emergency response / fire-fighting teams trained for a spillage event and appropriate equipment at each facility where fuel is stored. • Provide training for all personnel handling fuel and oil. • Take rapid action if uncontained spills and leakages occur, to prevent soil contamination, and ground and surface water pollution. • Do not allow soils to become contaminated and sterilized, or for water courses to be affected by runoff carrying toxic substances, affecting community water supplies, aquatic biodiversity and wildlife. • Have controls in place to minimize opportunities for fuel pilferage.							
7.3 Pollution to air, soil or water and danger (illness or injury) from refueling operations at Project laydown areas and construction sites.	• Follow the hazardous materials management guidelines fully, which include procedures for refueling vehicles and site plant. • Spill kits are to be carried by all refueling vehicles. • Refuel vehicles only on impermeable hard standings with controlled drainage (traps and interceptors). • Plant refueling on site is to be carried out according to strict protocols for refueling in unprotected areas. • Enforce the reporting system for spillage incidents.	Contractor's Site Manager assisted by Environment Manager	BOQ for spill kits and fire prevention equipment. Other measures: not applicable: represents good standard management practices.	C.9.1 E.9.1 E.9.2a E.9.2b E.9.2c	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check • Sampling of surface water, groundwater and/or soil when accidents occur.	Complete at check if compliance is not satisfactory.
7.4 Pollution to soil or water from the storage of steel members at Project laydown areas.	• Ensure that the specifications are for no steel members to have coatings with heavy metals or other toxic elements or compounds. • Submit certificates of coatings and the relevant material safety data sheet for approval by MCA-Nepal before importing any steel members.	Contractor's Project Manager. Project Engineer's Environmental Specialist	Not applicable: represents good standard management practices.	E.9.1 E.9.2a	• Before start of work. • Whenever deliveries occur.	• Project Engineer's Environment Specialist.	• Documents • Sampling of soil at laydown areas.	Complete at check if compliance is not satisfactory.

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Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring: Check Timing	Monitoring: Responsibility to Check	Monitoring: Condition Assessment	Monitoring: Action Required
8. Construction Materials Management								
8.1 Damage to the land from aggregate sources and quarries	• Only obtain aggregates from locations with valid environmental permits from MOFE (including local government divisions) that cover the volume required by the Project in addition to other production. • Identify aggregate sources and quarry areas as early as possible, and create specific risk assessment and mitigation plans for these areas. • Gain MCA-Nepal approval for all material sources. • Allow adequate time for the consultation, resettlement and compensation of people whose land is affected. • Install sediment control measures to prevent runoff from causing contamination and siltation of water bodies. • Do not allow any vehicle or machine to operate in a watercourse. • Take appropriate measures to prevent emissions and dust from affecting the ambient air quality outside the immediate site boundaries. • Ensure proper geotechnical management so that excavation and tips do not trigger slope instability or affect water courses in any way. • Ensure that material source areas are signed off by MCA-Nepal after Project-related extraction, with rehabilitation completed where necessary.	MCA-Nepal Environment Specialist to approve sources and inspect after Project-related extraction Contractor's engineers Contractor's Site Manager Contractor's Environment Manager	Construction materials are BOQ items. Erosion protection and land stabilization of material sources are BOQ items. Other measures: not applicable: represents good standard management practices.	C.5.4 E.5.9 E.5.14a–E.5.14f E.9.4	• Before start of work • Monthly during site operations. • After closure of quarries and pits.	• Project Engineer's Environment Specialist • MCA-Nepal Environment Specialist.	• Visual inspection • Documents • Interviews with the communities • Air quality monitoring with meters • Slope stability testing • To be completed at each check	Complete at check if compliance is not satisfactory.

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Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
8.2 Disturbance and danger from explosives and blasting	• Obtain formal licensing from the government. • Involve the Nepal Army from the planning stage onwards. • Abide by Nepalese laws and regulations regarding the handling, storage and use of explosives. • Be particularly strict in enforcing safety regulations when using explosives. • Follow the detailed specifications for blasting provided in the ESHSMP. • Ensure that blasting does not create excessive noise and vibration disturbance to wildlife and communities. • Do not allow any unauthorized person to have access to explosives. • Do not allow anyone to use welding equipment, smoke, cook food light any fire or use a mobile phone within 50 meters of an explosives store.	Contractor's Site Manager	Blasting is a BOQ item. Other measures: not applicable: represents good standard management practices.	E.5.12	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Manager.	• Visual inspection • Documents • Interviews with the workers • Noise measurements • To be completed at each check.	Complete at check if compliance is not satisfactory.
9. Waste Management								
9.1 Pollution of soil or water and ill-health from waste generation and management at camps, laydown areas and construction sites.	• Operate a waste management strategy based on principles of reduction, recovery, recycle and reuse. • Collect and segregate waste into hazardous and non-hazardous at the source. • Avoid waste spills during storage and handling. • Dispose of all waste in an appropriate manner. • Ensure use of PPE by staff when handling all forms of waste. • Ensure that waste collection, segregation, storage and disposal systems avoid environmental degradation, contamination, and hazards to human and animal health.	Contractor's Site Manager Contractor's Environment Manager	Waste management and recycling facilities are BOQ items. Other measures: not applicable: represents good standard management practices.	GoN Solid Waste Management Rules E.9.3a E.9.3b	• Before start of work. • Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • Interviews with the workers • To be completed at each check	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
	• Dispose of waste to MOFE-authorized facilities (including local government approved facilities). • If there are no alternatives, design and construct a landfill site that is lined and in an area that is not prone to slippage, cannot leach to surface water and groundwater, and is at least 500 meters from settlement. It should be located down gradient of any water supply springs or boreholes. • Ensure that the landfill site is in a secure compound and that its operation conforms to MOFE standards. • Deal with hazardous waste according to international best practice and MOFE guidelines.							
9.2 Pollution of soil or water from poor sanitation at work sites—camps, laydown areas and construction sites.	• Provide proper water closet toilet facilities at all long-term (> 1 month) work sites. • Separate toilets/rest rooms for men and women. • Do not allow water to run out at toilets. • Maintain all toilets in a clean and sanitary condition. • Provide proper earth pit latrines at all work sites where work will be undertaken for periods of up to one month. • Fill the latrines in once they become full and when site work is complete. • Do not allow site workers to defecate in the open anywhere on the site or in its vicinity. • Add the use of sanitation arrangements in workers' inductions.	Contractor's Site Manager Contractor's Environment Manager	Sanitation is a BOQ item. Other measures: not applicable: represents good standard management practices.	E.9.2d	• Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
10. Soil Erosion Control								
10.1 Clearance of vegetation leads to excessive risk of soil erosion.	• Only disturb the soil where it is necessary to do so for the agreed works. • Limit vegetation clearing to those trees approved by the Division Forest Office. • Only cut vegetation using saws and axes. Never clear vegetation using machines or fire. • Leave tree stumps and roots, smaller understory trees, shrubs, and the herbaceous layer intact to protect the soil from erosion. • Use existing tracks and previously disturbed areas as far as possible. • Allow small plants to grow back on the edges of tracks and other disturbed areas.	Contractor's Site Manager, supported by Environment Manager	Vegetation clearance is a BOQ item. This covers only the cutting and disposal of vegetation and specifically excludes ground disturbance.	C.8.4 E.5.9 E.5.14a–5.14f	• Before starting work. • Monthly during site operations. • After completion of site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check	Complete at check if compliance is not satisfactory.
10.2 Erosion and physical damage of soils and earthworks—all construction sites, camps and ancillary infrastructure areas.	• Where it is present, remove and stockpile topsoil to a depth of 200 mm for later site restoration use. • Store soil excavated for tower foundation construction in a designated location and replace it around the foundation during site restoration. • Do not allow erosion to happen without taking rapid control measures: install erosion and sediment controls as the very first physical site activity. • Grade any newly formed slopes to the minimum angle possible. • Cut slopes to grades appropriate to the material found. • Level surfaces to prevent erosion as soon as works have been completed. • Keep earth piles away from the edges of steep slopes and watercourses.	Contractor's Site Manager, supported by Environment Manager	Topsoil removal, stockpiling and replacement are BOQ items. Sediment controls, and slope earthworks, stabilization and protection are BOQ items.	C.5.4 C.5.5 C.8.4 E.5.9 E.5.14a–5.14f E.9.4	• Before starting work. • Monthly during site operations. • After completion of site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check	Complete at check if compliance is not satisfactory.
	• Undertake soil erosion and sediment controls as necessary, to protect areas from slips and erosion. All soil slopes steeper than 10° will be revegetated according to the guidelines in the ESHSMP. • Avoid compaction of the soil in temporary use areas by limiting machine and vehicle access. • Rip or deep-dig compacted soil at the start of site rehabilitation.							

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring: Check Timing	Monitoring: Responsibility to Check	Monitoring: Condition Assessment	Monitoring: Action Required
11. Water Resources Management								
11.1 Damage to water resources by pollution with sediment or chemicals in runoff entering any springs, streams, rivers, nearby wetlands or water supply boreholes.	• Do not dispose of anything into any kind of water body. • Keep earthworks, tracks and other cleared areas as far as possible from watercourses or bodies. • Where earthworks, tracks, roads and other cleared areas are within 50 meters of watercourses or bodies, take special care to ensure that fuel, oil and other hazardous substances, and any earthworks, are properly contained. • Ensure that all community water supplies are safeguarded. Confirm the location of local water supplies with the ESP-CA. Be prepared to bring in clean water for communities if the works pollute their water sources • Do not extract more than 20 percent of the flow from a spring or watercourse. Never take so much water from a supply that the normal users are short. • Schedule earthworks only in the dry season. • Use surface protection measures to control soil erosion and protect watercourses. • Regulate water discharge and run off using sediment traps and ponds. • Monitor downstream water quality routinely.	• Contractor's Site Manager, • Contractor's Environment Manager	Sediment controls are BOQ items. Other measures: not applicable: represents good standard management practices.	GoN Water Resources Management Regulations E.8.2 Guidelines for 10.1: C.8.4 E.5.9 E.5.14a–5.14f	• Before starting work. • Monthly during site operations. • After completion of site operations.	• Project Engineer's Environment Specialist and ESP Community Assistant together.	• Visual inspection • Documents • Interviews with the communities • Surface water sampling • Groundwater sampling • To be completed at each check.	Complete at check if compliance is not satisfactory.
12. Air Emissions Management								
12.1 Dust from construction sites and access tracks to ancillary infrastructure affects local communities and crops	• Enforce dust control measures during the dry season. • Enforce strict speed limits (20 km/h) on earth tracks by placing speed bumps. Always provide warning signs with speed bumps. • Spray water on to dry earth surfaces. • Stop work in very windy, dry weather.	Contractor's Site Manager, supported by Environment Manager	Speed bumps and water spraying are BOQ items. Other measures: not applicable: represents good standard management practices.	E.6.4 MCA-Nepal, Project Engineer's and Contractors' Traffic Management Plans	• Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • Air quality monitoring using dust meters • To be completed at each check.	Complete at check if compliance is not satisfactory.
12.2 Exhaust fumes affect local communities close to roads and all Project ancillary infrastructure.	• Use only vehicles and equipment with engines that comply with national emissions standards. • Maintain engines in good working order.	Contractor's Site Manager, supported by Environment Manager	Not applicable: represents good standard management practices.	Equipment Service Manuals	• Monthly during site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • Air quality monitoring using gas analyzers • To be completed at each check.	Complete at check if compliance is not satisfactory.

Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring			
					Check Timing	Responsibility to Check	Condition Assessment	Action Required
13. Biodiversity Management								
13.1 Vegetation (both natural plants and farm plants but particularly natural plants in forests), other than invasive species, is damaged or destroyed unnecessarily beyond the agreed boundaries.	• Only cut vegetation that is in the way. This means plants that are in the direct area required for the agreed works. • Do not cut any more vegetation than is necessary for site access and working. • Do not use fire to remove vegetation. • Do not burn cut vegetation.	Contractor's Site Manager, supported by Environment Manager	Not applicable: represents good standard management practices.	C.8.4 E.5.9	• Before starting work. • Monthly during site operations. • After completion of site operations.	• MCA-Nepal Environment Specialist.	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.
13.2 Illegal clearing or collection of forest resources, including NTFPs, by Contractors and workers.	• Instruct workforce not to collect or purchase NTFPs on site or in bazaars within 10 kilometers of work sites. • Avoid all use of fire. • Provide workers with food when they are living in places where there is no affordable market source of food.	Contractor's Site Manager, supported by Environment Manager	Not applicable: represents good standard management practices.	E.7.1 E.7.2	• Before starting work. • Monthly during site operations. • After completion of site operations.	• Project Engineer's Environment Specialist.	• Visual inspection • Documents • To be completed at each check.	Complete at check if compliance is not satisfactory.
13.3 Alien species invade areas of the RoW where natural forest is cleared, suppressing growth of low-stature native plants.	• Monitor areas where natural forest has been cleared. • If invasive species start to become a problem, devise and implement a site-specific control plan.	Project Engineer's Environment Specialist	Not applicable: represents good standard management practices.	None	• Before site clearance. • Annually during construction. • After completion of construction.	• MCA-Nepal's Environment Specialist.	• Visual inspection • To be completed at each check.	Complete at check if compliance is not satisfactory.
13.4 Wild animals other than very common or non-native pest species are killed.	• Instruct workforce not to hunt, deal in or transport wild meat on site. • Provide meat from domestic animals if there is no alternative. • Avoid all use of fire. • Provide workers with meat from domesticated animals when they are living in places where there is no affordable market source of it.	Contractor's Site Manager, supported by Environment Manager	Not applicable: represents good standard management practices.	C.8.6a–8.6c E.7.1 E.7.2	• Monthly during site operations.	• Project Engineer's Environment Specialist, supported by Social Safeguards Specialist.	• Visual inspection • Documents • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
13.5 Birds are killed by colliding with conductors, or by electrocutions.	• Install marker spheres on earth wires at all locations where the EIA recommended this method to improve visibility. • Construct transmission lines to design, so that the risk of electrocution of birds is eliminated.	Contractor's Site Manager, supported by Environment Manager	Conductor visibility marker spheres are a BOQ item.	APLIC Manuals	• Monthly during site operations.	• Project Engineer's Environment Specialist, supported by Social Safeguards Specialist.	• Visual inspection • Documents • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.
13.6 Bird nesting sites are reduced by vegetation clearance and other Project activities.	• If significant bird nesting sites are found to be destroyed during construction, install nesting ledges on towers (but not transmission towers) to provide alternatives.	Contractor's Site Manager, supported by Environment Manager	Towers and nesting ledges are a BOQ item.	APLIC Manuals	• Monthly during site operations.	• Project Engineer's Environment Specialist, supported by Social Safeguards Specialist.	• Visual inspection • Documents • Interviews with workers • To be completed at each check.	Complete at check if compliance is not satisfactory.

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Potential impacts	Mitigation Measures	Responsibility for Implementation	Budget Provision	Standard or Guideline to be met	Monitoring: Check Timing	Monitoring: Responsibility to Check	Monitoring: Condition Assessment	Monitoring: Action Required
14. Noise Abatement								
14.1 Noise disturbance at excessive levels from construction activities, laydown areas, quarries, etc.	• Minimize site-generated noise to the greatest possible extent. • Do not allow works to occur during the hours of darkness (6 pm to 6 am), or on religious holidays. • Provide warnings of blasting, starting at least 24 hours ahead, and ensure no one is within the 500-metre clearance zone. • Provide communities, through the ESP-CA, with details of the works program. • Do not deviate from the agreed timing of works. • Provide ear protection to all workers exposed to noise over 70 dB(A). • Do not allow any person to come close to a machine without having ear protection in place.	Contractor's Site Manager, supported by Environment Manager and Community Liaison Manager	Workers' ear protection is a BOQ item as part of PPE. Other measures: not applicable: represents good standard management practices.	GoN Noise Control Rules	• Before starting work. • Monthly during site operations.	• Project Engineer's Health and Safety Manager	• Visual inspection • Documents • Interviews with workers • Interviews with communities • Noise measurements • To be completed at each check.	Complete at check if compliance is not satisfactory.
15. Office Management								
15.1 Project offices cause unnecessary environmental pollution and energy waste.	• Open windows for ventilation rather than using air conditioners. • Do not have heaters or air conditioners on when doors and windows are open. • Turn off heaters, fans or air conditioning when you are not in a room. • Turn off lights when you are not in a room. • Do not print out documents unless you really need them. • Avoid using plastic water bottles and plastic cups for drinking water. Instead, use glass bottles and mugs. • Reuse water bottles by refilling.	MCA-Nepal Environment Specialist. Project Engineer's Environment Specialist. Contractor's Environment Manager	Not applicable: represents good standard management practices.	None	• Monthly during site operations.	• MCA-Nepal's Environment Specialist	• Visual inspection • To be completed at each check.	Complete at check if compliance is not satisfactory.

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9.10 MONITORING, REPORTING, AND ENFORCEMENT PROCESSES

This section explains the reporting and monitoring processes used for ESHS safeguarding by the Electricity Transmission Project.

9.10.1 Monitoring Processes

Project construction activities will be monitored and supervised to document that works are undertaken in accordance with the detailed Project design, permits, approvals, contract conditions and the measures described in the ESHSMP.

Pre-construction inspections of Project construction sites will be undertaken jointly by MCA-Nepal, the Project Engineer and each Contractor, to establish the initial site condition at the time of the Contractor being granted access to the site.

The mitigation and monitoring matrix in Section 9.9.2 identifies the monitoring frequency for each topic area at each part of the overall Project site during the pre-construction and construction phases. The Contractors are responsible for the implementation of most mitigation measures, but some are the responsibility of other entities, particularly the engineer, the RAP implementation consultant and MCA-Nepal itself. Consequently the monitoring of compliance is mostly the responsibility of the Project Engineer on behalf of MCA-Nepal, but in some cases it is the direct responsibility of MCA-Nepal. However, as the Contractors will be using the same reporting format for ESHS activities, there is an element of self-monitoring: the purpose of this is to force the Contractors to review their own activities in relation to ESHS compliance on a regular basis.

Every Contractor will submit monthly ESHS Performance Reports to the Project Engineer as part of the monthly reporting of each contract's activities. The Project Engineer will review these reports, and prepare its own independent monthly ESHS Performance Report, which will be submitted to MCA-Nepal along with the Contractors' monthly reports. MCA-Nepal will forward copies of all reports to MCC. The Project Engineer's reports will identify any discrepancies in the Contractors' ESHS Performance Reports, and whether each Contractor is in conformance with its ESHS performance requirements according to the contract and ESHSMP conditions. Where any of the sites or activities are not in full compliance, the Project Engineer will document these, identify opportunities for improvement, and provide directions to the Contractors on corrective actions. The Project Engineer will also provide a copy of its reports to the Contractors at the same time, for appropriate action; and the Contractors will undertake all actions as specified.

The ESP staff of MCA-Nepal will also carry out monitoring. For the areas of responsibility falling to them in the mitigation and monitoring matrix in Section 9.9.2, this will be done as per the specified timing. For all other areas, it will be done on a spot-check basis.

Any person identifying an ESHS non-compliance should use the standard ESHS monitoring format (see Chapter 10 – Environmental Monitoring) to alert their line manager as appropriate, in order to ensure that action is taken promptly to resolve the problem. The same form will be incorporated in the next monthly report. As stated in Section 9.10.4, non-compliances can also lead to immediate actions to stop tasks or close sites.

The Project Engineer and MCA-Nepal will carry out a post-construction audit of each completed Project work area (i.e., substations, tower sites, laydown areas, construction material sources, camps, access routes, etc.). All outstanding work will be completed to MCA-Nepal's satisfaction before a Contractor will be allowed to hand over any part of the site.

MOFE may conduct monitoring of the Contractors' activities to evaluate Project compliance with the ESHSMP, and other Project commitments, Project approval conditions and statutory requirements. MCA-Nepal, the Project Engineer and Contractors will provide MOFE with all necessary ESHS records and arrange for their relevant staff to be available during MOFE site inspections, if requested.

9.10.2 Reporting Processes

A single ESHS reporting form is used by all three tiers of organization in the ETP. The format for the form is given in Section 9.10.3.

The reporting system is as follows.

9.10.2.1 Contractors' Reporting

1. Each Contractor's ESHS team will complete Monthly ESHS Reports for the topics for which they are responsible, forming part of the overall monthly report for that contract. This will cover each area of responsibility for the respective Contractor, and the reporting will be broken down into appropriate sections of the Contractor's site. Particularly for transmission line contracts, this may require a number of each topic area reports to ensure that all sections of the site are reported; there will also be separate reporting for ancillary facilities, such as laydown areas, worker camps and construction material sources. The process of monitoring to compile the monthly reports should ensure that any areas of non-compliance are identified and resolved. Reports will include details on the site attendance of ESHS staff relative to the protocol for site visits approved by MCA-Nepal.

2. The Contractor's Monthly ESHS Report is to be combined with the Monthly Progress Report (covering all of the technical aspects) by the Site Manager and submitted to the Contractor's Project Manager.

3. The Contractor's Project Manager will review the combined report and issue instructions for any corrective actions required. Meanwhile they will also submit the combined report to the Resident Engineer.

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9.10.2.2 Project Engineer's Reporting

1. The Project Engineer's ESHS team will complete Monthly ESHS Reports for the topics for which they are responsible, forming part of the overall monthly report for the Project. The reporting will be broken down into appropriate sections of the Project site. Particularly for transmission line contracts, this may require a number of each topic area reports to ensure that all sections of the site are reported; there will also be separate reporting for ancillary facilities, such as laydown areas, worker camps and construction material sources. Reports will include details on the site attendance of ESHS staff relative to the protocol for site visits approved by MCA-Nepal.

2. The Engineer's Monthly ESHS Report is combined with the Monthly Progress Report (covering all of the technical aspects) by the Site Engineer and submitted to the Resident Engineer.

3. The Resident Engineer will review the combined report and the Contractors' combined monthly reports. They will issue instructions for any corrective actions required. Meanwhile they will also submit the combined reports of the Engineer and Contractors to the relevant MCA-Nepal Project Manager and Deputy Executive Director for Project Delivery.

9.10.2.3 MCA-Nepal's Reporting

1. The MCA-Nepal's ESP team will complete monitoring reports for the topics for which they are responsible, in a rolling program that is agreed with their respective Project Manager.

2. The Project Manager will review the ESP monitoring reports in connection with the Engineer's and Contractors' monthly reports. They will issue instructions to the Resident Engineer for any corrective actions required. Meanwhile they will also submit the reports to the Millennium Challenge Corporation.

The regular reporting and action flows are shown in the diagram below.

As well as the formal monthly reporting by the Contractors and engineer, and the agreed monitoring by MCA-Nepal's technical and ESP staff, non-compliance reporting can happen at any time. The process for this is described in Section 9.10.4.

