

Government of Nepal
Ministry of Physical Infrastructure and Transport
Department of Roads
Development Cooperation Implementation Division (DCID)
Babarmahal, Kathmandu

Strategic Road Connectivity and Trade Improvement Project (SRCTIP)

Biodiversity Management Plan
of East West (Mahendra) Highway (Kamala-Dhalkebar-Pathlaiya
Section)

Prepared by
Consulting Engineers Group (P) Ltd. India
JV with Civil Informatics and Solutions (P). Ltd.
Nepal

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ABBREVIATIONS

AoA	Area of Analysis
ADB	Asian Development Bank
AsETWG	Asian Elephant Transport Working Group
BMP	Biodiversity Management Plan
BZ	Buffer Zone
CCSG	Connectivity Conservation Specialist Group
CH	Critical Habitat
CHA	Critical habitat assessment
CITES	Convention on International Trade in Endangered Species
CoI	Corridor of Impact
CR	Critically Endangered
CWP	Chitwan National Park
DCID	Development Corporation Implementation Division
DFO	Divisional Forest Officer
DIA	Direct Impact Area
DNPWC	Department of National Parks and Wildlife Conservation
DOR	Department of Roads
EAAA	ecologically appropriate area(s) of analysis
EN	Endangered
ESMP	Environment Social Management Plan
EWB	East-West Highway
FW	Formation width
GON	Govt. of Nepal
GPS	Global Positioning System
HEC	Human Elephant Conflict
HFL	Highest Flood Level
IBA	Important Bird and Biodiversity Area
IBAT	Integrated Biodiversity Assessment tools
ICM	Integrated Catchment Management
IIA	Indirect Impact Area
IUCN	International Union for Conservation of Nature
KDP	Kamala-Dhalkebar-Pathlaiya
LBL	Lowest Bed Level
NGO	non-governmental organization.
NG	Net Gain
NNL	No Net Loss
NPWC	National Parks and Wildlife Conservation Act, 2029
NTFPs	Non-timber forest products
PAs	Protected Areas
PIA	Project Influence Area
PNP	Parsa National Park
PS	Performance Standard
PWR	Parsa Wildlife Reserve
ROW	Right of Way
SRCTIP	Strategic Road Connectivity and Trade Improvement Project
TCU	Tiger Conservation Unit
VECs	Valued Environmental Components
VMS	Variable Message Sign
VTR	Valmiki Tiger Reserve
VU	Vulnerable

Executive Summary

The DoR-DCID under the MoPIT, GoN is responsible for the procurement of component two which includes, "Detailed Design of Upgradation of Kamala- Dhalkebar -Pathlaiya KDP Road Section of Mahendra Highway and Bridges". The existing bridges at Kamala- Dhalkebar section are of two-lane standard while the bridges at Dhalkebar -Pathlaiya section are of intermediate lane (5.5 m width) standard. The bridges are the prime cause of the traffic congestion on that section of the highway.

To enhance the road capacity and efficiency in road transport, a need for up-gradation of the KDP Road section, 130 Kms of Mahendra Highway was felt and DoR initiated to upgrade the KDP Road section.

The existing 2-lane Kamala Dhalkebar Pathlaiya (KDP) road has been proposed to be improved into the 4-lane Asian Highway Standard (Class I). The road will be widened to 18 m width (7 m on either side with a 4 m center median). Service roads of width 6.5 m each will also be constructed in either side in urban areas. A total 60 bridges will be upgraded to four-lane capacity. Also, 122 culverts and 23 causeways will be converted into box culverts.

The road stretch lies in 6 Districts that is Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, and Bara of Madhesh Province. Also, passes through 16 Municipalities (including 1 sub-metropolitan city) and 78 wards. There are many settlements with mixed caste/ethnic group communities along the road alignment (adjoining the road alignment). Some of the major settlements are: Portaha, Godar, Birendra bazar, Bhiman, Dharapani, Kanchibazar, Puspapur, Bishrampur, Dhalkebar, Ranatol, Badahari, Lalgah, Bardibas, Raniganj, Lalbandi, Nawalpur, Harion, Naya Road, Karmaiya, Bagmati (east and west), Chapur, Nijgadh and Pathlaiya.

As per geographic condition, forests with project area lie within Terai Mixed Hardwood Forest zone that mainly consists of Sal *Shorea robusta* trees with other associate trees. Riverine forest can be found along the banks of rivers and streams with dominant species of Khair *Senegalia catechu* and Simal *Bombax ceiba*. Towards the southern west boundary of KDP Road, a section of 14 km stretch, from Chainage km 350+00 to km 366+420) runs parallel to the Parsa National Park

Parsa National Park is a protected area in the inner Terai lowlands of south-central Nepal. It covers an area of 627.39 km² in the Parsa, Makwanpur and Bara districts. Wide variety of threatened and endangered species are reported in the Parsa National Park. To understand the wildlife movement near the project road, identification of impacts and formulating site-specific mitigation plan a proper Biodiversity Management Plan BMP is required to integrated into one or more topic-specific management plans.