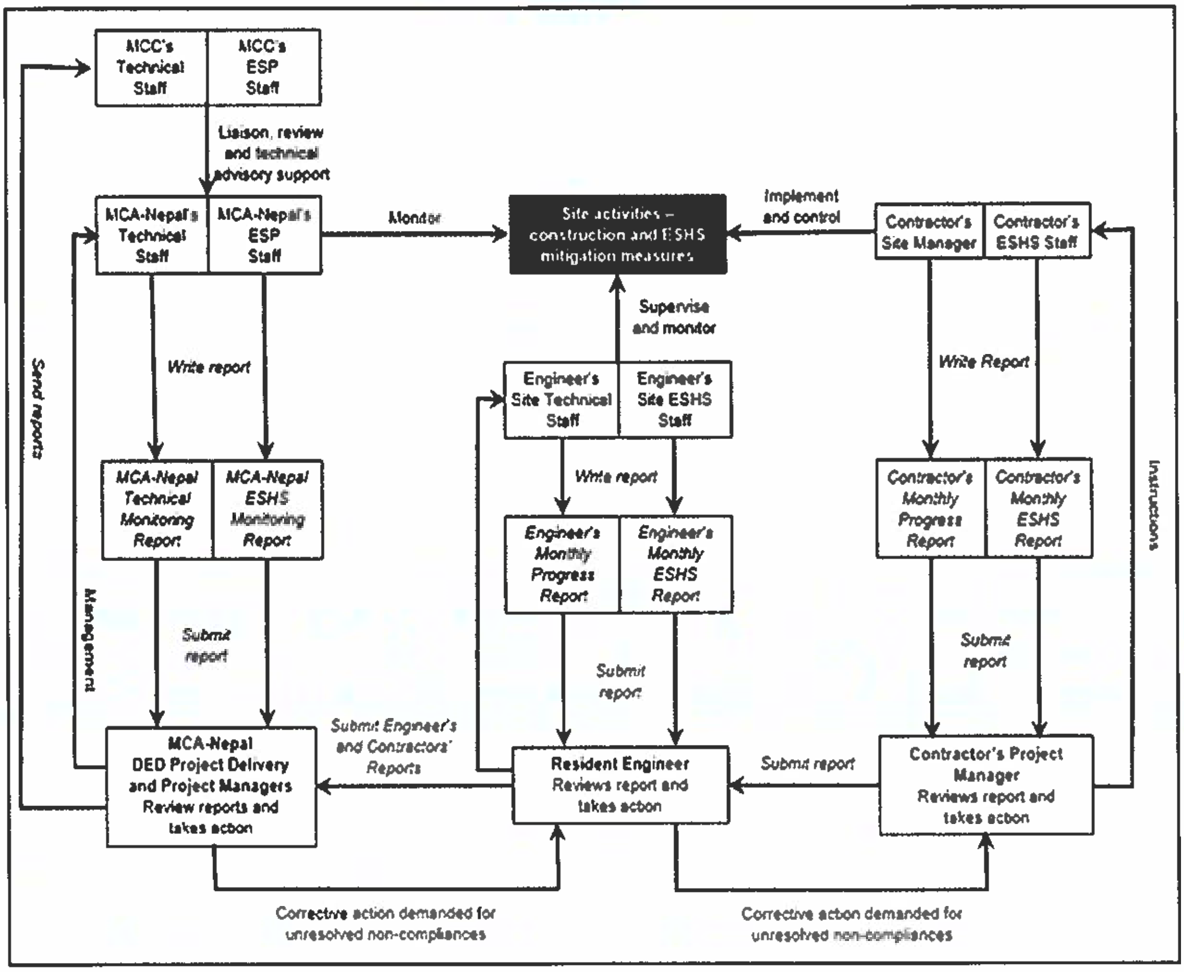

Figure 9.10-1: Regular Reporting and Action Flows

9.10.3 Monitoring Report Format

The format for monitoring reports to be used will be as shown below.

Table 9.10-1: Standard Monitoring Reporting Format—All Reports

Potential Impact	Mitigation Measures	Site Location	Check Date	Checker	Condition Assessment	Compliance			Action Required		
						Full	Part	None	Action	By whom	Deadline
Topic area											
From ESHSMP	*From ESHSMP*										

Some hypothetical worked examples of the monitoring report format are given below.

Table 9.10-2: Example of the Situation where Everything is in Compliance with Requirements

Potential Impact	Mitigation Measures	Site Location	Check Date	Checker	Condition Assessment	Compliance			Action Required		
						Full	Part	None	Action	By whom	Deadline
12. Air quality management											
12.1 Dust from construction sites and access tracks to ancillary infrastructure affects local communities and crops	Enforce dust control measures during the dry season. Enforce strict speed limits on earth tracks by placing speed bumps. Spray water on to dry earth surfaces. Stop work in very windy, dry weather.	Contract 01: Dandagaon Laydown Site	21 Sept 2019	MCA-ESP Specialist	Site is in good condition throughout. Contractor has all dust control measures in place and no problems were observed.				No action required	N.A.	N.A.

Table 9.10-3: Example of the Situation where the Contractor's Compliance is Incomplete

Potential Impact	Mitigation Measures	Site Location	Check Date	Checker	Condition Assessment	Compliance			Action Required		
						Full	Part	None	Action	By whom	Deadline
Topic area											
12.1 Dust from construction sites and access tracks to ancillary infrastructure affects local communities and crops	Enforce dust control measures during the dry season. Enforce strict speed limits on earth tracks by placing speed bumps. Spray water on to dry earth surfaces. Stop work in very windy, dry weather.	Contract 01: Dandagaon Laydown Site	21 Sept 2019	MCA-ESP Specialist	Some dust control measures are in place, but trucks are driving too fast so that dust is blowing over the neighboring bari land from time to time.				Drivers to be re-trained; site in-charge to observe and take disciplinary action against any driver not obeying rules.	Contractor's Site Manager	25 Sept 2019
									Re-check to ensure that compliance is now full.	Project Engineer's Environment Specialist	30 Sept 2019

Table 9.10-4: Example of the Situation where the Contractor is non-compliant, to be used as the basis for a Non-compliance Report by the Project Engineer's Environment Specialist

Potential Impact	Mitigation Measures	Site Location	Check Date	Checker	Condition Assessment	Compliance			Action Required		
						Full	Part	None	Action	By whom	Deadline
Topic area											
12.1 Dust from construction sites and access tracks to ancillary infrastructure affects local communities and crops	Enforce dust control measures during the dry season. Enforce strict speed limits on earth tracks by placing speed bumps. Spray water on to dry earth surfaces. Stop work in very windy, dry weather.	Contract 01: Dandagaon Laydown Site	21 Sept 2019	MCA-ESP Specialist	There are no dust controls in place. The wind is blowing dust from the stockpiles and from moving trucks into the houses and shops in the nearby bazaar.				Dust control measures will be implemented immediately as per the ESHSMP.	Contractor's Site Manager	23 Sept 2019
									Check that the dust control measures are effective; if not, work at the site will be stopped until they are.	Resident Engineer and Project Engineer's Environment Specialist	24 Sept 2019

9.10.4 Enforcement Processes

As stated in Section 9.10.1, any person identifying an ESHS non-compliance should use the standard ESHS monitoring format (see Sections 11.2 and 11.3) to alert their line manager as appropriate, in order to ensure that action is taken promptly to resolve the problem. The same form will be incorporated in the next monthly report.

However, non-compliances can also lead to immediate actions to stop tasks or close sites. This is essential where continued work will lead to a continuation or worsening of the ESHS infringement.

A non-compliance is any action or result of Project-related activities that leads to an infringement of any aspect of the ESHS safeguards as described in the ESHSMP. A near miss is where there appears to be a 90 percent chance of injury or pollution resulting from an action.

Table 9.10-5: ESHS Enforcement Matrix

ESHS Infringement Type (typical examples)	Authority Level			
	Action to Take	MCA-Nepal	Project Engineer	Contractors
• Death or serious accident involving hospitalization	Stop work at whole site	Any MCA-Nepal staff ESP Team Members ESP-CA	Any of Project Engineer's staff ESP Team Members	Any of Contractor's staff ESP Team Members
• Accident requiring first aid • Spill or leakage of fuel or paint (> 10 liters) • Serious erosion of soil (> 5 m^3 displaced) or landslide •	Stop task	Any MCA-Nepal staff ESP Team Members ESP-CA	Any of Project Engineer's staff ESP Team Members	Any of Contractor's staff ESP Team Members
• Spill or leakage of fuel or paint (< 10 liters) • Non-compliance with PPE requirements • Vegetation damaged outside agreed areas • Drinking water supplies affected by sediment or other pollution • Houses, schools or clinics affected by dust • Workers, houses, schools or clinics affected by noise above ESHSMP limits	Report immediately	MCA-Nepal HQ staff ESP Team Members ESP-CA	Any of Project Engineer's staff ESP Team Members	Any of Contractor's staff ESP Team Members

ESHS Infringement Type (typical examples)	Authority Level			
	Action to Take	MCA-Nepal	Project Engineer	Contractors
• Harassment of workers or local community members, including sexual harassment • Workers causing disturbance due to drunkenness, gambling, using drugs, or prostitutes • Evidence of discrimination in workforce • Evidence of trafficking in persons • Minor erosion of soil (< 5 m^3 displaced) • Streams and irrigation kilos affected by sediment or pollution • Agricultural and forest land affected by dust • Incorrect management of waste	Report immediately	Any MCA-Nepal staff ESP Team Members ESP-CA	Any of Project Engineer's staff ESP Team Members	Any of Contractor's staff ESP Team Members

9.10.4.1 Action Sequence in the Event of a Non-Compliance

If you witness a non-compliance, you should follow this simple procedure.

According to your position in the overall Project, and following the guidance in the ESHS Enforcement Matrix, take the following action.

9.10.4.1.1 Events Requiring Stop Work at Whole Site

1. Take any action necessary to save life, but do not endanger yourself or others.
2. Move people away from danger.
3. Take any action necessary to reduce pollution, if it is safe to do so.
4. Call for medical or other emergency assistance if necessary.
5. Contact the Contractor's site in-charge; inform them of the event; and instruct them to stop all work on the site.
6. Inform your line manager.
7. If necessary, inform the civil authorities.
8. Remain at the site and take any necessary action required to help resolve the crisis.

9.10.4.1.2 Events Requiring Stop Task

1. Take any action necessary to administer first aid if needed.

2. Move people away from danger.

3. Take any action necessary to reduce pollution, if it is safe to do so.

4. Call for medical or other emergency assistance if necessary.

5. Contact the Contractor's site in-charge; inform them of the event; and instruct them to stop all work on the task.

6. Inform your line manager.

7. If necessary, inform the civil authorities.

8. Remain at the site and take any necessary action required to help resolve the crisis.

9. Initiate the Procedure for Emergency Preparedness and Response as applicable.

9.10.4.1.3 Events Requiring Reporting Immediately

1. If possible, talk to the site in-charge and tell them of the problem that you have seen, and discuss what should be done to rectify it.

2. Complete a monitoring report format and submit it to your line manager. If possible, send photographs as well. This should be done from the site using your mobile phone, or from the nearest place where you can get a signal.

3. If you cannot complete a monitoring report format, send the key details and photographs by phone, or call your line manager at the earliest opportunity. Follow it up with a completed monitoring report format as soon as you are able to.

If the Contractor has not taken appropriate action to achieve compliance with ESHS requirements after the expiry of the time period for action as notified, then the next level of enforcement is triggered. Examples follow.

Example 1. A significant spill of fuel occurs during the transfer from a tanker to a delivery tank. The person who discovers the incident, orders the task to be stopped and submits a report. The Resident Engineer formally issues a non-compliance order with a ten-day deadline for the problem to be resolved. After 12 days the Project Engineer's Environmental Specialist finds that no action has been taken. He or she will then order that all work is stopped on the site, and issue a further report.

Example 2. Minor soil erosion on a site is witnessed by the MCA-Nepal ESP Specialist (Environment). This is reported and with the instruction of the MCA-Nepal Project Manager, a non-compliance order is formally issued by the Resident Engineer a with a three-week deadline for erosion protection to be put in place. After one month the Project Engineer's Environmental Specialist finds that no such action has been taken. He or she will then order that all the task is stopped, and issue a further report. In this context, the task might involve the excavation of tower foundations, and therefore stopping the task would halt the key work of a tower construction site.

9.11 OPERATOR'S ESHSMP

9.11.1 Key Highlights of Operator's Mitigation Measures

This section describes the minimum requirements for the Operator's ESHSMP. The Operator in this case is assumed to be NEA or another Government of Nepal (GoN) entity to whom the facilities will be turned over at the completion of construction, Table 9.11-1 lists the Management Plans required for this phase, which will be prepared by the Operations Manager and implemented, in addition to, and in keeping with, the other management plans prepared for the Project and the requirements of the applicable reference framework.

Table 9.11-1: Operator's ESHSMP Minimum Requirements

Management Plan	Minimum Requirements
Hazardous Materials and Waste Management	• Hazardous materials and waste (e.g., used oil, transformer oil, and oil-soaked cloths) will be properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system, and ultimately transported offsite to an approved disposal facility. • Fuel, lubricants, oils, grease, chemical will be stored at designated area with impervious surface and a secondary containment system. • Detail good housekeeping procedures to store the hazardous materials in accordance with their hazard category • Appropriate training will be provided for all workers responsible for handling hazardous materials. • Outline training requirements for the vehicle drivers and equipment operators on effective chemical handling and storage to reduce the risk of a spill and/ or leak event. • Detail the maintenance and monitoring requirements for storage tanks to check for leaks on a regular basis. • Maintenance of vehicles, machineries and equipment's will be carried out only in designated area with an appropriate oil/grease trap at least 50 m from any streams or other waterbodies. • Solid waste generated from the substations and accommodations areas will be collected through proper collection system and stored at designated locations. • Random disposal of solid waste will not be allowed. • Employees will be given training towards proactive use of designated areas/bins for waste disposal.
Emergency Response Plan	• The Emergency Response Plan will address, at a minimum, the following potential emergencies: – Earthquakes – Landslide or slope failure – Fires – Electrical Emergencies – Road accidents • Identify the required preventative measures. • Identify the roles and responsibilities of personnel in the event of an emergency. • Detail the required control materials and first aid equipment to be stored and available to respond to a disaster/emergency. • Clearly document emergency control procedures, including designated exit routes, evacuation plans, and assembly areas. • Describe communication protocols, government and public notification requirements and systems. • At least annual review and update of the Emergency Response Plan.

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Management Plan	Minimum Requirements
Spill Prevention and Control Management	• Identify the required preventative measures. • Identify the roles and responsibilities of personnel in the event of a spill. • Inventory the hazardous liquids present on site. • Detail the required spill control materials to be stored at the three new substation sites. • Describe notification requirements, including the local community and appropriate government agencies. • Clearly document spill control procedures, including: – Assess the nature of the substance that has spilled/leaked and treat injured persons accordingly. – Take actions to prevent spills from reaching a stream or waterbody. – Spills will not be flushed to local surface drainage systems or streams. Instead, government approved clean-up and disposal procedures will be carried out. – The Operator will prepare a report describing the root cause analysis for the spill or incident and the remedial action that was taken, consequences/damage from the spill, and proposed corrective actions. – All responsible personnel will receive training on environmental emergency spill procedures,
Wastewater Management	• No treated /raw sewage will be discharged to any waterbodies. • Open defecation and random disposal of sewage will be strictly restricted. • Properly operate and maintain the wastewater management facilities at each substation.
Biodiversity Management	• Monitor success of compensatory plantation for at least 5 years and replace seedlings that do not survive. • Monitor bird collision mortality and install additional bird diverters if needed. • In terms of RoW maintenance, trim and lop trees instead of tree clearing to the extent possible to reduce forest clearing.
Air Quality Management	• Regular maintenance of vehicles will be undertaken.
	• Regularly check pressure and use manufacturer-specified equipment to monitor for leaks of sulfur hexafluoride from the gas insulated switchgear at the substations.
	• Restriction on unnecessary honking.
Noise Management	• Use rubber padding underneath high noise and vibration generating machines.
	• Provide appropriate PPE for workers in high noise areas.
	• Restrict unnecessary honking. • Limit noise-generating activities to daytime hours (6am–10pm).
Worker Accommodations	• The worker accommodation and support facilities design will be in general conformance with the IFC Guidance Note on Worker Accommodations: processes and standards—a guidance note by IFC and the EBRD (IFC and EBRD 2009).
Labor Management	• Induction training for new employees will be conducted prior to starting the work at site.

Management Plan	Minimum Requirements
	• Grievance Redress Mechanism for the workers.
	• Disclosure of information to the local community, will be adequate and timely in terms of Project activities and available opportunities, in keeping with Stakeholder Engagement Plan formulated for the Project.
Community Health and Safety	• Establish a community grievance redress mechanism. • Any trainings, workshop, skill development and vocational program as proposed in the Nepal employment and Skill Training plan will be implemented. • Orientation on Workers Code of Conduct, Anti-sexual Harassment Policy, and TIP Management Plan
Stakeholder Engagement	• In order to manage and address any complaints, queries or issues raised by the community, the Project team will need to maintain and implement the Grievance Redress Mechanism. The same will need to be communicated to the nearby settlements.
	• Contractors will transport labor and materials for maintenance so that it does not increase traffic on the existing roads.
Occupational Health and Safety	• Develop an OHS Management Plan based on a Hazard Identification and Risk Assessment and apply the hierarchical principles of the safety pyramid: • Conduct H&S training for all new employees and employees assuming new work responsibilities. • Provide appropriate PPE and fall protection equipment to all employees in keeping with their work responsibilities. • Conduct periodic H&S refresher training. • Cranes and other lifting equipment will be operated by trained and authorized persons.
	• Training to the workers on climbing techniques, and rescue of fall-arrested workers. • Details of health and safety related incidence will be recorded and maintained.

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CHAPTER TEN
ENVIRONMENTAL MONITORING

10.1 OBJECTIVES AND REQUIREMENTS OF MONITORING

Article 39(1) and 39(2) of the EPA (2019) make provision for environmental monitoring. Article 45(1) of the EPR (2020) requires MCA-Nepal to monitor impact of the project on environment every six months and submit monitoring report to concerned agency. This chapter presents the ETP Environmental Monitoring Framework, which was developed in accordance with the Hydropower EIA Manual (MoFE 2018), and includes applicable environmental, social, health and safety (ESHS) monitoring. Per the manual, three types of monitoring are proposed:

- Baseline monitoring—substantial baseline monitoring and data collection has already been conducted in preparation of this EIA, but some additional baseline monitoring is recommended to better characterize existing conditions and establish a baseline for measuring change over time.
- Compliance monitoring—where applicable Nepali regulatory standards exist (e.g., air quality, water quality, noise), compliance monitoring documents the Project's compliance with these regulatory standards as well as confirming Design and Build (D&B) Contractor's compliance with proposed environmental, social, health and safety mitigation and enhancement measures described in this EIA.
- Impact monitoring—where regulatory standards do not exist, impact monitoring documents the Project's performance relative to impact predictions included in this EIA.

Baseline data collection will be completed prior to the initiation of construction. The compliance and impact monitoring activities will be performed during construction and operation phases of the project. The focus of the ETP environmental, social, health and safety monitoring framework is to execute construction and operation activities that strictly comply with Environment, Social, Health, and Safety Management Plan (ESHSMP) provisions and to avoid or reduce direct and indirect Project residual environmental impacts, including unforeseen effects.

The monitoring of the ESHSMP will:

- Track and report the effectiveness of the mitigation measures and responsibilities identified and conducted through the ESHSMP;
- Inform on the need to implement new, or modify existing, mitigation measures;
- Identify potential new areas of impact exposure that were not identified in the ESHSMP; and, if applicable

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- Identify the need for corrective actions to bring the construction and operation of the ETP into compliance with the EIA and the ESHSMP.

10.2 PHASES OF MONITORING

Monitoring phases will include baseline, compliance, and impact monitoring periods, as shown in Table 10.3-1 through 10.3-3, and discussed further below.

10.2.1 Baseline Monitoring

The baseline data will provide a benchmark for comparison of physical, biological, socio-economic and cultural conditions for the ongoing monitoring that will occur during Project construction and operation. Three additional pre-construction baseline data collection activities are recommended, in addition to the baseline data collection already conducted and described in Chapter 5 of this EIA:

- Landslides and erosion—the Project alignment was selected to avoid and reduce crossing of areas susceptible to landslides, slope failures, and erosion. Further documentation of slope condition and the location and extent of any landslides along the Right of Way (RoW) would provide a more robust baseline against which to determine whether the Project has contributed to any new, or worsening of existing, landslides and slope failures.

- Springs—the Project alignment was selected to avoid any springs. This additional baseline monitoring would document the flow in any springs located within 100 meters of a transmission tower so there is documentation to determine whether a tower has potentially impacted the flow in any spring.

- Critically Endangered (CR) and Endangered (EN) Birds—there are several species of CR and EN birds found in the Project area of influence. Historic data collected and Project baseline studies have already determined the presence of these species and their general flight patterns and directions. This additional data collection will help to better estimate the populations of these species as an enhanced baseline.

10.2.2 Construction Phase Monitoring (Compliance and Impact Monitoring)

The construction phase will trigger a new round of monitoring, as shown in Table 10.3-1 through 10.3-3. The emphasis of this monitoring will be to confirm that the D&B Contractor and other key players are complying with the terms of the EIA and ESHSMP. The main purposes of this monitoring will be to assess whether the D&B Contractor is in compliance with EIA ESHS requirements and is satisfactorily implementing all required mitigation measures.

Further, the monitoring will establish whether the D&B Contractor is complying in a timely and adequate manner with all aspects of the ESHSMP as described in Chapter 9 and the annexes.

10.2.3 Operations and Maintenance Phase Monitoring (Compliance and Impact Monitoring)

Once the ETP construction has been completed and is under operation, operations and maintenance phase monitoring will begin (Table 10.3-1 through 10.3-3).This monitoring will typically continue for the first two years of operation to assure project conformance with the impacts predicted in the EIA, but for some issues (e.g., landslides, EN birds), monitoring should continue for the life of the facility, or until it can be demonstrated that the impacts have stabilized (i.e., no new impacts over a 2 year period).

Compliance and impact monitoring at this phase will be carried out to assess the actual level of impact of the Project on physical, biological, and socioeconomic and cultural environment of the area. This monitoring will also gauge the accuracy of the predicted impacts, the effectiveness of the ESHSMP mitigation measures, and identify unanticipated and emerging issues requiring the development of new mitigation or corrective actions.

10.3 MONITORING FRAMEWORK

Table 10.3-1 through 10.3-3 present the Monitoring Framework that has been established for the ETP, based on MoFE guidance (MoFE 2018). This framework indicates the following:

- Issue for Monitoring: Identifies key issues that require monitoring. These issues are selected because they provide a good representation of the potential impacts and mitigation measures associated with the ETP. As the Project moves into the construction and operation phases, and unforeseen issues arise, additional issues may need to be added in order to achieve the requirements of the ESHSMP and EIA.
- Indicators: valid and representative physical, biological, or socioeconomic and cultural aspects to be assessed to determine compliance with the ESHSMP.
- Location(s): where monitoring will occur.
- Methods: indicates procedures, equipment, and analytical approaches that will provide reliable and defensible information regarding the state of the resource being monitored.
- Frequency of monitoring: is determined so as to reliably support the overall monitoring assessment.
- Responsibility: shows the responsibilities for monitoring (also see Tables 10.3-1 to 10.3-3).
- Cost: initial estimate of the cost of the proposed monitoring. These costs may change over time and it will be the responsibility of the Project Owner to update these and allocate adequate budget to continue the monitoring program throughout the Project life.