For collection of baseline information site visits were conducted from 25 to 27th January 2022, 31st May to 5th June & February 7th to 14th 2023. Field level assistants and surveyor were mobilized for field work and survey during the month of May and June.

Around 53.54% of the road alignment passes through forest area as shown in Figure 1. Altogether 30 species were recorded within 41 quadrat samples. Among them, Sal (*Shorea robusta*) had the highest number with density of 71.61/ha. It was also the most abundant species with an occurrence of 41.46% as shown in **Figure 1-2**.

Elephant movement was noticed between the road stretch of km 363+100 to km 334+500. By connecting the information gathered by all possible sources estimated elephant population was between 6-7 individuals which are partial migrants with in the Parsa National Park and associated community reserves. Unprecedented travel movement of elephant was noticed near the village Piluwa Village which is 300 m from the km 357+800, Tangia Basti 2.5 km from the chainage 351+000. The elephant movement is shown in **Figure 0-1 and Figure 3-8 (enlarged view)**.

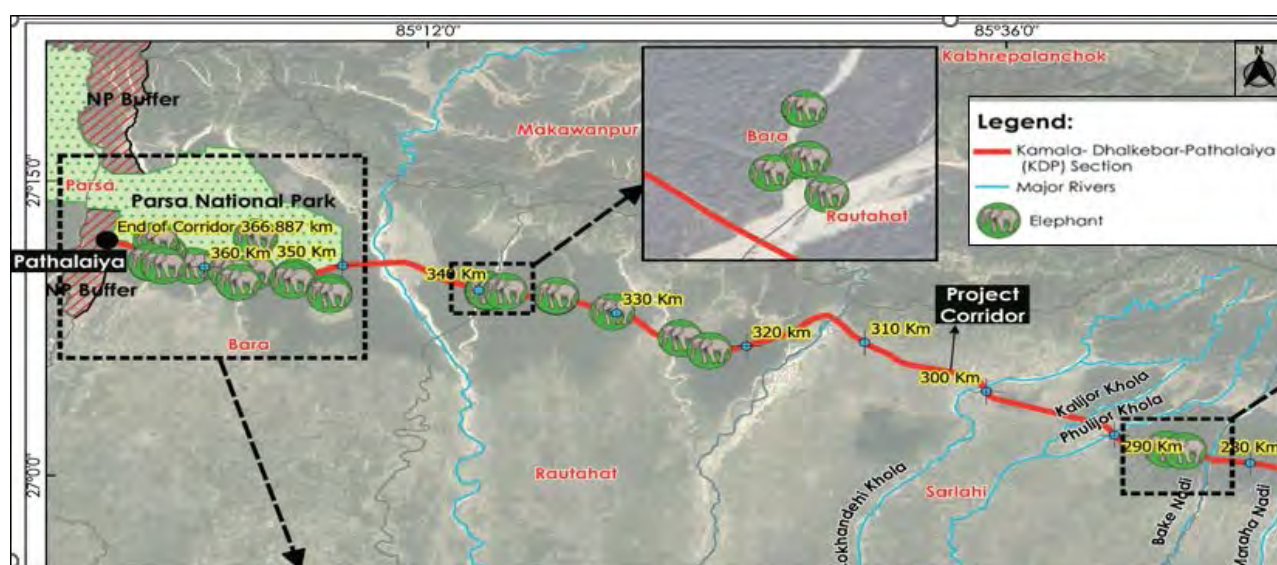


Figure 0-1: Elephant movement along the KDP Road

As per the Nepal Tiger census, 2022, tiger population in Parsa National Park increased from 18 to 41 individuals from the year 2018 to 2022. With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely PNP FT-79 & PNP FT-78 were reported part of the project road. These locations were identified between the chainage 333+100 to 327+700, this section is outside the Parsa National Park. Map illustrating the distribution of tigers near the project road (Pithalaiya) as per the recent tiger census (2022) is given as **Figure 3-12**.

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

Based on the information collected in section above and further desk-based review has been carried out using IBAT screening, referring to the IUCN red list data and other relevant literature a critical habitat assessment (CHA) was carried out as per Environmental and Social Standards ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

An attempt has been made to establish the status of population at global scale as per IUCN range distribution maps and local scale by site investigation studies, stake holder consultation with locals & forest/wildlife department. Near the project road Movement of higher vertebrates is more evident for namely Asian elephant (*Elephas maximus*) and Royal Bengal Tiger (*Panthera tigris*).