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Table 10.3-1: Pre-Construction—Baseline Monitoring

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)[1]
Landslides and Erosion	Number of landslide/ debris flow/gully sites along RoW marked on Project Alignment Sheets	Along entire length of RoW, including sites 100 meters up and down slope.	Direct observation and mapping by a geologist or geomorphologist	Once before initiation of construction	Outsourced to Geologist or Geomorphologist	1,000,000
Springs	Flow in liters per second	Any springs used by local communities as a water source and located within 100 meters down gradient from any transmission towers	Use measured container	Once during pre-construction	Outsourced to monitoring contractor	500,000
Birds	EN Bird Monitoring	Along vantage point survey locations used for the baseline survey	Vantage point surveys	Once each during Spring and Fall migratory seasons (March and October)	Outsourced to Avian Specialist	800,000
					Total	**2,300,000**

Source: Consultant Team 2020

Table 10.3-2: Construction Phase—Compliance and Impact Monitoring

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)[2]
			Compliance Monitoring			
Air Quality	CO, NOx, SOx, PM_{10}, $PM_{2.5}$, CO_2.	Within 3 new substations sites (Ratmate, New Damauli, and New Butwal)	Standard air quality monitor	Once per quarter	Outsourced to monitoring contractor	500,000
Water Quality	Fecal coliforms, etc.	Upstream and downstream of three new substations	As per Nepal Drinking Water Quality Standard Annex	Once per quarter	Outsourced to monitoring contractor	700,000
Noise Level	LAeq (dBA)	At nearest noise sensitive receptor to the three new substations	Type 1 and Type 2 sound level meter meeting IEC Standard	Once continuous for 48 hours	Outsourced to monitoring contractor	150,000
Forest Clearing	Incidents of clearing trees not approved (marked) by Divisional Forest Office	Spot checks and grievance-based monitoring along entire length of RoW and substations	Direct observation of compliance with Forest Clearing Plan Consultation with Community Forest User Groups (CFUGs) and Division and Sub-division Forest Office and grievances filed	Monthly or grievance based, whichever is more frequent	MCA-Nepal Independent Project Engineer	Included in Construction Monitoring Budget
Law and Order	Number of police complaints attributed to the Project workforce	All 30 municipalities along the RoW	Consultation with municipal authorities	Once per month	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
ESHSMP Mitigation Measures	All construction phase mitigation measures from Chapter 8 of EIA – to confirm their proper implementation	Varies	Direct observation and documentation	Varies	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
			Impact Monitoring			
Landslides and Erosion	Number of new landslide/ debris flow/gully sites along RoW marked on Project Alignment Sheets	Along entire length of RoW, including sites 100 meters up and down-slope	Direct observation by geologist or geomorphologist	Twice per year	Outsourced to Geologist or Geomorphologist	3,500,000

[1] Total monitoring costs per project phase
[2] Total monitoring costs per project phase

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)
Springs	Flow in liters per second	Grievance-based monitoring of springs located within or 100 meters down-slope from the RoW	Use measured container	Grievance based	Outsourced to monitoring contractor	500,000
Land Use	Site Rehabilitation	Entire length of RoW and substation sites	Monitoring of rehabilitation success/failure of disturbed areas. Monitoring is to consist of regular inspections (three at monthly intervals) to determine plant establishment. Where plant establishment is determined to have failed, replanting will be required	Monthly for first three months after planting and at the closeout audit.	D&B Contractor	Included in D&B Budget
Forest	Compensatory Afforestation	Compensatory Afforestation site(s)	Monitoring of afforestation success/failure is to occur on all afforestation sites. Where plant establishment is determined to have failed, re-planting will be required.	Monthly for the first year after replanting and twice per year for the next four years	Afforestation Contractor	Included in Afforestation Budget
Wildlife	Physical relocation of slow-moving species (e.g., pangolins, tortoises) prior to clearing and during construction	Within RoW in areas to be cleared or disturbed	Wildlife physical relocation of slow-moving species (e.g., pangolins, tortoises) prior to clearing and during construction within Project Area	During forest clearing	Outsourced to Wildlife Specialist	3,000,000
Wildlife	Vehicle Strikes by D&B Contractor vehicles	Along any roads used by Project vehicles	Records by drivers	Occurrence based	D&B Contractor	Included in D&B Budget
Wildlife	Injured Wildlife Protocol	Entire length of RoW and substation sites	Records are to be kept and regularly reviewed for implementation of the Injured Wildlife Protocol.	Occurrence based	D&B Contractor	Included in D&B Budget
Birds	Habitat Use and Trends in Bird Population	Within EAA associated with habitat for critical habitat bird species	Vantage point surveys at established survey locations	Three times per year – once during breeding season (May to July) and each migratory seasons (March and October)	Outsourced to Avian Specialist	1,800,000
Invasive Species	Presence of invasive species	Locations where forest clearance of Natural Habitat has occurred along the RoW	Direct observation and photographic documentation of the presence and spatial extent of any invasive species. All invasive species identified should be eradicated.	Annually and a post-construction completion audit	Outsourced to Forester	3,200,000
Erosion	Stream bank stabilization	At all locally sourced aggregate locations	Direct observation and photographic documentation of stabilization of all disturbed areas	Once per month for two months following aggregate sourcing	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
Public Health	Incidents of communicable diseases	All nearby villages	Consultation with municipal health clinics	Once per month	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
Occupational Health	Number of first aid and lost time incidents and fatalities	All construction work areas	D&B Contractor tracking	Once per month	D&B Contractor	Included in D&B Budget
Trafficking in Persons (including child labor restrictions and anti- sexual harassment)	• Documentation that required policies have been prepared • Delivery of training • Holding awareness and community outreach events	Each D&B contractor	• Review of Policy • Training delivery and number of persons trained to be included in D&B contractors' reporting requirements • Direct observation, participation in events • Approval of awareness material • Review of Grievances for trafficking in persons and related issues	Monthly (reporting) Quarterly monitoring. Once every three months	MCA Nepal Gender and Social Inclusion (GSI) Specialist D&B Contractor's GSI Manager	Included in Construction Monitoring Budget

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)
Physical Displacement	Compliance with Resettlement Policy Framework (RPF) policies and procedures and the specific Resettlement Action Plan (RAP) Package relative to physical displacement, including: • RAP survey coverage (all households (HHs) that are likely to be physically displaced including - owners, tenants, occupiers, users); • GSI provisions, including for the vulnerable (VU) groups of people; • Resettlement options- location, compensation choices; • Delivery of compensation, allowances, support and assistance as per entitlement matrix; • Resettlement of physically displaced HHs; and • Grievances received, redressed, by issue, location.	Ratmate Substation (RTE) and all locations of physical displacement along the TL RoW. At resettlement sites where the physically displaced HHs have resettled.	As per RPF, as described in RAP: • Consultations with physically displaced HHs • Review of the Project Affected HH data, based on land and asset survey, HH socioeconomic profile (RAP survey data). • Review of disbursement processes for compensation and allowances, including provisions to mitigate gender-based barriers to accessing and controlling compensation and allowances, to ensure compliance with safeguards in RAP • Post-resettlement monitoring of physically displaced HHs (at locations of new homes) based on the specific monitoring/ mechanisms part of each RAP Package • Monthly report on RAP activities including KPIs, (grievances received, redressed)	Monthly during construction phase, while RAP activities are in progress One completion audit One post-completion audit Post resettlement monitoring	MCA-Nepal RAP Implementation Contractor/s	Included in RAP Budget
Economic Displacement and Livelihood Impacts	Compliance with the RPF procedures and requirements relative to economic displacement and livelihood impacts along with indicators identified as a part of the specific RAP Package, including • RAP survey coverage—all HHs that are likely to be economically displaced including: – Owners, tenants, occupiers, users); – All types of affected land and assets used for production, economic dependence including productivity of land, types of trees, assets and businesses, etc.; – Livelihoods and dependence on potentially affected land; • GSI provisions, including for VU groups of people; • Delivery of compensation, allowances, support and assistance as per entitlement matrix; • Restoration of livelihoods and incomes; and • Grievances received, redressed, by issue, location.	Spots checks and grievance-based monitoring at the RTE and all locations of economic displacement along the TL RoW At locations of livelihoods restoration programs	Direct observation and review of documentation maintained as part of the RAP, including documentation of compensation payment, livelihood restoration activities, etc. Public consultations with the local community inclusive of displaced women, Dalits, and VU groups Discussions with the Community Liaison Officers/ ESP Community Assistantss for the project Consultations with economically displaced HHs, inclusive of displaced women, Dalits, and VU groups Monthly report on RAP activities and indicators (e.g., grievances received and redressed)	Monthly during construction phase, while RAP activities are in progress After Draft RAP and prior to land acquisition and construction	MCA-Nepal RAP Implementation Contractor	Included in RAP Budget
Impacts due to Temporary Land Access (TLA).	Compliance with RPF and TLA procedures and requirements, including • Duration of access • Compensation for loss and agreement to restore • Grievances received, redressed, by issue and location • Post-restoration use	Spot checks and grievance-based monitoring along the TL route at locations accessed under the TLA process.	Direct observation and review of reports on TLA activities, including grievances received and addressed	Once every six months for the duration of the construction phase	MCA-Nepal RAP Implementation Contractor/s	Included in RAP Budget

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)
CFUG/LHFG compensation	CFUG/LHFG have received compensation for loss or clearing of community managed lands LHFG members (in areas where more than 10% LHF is within the RoW) are able to access and participate in livelihoods restoration programs	Each CFUG/LHFG	Review of documentation to confirm compensation paid Review of monthly report on RAP activities and indicators, (grievances received, redressed, Livelihoods Restoration activities)	Quarterly and Post-construction completion audit	MCA-Nepal RAP Implementation Contractor	Included in RAP Budget
Worker Code of Conduct and Induction Training	Documentation that all employees have received Induction Training and signed the Worker Code of Conduct	D&B Contractor office and one substation and one work crew per each TL segment	Review D&B Contractor documentation	Quarterly	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
Cultural Heritage	Chance Finds	D&B Contractor office	Review D&B Contractor documentation. Consult with local communities	Quarterly	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
Grievances	Number of grievances	Entire project area	Review of the Grievance Redress Mechanism database and records filed with DLOs at Project Information Centers	Once per month	MCA-Nepal Owner's Project Engineer	Included in Construction Monitoring Budget
					Total	13,150,000

Source: Consultant Team 2020

Table 10.3-3: Operations Phase—Compliance and Impact Monitoring

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)
			Compliance Monitoring			
Water Quality	Fecal coliforms	Upstream and downstream of three new substations	As per Nepal Drinking Water Quality Standard Annex	Quarterly for the first year	Outsourced to monitoring contactor	200,000
Noise Level	LAeq (dBA)	Three new substations	Type 1 and Type 2 sound level meter meeting IEC Standard	Once after commencement of full operations continuous for 48 hours	Outsourced to monitoring contractor	150,000
ESHSMP Mitigation Measures	All operations phase mitigation measures from Chapter 8 of EIA—to confirm their proper implementation	Varies	Direct observation and documentation	Varies	Project Operator	Included in Project Operations Budget
			Impact Monitoring			
Landslides and Erosion	Number of new landslides, debris flow, and gully sites along RoW marked on Project Alignment Sheets	Along entire length of RoW, including sites 100 meters up and down gradient	Direct observation and mapping by professional geologist or geomorphologist	Annually after the monsoon season for the first five years	Outsourced to Geologist or Geomorphologist	2,500,000
Forest Status	Reports of illegal logging or timber harvest	Spot checks and grievance-based monitoring along entire length of RoW with adjoining forest	Direct observation and photographic documentation in consultation with CFUGs and Divisional Forest Office	Twice a year for the first five years	Outsourced to Forester	2,000,000
Forest Status	Invasive species	Along entire length of RoW with forest clearing	Direct observation by a forester	Once a year for the first five years	Outsourced to Forester	4,000,000
Wildlife	Number of reported poaching incidents	Along entire length of RoW	Grievance reports and consultation with CFUGs and Divisional Forest Office	Twice a year for the first five years	Project Operator	Included in Project Operations Budget
Birds	Number of bird carcasses found	Sampling in targeted area covered by vantage point surveys	Direct observation and documentation by avian specialist	Twice a year for the first five years during migration season (March/April and Sept/Oct)	Outsourced to Avian Specialist	4,000,000

Issue for Monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs)
Birds	CR and EN Bird populations	Within EAA associated with habitat for critical habitat bird species	Vantage point surveys are to be conducted at same locations as Pre-Construction Baseline Monitoring.	Twice a year for the first five years	Outsourced to Avian Specialist	4,000,000
Physical Displacement	Compliance with applicable RAP: • Resettlement of all physically displaced HHs at new/other locations (within project districts), with adequate security of tenure • Grievances received, redressed, by issue and location, including by host communities where displaced HHs have resettled (as applicable)	All locations of resettlement (of physically displaced HHs), which are within the 30 municipalities/rural municipalities through which the TL passes. [Those who have opted for cash compensation for relocation to other areas in Nepal or outside the country are not included in this monitoring exercise].	As per RPF, as described in RAP: • Documentation of resettlement locations • Consultations with physically displaced (resettled) HHs • Consultations with host communities at sites of relocation/resettlement (as applicable)	Annually for the first two years of operations or until full compliance with RAP is documented, whichever is later	MCA-Nepal RAP Implementation Contractor	Included in RAP Budget
Economic Displacement	Compliance with applicable RAP: • Restoration of incomes and livelihoods of all economically displaced HHs (including LHFG members who opt for livelihood restoration activities) to at least pre-displacement levels if not improved • Grievances received, redressed, by issue and location, including regarding Livelihoods restoration activities (as applicable)	Spots checks and grievance-based monitoring around the RTE and all locations of economic resettlement along the TL RoW, within the 30 Project municipalities/rural municipalities At locations of Livelihoods restoration program activities	As per RAP-LRP including the below: Direct observation and review of documentation maintained as part of the RAP/LRP, including documentation of livelihood restoration activities. Public consultations with the local community inclusive of displaced women, Dalits, and VU groups Consultations with some (sample) economically displaced HHs, inclusive of displaced women, Dalits, and VU groups Discussions with a sample of those participating in Livelihoods Restoration Program activities	Annually for the first two years of operations or until full compliance with RAP is documented, whichever is later	MCA-Nepal RAP Implementation Contractor	Included in RAP Budget
Livelihood Restoration of Project Affected HHs	The Resettlement Completion Audit (towards the end of RAP implementation) will identify any residual issues/impacts along with corrective actions	Specific locations/settlements/ districts as identified by the Corrective Action Plan of the Resettlement Completion Audit	The Resettlement Completion Audit will specify completion indicators and the monitoring mechanism for the same as a part of its Corrective Action Plan	To be determined by the Resettlement Completion Audit	NEA's ESSD and MCA-Nepal RAP Implementation Contractor	Included in RAP Budget
					Total	**16,850,000**
					Total Environmental and Social Monitoring Cost (Tables 10.3-1, 10.3-2 and 10.3-3)	**34,000,000**

Source: Consultant Team 2020

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10.4 INSTITUTIONAL STRUCTURE AND HUMAN RESOURCE REQUIREMENTS

As listed in Table 10.3-1 through 10.3-3, numerous entities will have important responsibilities in the ESHS monitoring program. Table 10.4-1 below, presents the entities and organizations with monitoring responsibilities.

Table 10.4-1: Institutional Structure for the ESHS Monitoring Program

Organization	Organizational Monitoring Responsibility	Reports to:	Personnel Requirements	Personnel Roles
Construction Phase				
MCC	Donor; Approves monitoring reports and disbursements	U.S. Government	MCC-Nepal Resident Country Director	Approves Monitoring Reports. Primary contact between Government of Nepal (GoN) and MCC.
			MCC-ESP (Washington DC based)	Reviews Reports, provides feedback to MCA-Nepal on MCC requirements
MCA-Nepal	Contracts for engineering, procurement, and construction of the ETP. Participates in periodic monitoring and auditing.	GoN, MCC	MCA-Nepal Executive Director	Approves and submits reports to MCC and D&B Contractor
			MCA-Nepal Quality Assurance Managers	Reviews, approves D&B reports. Develops corrective action plans for the D&B Contractor. Communicates on ESHS protection issues with MCC-ESP.
			MCA-Nepal Quality Assurance Manager – Environment, Health and Safety Environmental Specialist	Monitors the level of achievement on all environmental aspects of the project, and health and safety issues. Participates in monitoring physical and biological aspects
			MCA-Nepal Quality Assurance Manager – Social Inclusion and Resettlement Land Acquisition Specialist GSI Specialist	Monitors the level of achievement on all resettlement and compensatory aspects of the project. Participates in monitoring social aspects, including compensation Participates in monitoring of GSI requirements
			Communications and Outreach Team	Stakeholder engagement (women, Dalits, and VU social groups)

Organization	Organizational Monitoring Responsibility	Reports to:	Personnel Requirements	Personnel Roles
Project Engineer	Oversight over all D&B construction contracts. Carries out required monitoring. Reviews and approves D&B monthly monitoring reports,	MCA-Nepal	Project Manager	Reviews, approves construction phase monitoring. Develops corrective action plans as required. Communicates on ESHS protection issues with MCA-Nepal.
			Environmental Specialist	Carries out monitoring of physical and biological aspects
			Social Specialist	Carries out monitoring of social aspects, including compensation and inclusive stakeholder engagement (women, Dalits, and VU social groups)
			GSI Specialist	Monitors and reviews Engineer's and Contractors' performance, undertakes GSI awareness training for both Engineer and Contractors.
			Geomorphologist/ Soil Conservation Specialist	Responsible for checking the conditions around aggregate sources and completed work sites.
			Health & Safety Specialist	Monitors the D&B H&S performance
RAP Implementation Contractor	Oversees implementation of RAP on behalf of MCA-Nepal. Carries out required monitoring. Produces monthly reports	MCA-Nepal	RAP Implementation Manager	Oversees and coordinates all RAP implementation-related activities
D&B Contractor	Carries out internal monitoring to ensure compliance with the ESHSMP and their CESMP, including all the individual subject management plans.	MCA-Nepal	ESHS Manager	Approves and submits reports to MCA-Nepal. Ensures that corrective measures are completed.
			Environmental, Social, GSI, and H&S teams	Conducts internal monitoring of D&B's compliance with CESMP and overall ESHS performance. Includes stakeholder engagement and administers worker and community grievance mechanisms

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Organization	Organizational Monitoring Responsibility	Reports to:	Personnel Requirements	Personnel Roles
Operations Phase				
Project Operator (i.e., entity who will assume responsibility for operating the ETP once construction is complete	Responsible for monitoring of the ETP during the operation phase. Participates in periodic monitoring and auditing.	GoN	Project Operations Manager	Approves and submits reports to MCC. Ensures that corrective measures are completed.
			Project Operations Environmental and Social Director	Reviews, approves operational phase monitoring reports. Develops corrective action plans as required. Communicates on E&S issues with the Project Operations Manager.
			Environmental Specialist	Participates in monitoring physical and biological aspects
			Social Specialist	Participates in monitoring social aspects, including compensation and inclusive stakeholder engagement (women, Dalits, and VU social groups)

Source: Consultant Team 2020

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10.5 ESHS MONITORING AND REPORTING

MCA-Nepal and its Owner's Project Engineer will undertake regular ESHS monitoring in accordance with the monitoring frequency identified in Tables 10.3-1 through 10.3-3. For some issues, this monitoring will be undertaken by the Project Engineer. For some other issues (e.g., health and safety performance), the monitoring will be undertaken by the D&B Contractor, with the MCA-Nepal Owner's Project Engineer doing spot checks or other methods to verify the D&B Contractor's data. The Project Engineer will routinely monitor substation and tower work areas to ensure the D&B Contractor is meeting MCA-Nepal's ESHS performance requirements, as included in the D&B contracts.

Project construction activities will be monitored and supervised to document that works are undertaken in accordance with the detailed Project design, environmental plans, permits, approvals, contract conditions, and the principles outlined in this ESHSMP. Pre-construction inspections of Project construction sites shall be jointly undertaken by MCA-Nepal, the Owner's Project Engineer, and the D&B Contractor, once the D&B Contractor has surveyed and pegged each site.

If any of these sites or activities are not in accordance with the contract and ESHSMP conditions, MCA-Nepal and its Owner's Project Engineer will document these and specify corrective measures in the Reports, which will be provided to MCC. MCA-Nepal and its Owner's Project Engineer will provide a copy of the Reports to the D&B Contractor within five days of the inspection, for appropriate action, and the D&B Contractor shall undertake all actions as specified.

MoFE may conduct monitoring of the D&B Contractor's activities to evaluate Project compliance with the ESHSMP, other project commitments, Project approval conditions, and statutory requirements. MCA-Nepal will provide MoFE with all necessary environmental records and arrange for MCA-Nepal, the Construction E&S Monitoring Contractor, and the D&B Contractor staff to be available during MoFE site inspections, if requested.

The D&B Contractor shall submit monthly ESHS Performance Reports to MCA-Nepal. The Owner's Project Engineer will review these reports, and prepare its own independent monthly ESHS report, which will be submitted to MCA-Nepal, MCC, and the D&B Contractor. The report will identify whether the D&B Contractor is in conformance with its ESHS performance requirements, identify opportunities for improvement, and, when the D&B Contractor is not in conformance with its ESHS requirements, provide directions to the D&B Contractor on corrective actions.

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CHAPTER ELEVEN
ENVIRONMENTAL AUDITS

11.1 OBJECTIVES OF ENVIRONMENTAL AUDITS

The objectives of performing what MCA-Nepal refers to as environmental, social, health and safety (ESHS) auditing are to evaluate whether ESHS risks identified in the EIA are effectively mitigated and comply with the requirements of the Environmental, Social, Health, and Safety Management Plan (ESHSMP). The audits will also provide guidance on corrective actions required to address non-compliances and will provide baseline information for future audits and other monitoring activities.

NEA or another Government of Nepal (GoN) entity, to whom the facilities will be turned over at the completion of construction, will be responsible for conducting the environmental auditing of the Project during operations. In keeping with its requirements, Ministry of Forests and Environment (MoFE) will conduct their environmental audit after two years of operation.

MCA-Nepal will also carry out environmental audits upon hand-over from the Design and Build (D&B) Contractors of completed portions of the Project, using the guidance presented in this chapter. This will be to ensure that the provisions of the ESHSMP and other contractual requirements have been met by the D&B Contractors.

11.1.1 Types of Audits

In general accordance with the MoFE Hydropower Environmental Impact Assessment Manual (MoFE 2018), MCA-Nepal proposes three types of audits for the ETP:

- **Completion Audit**: The purpose of these audits will be to ensure that the D&B Contractors and others involved in the implementation of the Project have complied with the terms of the EIA and the ESHSMP. Specifically, MCA-Nepal will conduct these audits at the completion of each construction contract as part of the "hand-over" process.
- **EIA Audit**: Article 12(1) of the EPA(2019) requires MoFE or agency designated by the MoFE to conduct environmental audit within six months after two years of the completion of the project. As stated in the MoFE Manual, "Generally, it will be appropriate to maintain uniformity between the methods employed in collecting baseline data and information, and carrying out monitoring during the EIA. The EIA audit is carried out after 2 years of commencement of the project. The GoN is responsible for carrying out this audit" (MoFE 2018, p.66). This is a one-time audit by the MoFE
- **Project Impact Audit:** The purpose is to identify and assess the actual Project-related ESHS impacts over time, the effectiveness of environmental impact mitigation and enhancement measures, and functioning of monitoring mechanisms. The GoN will conduct this audit every two years during the operation period.

The purpose of these three types of audits is to identify any corrective actions needed to bring the Project's ESHS performance into compliance with the ESHSMP and with any other applicable regulatory requirements. If necessary, a Corrective Action Plan will be developed and implemented. Table 11.1-1 identifies the various responsibilities for Environmental Audits, general timing, and estimated cost.

Table 11.1-1: Responsibilities for Environmental Audits

Type of Environmental Audit	Description	Responsibility			Costs (NRs)
		Conduct	Approve	Corrective Actions	
Completion Audit	Completion audits for each of the D&B Contractors working on the Project prior to their close-out payment	MCA-Nepal	MCA-Nepal and MCC	D&B Contractors during defects liability period	2,000,000
EIA Audit	Per MoFE requirements, these environmental audits will be conducted after two years of operation	MoFE	MoFE	D&B Contractors during defects liability period. Afterwards, Project Operator	1,500,000
Project Impact Audit	In order to identify environmental changes due to the ETP, this audit will be conducted every two years during Project operations	Project Operator	Project Operator	D&B Contractors during defects liability period. Afterwards, Project Operator	750,000 (per audit)

Source: Consultant Team 2020

11.1.2 Regulatory and Legal Requirement

The EIA Audit is required pursuant to Article 12(1) of the Environment Protection Act (2019), which requires, for projects that require an EIA, that MoFE examine the environmental impacts caused by the implementation of such projects, and evaluate measures adopted to minimize such impacts after two years of project completion. MoFE should also maintain an updated audit report. The MoFE Hydropower Environmental Impact Assessment Manual (MoFE 2018, p. 66) specifies the following requirement regarding environmental audits:

> *"The environmental audit shall be conducted after two years of the operation of the proposal or delivery of service from the proposal/project. The official record and environmental monitoring reports concerning the implementation of environment protection measures required for environmental audit shall be provided by the proponent to the prescribed environmental auditor."*

The Completion Audit is required pursuant to the agreement (i.e., Compact) signed between the GoN and the U.S. MCC (Compact 2017), which requires that the ETP comply with MCC's Environmental Guidelines, which incorporate the International Finance Corporation

(IFC) Performance Standards. The IFC Performance Standards Guidance Notes (IFC 2012) provide specific guidance on the need for and contents of Environmental Audits.

The Project Impact Audit is not mandated by any legal or regulatory requirement, but is considered international good practice.

11.2 ENVIRONMENTAL AUDIT REPORT DOCUMENTATION

Section 9.7 of the Hydropower EIA Manual (MoFE 2018) specifies the format of an environmental audit. This format has been adopted by MCA-Nepal, together with further clarifications and guidance from the IFC Performance Standards Guidance Notes (IFC 2012). All Environmental Audits for the ETP will have the following format:

Chapter 1: Executive Summary

Chapter 2: Description of Audit Administrative Activities. Interviews conducted in project site, party conducting audit and the audit area and methods shall be included in this study. Similarly, data and details concerned with environmental monitoring and audit must also be included.

Chapter 3: Full Audit Details. This includes a full summary of the audit procedures and findings. For purposes of the Completion Audit, and in accordance with the IFC Performance Standards Guidance Note referenced above, MCA-Nepal will supplement this chapter to include the contents of Table 11.2-1:

- *Scope of the Audit:* A description of what the audit focused upon (where the audit was conducted), what was audited (e.g., processes, organization, operations), when the period of performance began and ended (did the audit cover a month, a year, or all operations since inception?).
- *Regulatory and Legal Setting:* Tabular summary of Nepal, local and any other applicable environmental and occupational health and safety laws, regulations, guidelines, and policies as they may directly pertain to the scope of the audit. This section would include a description of the Environmental Management Plan requirements pertaining to this EIA.
- *Audit and Site Investigation Procedure:* Brief overview of the approach used to conduct the audit. A discussion of the records review, site reconnaissance, and interview activities; a description of the site sampling plan and chemical testing plan, field investigations, environmental sampling and chemical analyses and methods, if applicable.
- *Findings and Areas of Concern:* Detailed discussion of all environmental and occupational health and safety areas of concern. The areas of concern should be discussed in terms of both existing facilities and operations and contamination or damages due to past activities, including the affected media and its quality and recommendations for further investigation and remediation, if applicable. The report may wish to consider prioritizing findings into categories: immediate action, mid-term action, and long-term action.

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Chapter 4: Suggestions and Corrective Actions. To be complied with regarding the project. The IFC Guidance specifies that this should include, for each area of concern, specifics on the appropriate corrective actions to mitigate them and their rationale. The report should indicate priorities for action; provide estimates of the cost of implementing the corrective actions, and a schedule for their implementation.

Appendices: These should include references, copies of interview forms, any details regarding the audit protocol not already included, and data obtained during the audit.

Table 11.2-1: Project Environmental, Social, Health & Safety Form Example

Project: ______________________ Project Handover Date______________________
Completed by: ______________________ Reviewed by: ______________ESHS Form Completion Date__________

Item	Summary Description	Status (indicate "red flag" items)	Corrective or Other Measures Needed	Responsibility for Corrective Actions	References (e.g., links to reports)	Deadline Date for Action
Project Description	Short description of the project, sufficient to identify it uniquely	Is this changing or has it changed?	Finalization of the Project Description if needed	MCA-Nepal	Location of this information. Can refer to reports such as EIAs and design reports.	In time to allow other activities below
Construction Contracts	Name of contractors, construction duration, completion date and defects liability period	Major delays?	Technical problems to be resolved, "snag list" requirements	MCA-Nepal to approve. Contractor to implement	Location of the hand-over documents	Prior to hand-over
ESHSMP	Summary of key mitigation measures, including operational requirements	Compliance? Has monitoring revealed problems?	If monitoring indicates problems, is any additional mitigation needed? (see below)	MCA-Nepal to approve. Contractor to implement	Location of the latest version of the Project ESHSMP	Prior to hand-over
Predicted Potential Impacts	Summary of main potential impacts from EIA, Environmental Audit, and/or ESHSMP	Have major environmental or social risks been identified?	Principal mitigation measures required in ESHSMP	Contractor to implement	Location of the latest version of the Project EIA, Electricity Act, ESHSMP	Prior to construction
Actual Impacts Observed	Residual negative impacts observed during monitoring and/or the Environmental Audit.	Have major residual environmental or social risks been identified?	Develop and implement adequate mitigation. If no mitigation is possible for major residual environmental or social risks, then the specific activity causing the risk is to be discontinued and environment to be restored	MCA-Nepal to approve. Contractor to implement	Location of all monitoring reports for the project, as well as design and implementation reports for any new mitigation.	Prior to hand-over

Item	Summary Description	Status (indicate "red flag" items)	Corrective or Other Measures Needed	Responsibility for Corrective Actions	References (e.g., links to reports)	Deadline Date for Action
Grievance/ Complaint Mechanism	MCA-Nepal Grievance and Complaint Resolution Process applicable to the Project	Any unresolved complaints?	Grievance/ complaint to be resolved prior to hand-over, or addressed by Project Operator	MCA-Nepal to approve. Contractor to implement, as appropriate	Location of the grievance process and complaints register	Resolution prior to hand-over
Resettlement Issues	Remaining claims whether or not covered in the RAP	Any unresolved grievances?	Grievance to be resolved prior to hand-over. Certification of RAP completion	MCA-Nepal	Location of the RAP and grievance process	Prior to hand-over
Gender Issues	Summary of key impacts on range of beneficiaries and compliance with Gender Integration Plan	Any gender related risks?	Plan for introducing and incorporating risk mitigation through Project Operator	MCA-Nepal, and contractor or Project Operator	Location of stakeholder meetings, project reports	Prior to handover
Community Involvement	Results of meetings, workshops, and other community involvement for Project	Any unresolved community issues?	Community issues to be resolved prior to hand-over, or addressed by new Operator	MCA-Nepal approval. Contractor or new Project Operator to implement	Location of minutes of community and stakeholder meetings.	Prior to hand-over
Corrective Action Plan	Identified those measures required to bring the Project into conformance with ESHS requirements	Compliance?	Contractor to immediately reach compliance with the Corrective Action Plan	MCA-Nepal to approve. Contractor to implement	Location of the monitoring reports and hand-over documents	Immediately upon Contractor notification

Source: Consultant Team 2020

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CHAPTER TWELVE
CONCLUSIONS AND COMMITMENT

MCA-Nepal is proposing to construct the ETP, which will include an 313.9-kilometer-long double-circuit 400 kilovolt transmission line, three new substations (i.e., New Butwal, New Damauli, and Ratmate), and connections to two existing substations (New Hetauda and Lapsiphedi). Project construction and operation will result in other benefits and impacts which are summarized below.

This environmental impact assessment (EIA) report has been prepared per the guidance detailed in the Scoping Document and Terms of Reference approved in April, 2019 by the Government of Nepal, and has effectively met the requirements of both the documents through this EIA. The EIA report is based on desktop study, field survey, and light detection and ranging (LiDAR) survey, and detailed evaluation of Project impacts. In addition, this EIA report has been prepared in accordance with the following EIA objectives as stated in Section 1.5:

- Developed the Project in compliance with Nepali regulations and laws, Millennium Challenge Corporation Environmental Guidelines, the Department of Electricity Development guidelines for conducting EIA (DoED 2001) and the Ministry of Forests and Environment's Hydropower Environmental Impact Assessment Manual (MoFE 2018).
- Introduced the Project and provided an opportunity for stakeholders to provide suggestions and concerns about the Project.
- Established the existing status of the physical, biological, socioeconomic, and cultural environments of the Project-affected areas.
- Examined the activities of the Project to identify the potential environmental issues and impacts.
- Identified and evaluated various alternatives to avoid or minimize impacts to the extent possible.
- Evaluated and identifying potential beneficial and adverse impacts of the Project and proposed mitigation measures to avoid, minimize, or mitigate/manage these impacts.
- Reduced the overall environmental, social, and economic costs of the Project as far as practicable as well as optimizing Project benefits.
- Established an Environmental Social, Health, and Safety Management Plan (ESHSMP) based on management and mitigation measures identified in the EIA.

12.1 CONCLUSIONS

The main conclusions of the EIA report are as follows:

12.1.1 Project Benefits

The ETP will function as a key component of Nepal's east-west electricity transmission network, as identified in the Transmission System Development Plan of Nepal (MoEWRI 2018). The ETP will help to evacuate electricity generated from existing and proposed hydropower projects in various river basins along the alignment, transmit the electricity to where it is needed, and enable import (initially) and export (ultimately) of electricity to India by including a major cross-border interconnection with India.

The overall objectives of this Project are to achieve the following:

- Improve the living conditions for a large number of people of Nepal through improved electricity access and reliability.
- Attract and promote industrial and commercial development in Nepal through improved electricity reliability.
- Increase revenues to the government of Nepal by facilitating the sale and transfer of domestic-generated power to India.

In addition, the Project will employ over 7,300 full-time equivalent workers over the 3.5-year construction phase, about 60 percent of positions are expected to be filled by Nepali workers. Additionally, there will be 400 permanent job positions, all of which will likely be Nepali workers. The construction contractor's will target meeting a goal of women representing 33 percent of total employment and will strictly implement the principle of "equal pay for equal work." MCA-Nepal will also encourage the construction contractors to hire individuals from marginalized and traditionally excluded groups to the extent they are qualified. The Project will also need to purchase a wide variety of construction materials (e.g., aggregate, cement, rebar) and will require a wide range of support services (e.g., food, cleaning, vehicle rental) which will create opportunities for local businesses. The Project should result in new or improved skills for many Nepali workers, which should improve their competitiveness for future employment opportunities.

MCA-Nepal will also be contributing at least 0.75 percent of Project costs through their MCA Partnership program to increase access, reliability, and productive use of electricity within Project-affected municipalities.

12.1.2 Project Impacts

MCA-Nepal has applied the concept of the mitigation hierarchy by first avoiding impacts to the extent possible; where avoidance is not possible, MCA-Nepal will minimize impacts and mitigate any remaining impacts so all residual impacts are of only minor or negligible significance.

MCA-Nepal spent approximately three years optimizing the proposed transmission line alignment based on detailed environmental and social baseline studies and consultations with government officials, conservation organizations, civil society groups, and affected communities—including the concerned municipalities. This resulted in the Project's avoidance of all national parks/buffer zones, RAMSAR wetlands, and known cultural heritage sites. The Project also sought to reduce the amount of physical displacement, crossing of major bird flyways, and impacts on important nesting, roosting, feeding, and soaring areas for several critically endangered and endangered bird species.

MCA-Nepal optimized the transmission tower design to further avoid and reduce impacts by:

- Raising tower heights (average height of 61 meters), allowing the transmission lines to span over large forested areas to reduce forest clearing;
- Reducing the number of towers to reduce required land acquisition and forest clearing for the tower pads;
- Creating special tower types that allow for long spans across river and stream valleys—ultimately reducing clearance of forest on steep slopes, impacts to floodplain areas, and protecting riparian areas; and
- Providing a 46 meter wide right-of-way (RoW) and maintaining the transmission lines well above the ground which results in full compliance with World Health Organization health standards for exposure to electro-magnetic fields.

The impacts that remain are unavoidable, as described below:

- River crossings—the Project must cross 54 rivers and major streams. All of these will be spanned with no towers located in any river channels or other water bodies. Twenty two towers will be located within a floodplain in order to reduce physical displacement and impacts on high value agricultural land.
- Impacts to the Chure Conservation Area—given that the Project is intended to be able to deliver electricity generated by hydropower projects in the Middle Mountain and High Mountain regions of Nepal to the India border, crossing the Chure is unavoidable. MCA-Nepal has minimized forest clearing in this area and will restrict any aggregate sourcing within the Chure Conservation Area.
- Impacts to the Nawalparasi Forest Important Bird Area (IBA)—given that the New Butwal substation is located within this IBA, avoidance is impossible. MCA-Nepal, however, has worked closely with Nepali non-governmental organizations to minimize impacts on endangered bird species found in this area.
- Impacts to Forests—some forest clearing is unavoidable. As mentioned above, MCA-Nepal has taken measures to minimize the extent of clearing to only 45.6 percent of the total forest within the RoW. MCA-Nepal will mitigate for this loss of forest by re-planting cleared trees on a 1:10 basis (i.e., plant 10 saplings for each tree cleared) in accordance

with MoFE's Working Procedure with Standards for the Use of Forest Lands for National-Priority Infrastructures in Nepal 2076 BS (2019 AD)

- Impacts to community forests (CF) and leasehold forests (LHF)—it is impossible to avoid the large number of CFs and LHFs found along the RoW without substantially increasing the extent of physical and economic displacement and overall impacts to local communities. Overall, the impacts to CFs and LHFs are quite small, with only 1.3 percent of the total affected CF/LHF area to be cleared and only 0.2 percent to be acquired. There are some individual CFs and LHFs that are more impacted than others. MCA-Nepal will mitigate these impacts through entitlements included in the resettlement action plan and provide livelihood support for vulnerable households.

- Physical Resettlement—minimizing the need for physical resettlement was one of the major criteria used in developing the EIA alignment. MCA-Nepal was able to reduce the amount of physical resettlement from over 500 households in the original Detailed Feasibility Study alignment to 187 households (943 people) in the proposed EIA alignment. Of these 187 households, 37 are located within the Ratmate Substation footprint and 150 along the transmission line RoW.

- Loss of High Value Land—the Project will impact some high value agricultural land and community forest land, although impacts to these lands have been reduced to the extent practicable.

- Potential for conflicts between construction workers and local communities—this impact is also unavoidable as construction workers will need to mobilize to construction sites near communities. However, this impact will be mitigated to some extent by the likely large number of local workers and through the D&B Contractor's preparation, implementation, and enforcement of a Worker Code of Conduct, Worker Access Management Protocol, Anti-sexual Harassment Policy, and Trafficking in Persons (TIP) Risk Management Plan.

Tables 12.1-1, 12.1-2 and 12.1-3 present each of the aspects (resource areas) evaluated in the EIA, identify key environmental impacts, and predict the pre-mitigation significance (see Chapter 7) and post-mitigation (residual) significance (see Chapter 8) of Project impacts on these resources, which takes into consideration the proposed mitigation for the Project's construction and operation phases, respectively. As these tables show, all of the Project's residual impacts are considered negligible or of minor residual significance with the exception of the risk of increased mortality for critically endangered and endangered birds (e.g., Himalayan griffon, several species of vultures, Steppe eagle, and Sarus crane) from colliding with the transmission lines. MCA-Nepal is proposing mitigation measures to reduce threats to these species and additional actions to offset this unavoidable moderate residual impact.

Table 12.1-1: Summary of Project Construction Phase Impacts and Residual Significance

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Topography/Geology/ Soils	Erosion and Landslides	Moderate	Minor
Air Quality	Fugitive Dust Emissions	Minor	Negligible
	Transmission Line Emissions	Negligible	Negligible
	Substation Emissions	Negligible	Negligible
Water Resources	Water Sourcing	Minor	Negligible
	Aggregate Sourcing	Minor	Negligible
	River Crossing and Floodplains	Negligible	Negligible
	Sedimentation	Moderate	Minor
	Wastewater Discharges	Minor	Negligible
	Hazardous Materials Spills	Minor	Negligible
	Improper Solid Waste Disposal	Minor	Negligible
Acoustic Environment	Transmission Line Construction Noise	Minor	Negligible
	New Substation Construction Noise	Minor	Negligible
	Existing Substation Construction Noise	Negligible	Negligible
	Noise from Helicopter Use	Moderate	Minor
	Noise/Vibration from Explosives/Implosives Use	Moderate	Negligible
Landscape Values	Degradation of Scenic Viewsheds	Minor	Minor
Biological Environment			
Protected Areas and Internationally Recognized Areas for Biodiversity	Chure Conservation Area	Moderate	Minor
	Terai Arc Landscape	Negligible	Negligible
	Chitwan Annapurna Landscape	Negligible	Negligible
	Shivapuri-Nagarun National Park	Negligible	Negligible
	Parsa National Park and IBA	Negligible	Negligible
	Nawalparasi Forest IBA	Minor	Negligible
Forests and Vegetation	Impacts to Forests	Major	Minor
	Introduction of Invasive Species	Minor	Minor
	Increase in Fire Hazard	Moderate	Minor
	Edge Effects	Minor	Minor
	Induced Clearing and NTFP Collection	Minor	Minor
Wildlife Species	Fauna Disturbance and Displacement	Moderate	Minor

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
	Hunting and Poaching of Fauna	Moderate	Minor
	Increased Mortality from Vehicles	Negligible	Negligible
	Enhanced Risk of Wildlife-Human Conflict	Negligible	Negligible
	Increased Habitat Fragmentation	Moderate	Minor
Social Environment			
Change in Land Ownership and Use	Physical Displacement	Major	Minor
	Economic Displacement/Loss of Livelihood	Major	Minor
	Temporary Access Related Impacts	Minor	Negligible
Community Health, Safety and Security	Risk of TIP and Child Labor	Moderate	Minor
	Nuisance Impacts on Local Communities	Minor	Negligible
	Risk of Communicable Diseases and Vector Borne Diseases	Minor	Negligible
	Potential Community Conflict	Moderate	Minor
	Potential Safety and Security Impacts	Minor	Negligible
Community Resources and Infrastructure	Impacts on Natural Resources	Moderate	Minor
	Stress on Physical Infrastructure	Minor	Negligible
Local Economy and Employment	Effects on Local Economy and Employment	Minor	Positive
Vulnerable People	Impacts on Indigenous People and Vulnerable Groups	Moderate	Minor
Gender	Impacts on Women	Moderate	Minor
Cultural Heritage	Impacts on Tangible Resources	Negligible	Negligible
	Impacts on Intangible Resources	Moderate	Negligible

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Table 12.1-2: Summary of Project Operation Phase Impacts and Residual Significance

Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Topography/Geology/ Soils	Erosion and Landslides	Moderate	Negligible
Air Quality	Substation Emissions	Negligible	Negligible
Water Resources	River Crossings and Floodplain Impacts	Minor	Negligible
	Sedimentation	Moderate	Negligible
	Wastewater Discharges	Minor	Negligible
	Hazardous Material Spills	Minor	Negligible
	Improper Solid Waste Disposal	Negligible	Negligible
Acoustic Environment	Transmission Line Operation Noise	Minor	Negligible
	Substation Operation Noise	Minor	Negligible
Landscape Values	Degradation of Viewsheds	Minor	Minor
Biological Environment			
Protected Areas and Internationally Recognized Areas for Biodiversity	Chure Conservation Area	Minor	Negligible
	Terai Arc Landscape	Negligible	Negligible
	Chitwan Annapurna Landscape	Negligible	Negligible
	Shivapuri-Nagarjun National Park	Negligible	Negligible
	Parsa National Park and IBA	Negligible	Negligible
	Nawalparasi Forest IBA	Minor	Negligible
Forests and Vegetation	Impacts to Forests	Minor	Negligible
	Introduction of Invasive Species	Minor	Negligible
	Increase in Fire Hazard	Minor	Negligible
	Edge Effects	Negligible	Negligible
	Induced Clearing and NTFP Collection	Negligible	Negligible
Wildlife Species	Fauna Disturbance and Displacement	Negligible	Negligible
	Hunting and Poaching of Fauna	Minor	Negligible
	Increased Mortality from Vehicles	Negligible	Negligible
	Enhanced Risk of Wildlife-Human Conflict	Negligible	Negligible
	Increased Habitat Fragmentation	Negligible	Negligible
	Bird Collision Risk	Major	Moderate[1]
Social Environment			

Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Change in Land Ownership/Use	Temporary Access Related Impacts on Private Land	Negligible	Negligible
Community Health, Safety, and Security	Electromagnetic Field Effects	Negligible	Negligible
Community Resources	Impact on Natural Resources	Negligible	Negligible
	Stress on Physical Infrastructure	Negligible	Negligible
Vulnerable People	Impacts on Indigenous/Vulnerable Peoples	Minor	Negligible
Gender	Impacts on Women	Minor	Negligible

[1] MCA-Nepal proposes mitigation measures to reduce threats to these bird species and additional actions to offset this unavoidable moderate residual impact.

Table 12.1-3: Summary of Combined Construction & Operation Phases and Residual Significance

Aspect/Resource	Impact	Pre-mitigation Significance	Post-mitigation Significance
Physical Environment			
Climate Change	Greenhouse Gas Emissions	Positive	Positive

12.2 COMMITMENT

The overall conclusion of this EIA is that the substantial benefits of this Project to the government, economy, and people of Nepal outweigh the Project's relatively minor residual impacts. MCA-Nepal abides by its commitments made in this EIA Report. MCA-Nepal will also adopt an Environmental and Social Management System, implement a detailed Environmental and Social Management Plan, include environmental and social performance requirements in the D&B contracts, and conduct a robust environmental and social monitoring program. These measures will help ensure all required mitigation measures and other conditions of EIA approval are successfully implemented and that actual Project impacts are consistent with those predicted in this EIA.

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