No Net loss/ Net gain approach: Achieving No Net Loss and progressing towards a Net Gain with application of the mitigation hierarchy covering avoidance, minimization and restoration actions is shown in Figure 7.2. Overall, an offsets strategy in the project road is aimed to achieve a balance between the infrastructure development and the protection of the environment and communities affected by the project. It involved a combination of proactive planning by proposing underpasses, guiding fences, canopy bridges, speed restrictions and development implementation of appropriate measures to minimize, offset negative impacts and Net gain of additional forest area through afforestation program will benefit overall ecosystem functions of the study area.

Mitigation Measures such Underpasses/Bridge for Elephant Crossing, after observing the height of the underpass proposed by different agencies in different countries, it is recommended that minimum height of bridge for elephant crossing is 6.5 m with adequate openness index ranges from 5.30 to 20.25 which exhibits a high degree of openness for the target species. Eight (08) bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura were proposed for elephant, tiger and ungulate crossings and ten (10) bridges/culverts at CH 271+514 (Gadhanta), 274+925 (Belgachhi /DhungreKhola), 275+630 (Tuteshwor-

1), 277+266 (Maraha), 278+913 (Dholan), 282+758 (Bankhe), 285+721 (Amuwa), 292+703 (Kalinjor – 2), 317+698 (Paurahi), 322+553 (existing causeway) were proposed for medium size animal crossings like tiger and ungulates. Six canopy bridges are proposed in which four canopy bridges are proposed near the Parsa National Park and other two are proposed near the associated reserve forest which are more than 30 km from the Parsa National Park. Installation of 6 Arboreal Mammal Canopy Bridges are also suggested at the same location near CH:364+200, CH:357+500, CH:349+200, CH:340+900, CH:336+400, CH:330+700.

T-top Noise barriers are proposed near the Dudhra River Bridge Ch 363+600, Balganga River Bridge Ch 360+800, Pashah River Bridge Ch 357+070, Bakaiya River Bridge Ch 347+200, Dhansar River Bridge Ch 339+300 where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves. Total length of noise barrier is total of bridge Length on RHS & LHS and 10 m on either side of the bridge.

The implementation of the Solar Electric Fencing, Bio fencing near 3 villages: Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS present a chance to implement net gain measures, which benefit both communities and wildlife. By implementing these strategies, we can mitigate conflicts, ensuring the safety of both humans and elephants.

Apart from the implementation of the Solar Electric Fencing near 3 problematic village namely Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS. Bio fencing is also suggested around the settlement as a long-term approach towards addressing the Human Wildlife Conflict near the project road. Bio-fencing is indeed a viable long-term approach to mitigating human-wildlife conflict near project roads or settlements which reserving ecological connectivity and promoting sustainable development.

As per the recommended compensatory afforestation rate for the removal of 28,120 trees within the RoW, total 2,81,200 trees will be planted in which a net gain of 2,53,050 trees will be achieved. The compensatory afforestation will require a total area of 290 ha. Net gain of 261 ha will be obtained through afforestation program. Compensatory afforestation plan is proposed with approximate budget of NPR 293.8 million (2.22 million US\$¹).

Other best practices such as providing annual maintenance of river depth, other improvement proposals required to facilitate wildlife to walk along the banks and avoid crossing through the road are proposed. Proposed camera traps are recommended to be positioned 0.5 m to 1.0 m above the ground facing into or at an angle across the opening of structures. Eight camera trap locations were proposed near the elephant/tiger crossing locations near the CH 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves. Continuous recording with cameras shall be connected to PNP monitoring cell. Budget provisions were given for camera traps in the wildlife monitoring section of estimated budget for BMP. Wildlife movement monitoring and setting up a Rapid Response Wildlife Management Unit is proposed during construction and operation phase with appropriate budget.

¹ Based on the conversation rate of Nepal Rastra Bank on 18th March-2024

1. Introduction

1.1 Project Description

The Strategic Road Connectivity and Trade Improvement Project (SRCTIP) is funded by the World Bank (WB under IDA credit No 6673-NP & 6674-NP to improve the efficiency and safety of select transport infrastructure, improve the efficiency of cross-border trade, and strengthen capacity for strategic road network management in Nepal. This project has four components. 1) The first component, Trade Facilitation, 2) The second component, Regional Road Connectivity, comprises three sub-components: (i) Improvement of the existing Nagdhunga- Naubise- Mugling road to two lanes, with one-meter paved willers; (ii) Upgrading of the KDP road from two lanes to four lanes; (iii) A safe corridor demonstration program (SCDP), with support for road safety improvement initiatives including enforcement and post-crash response, covering a length of about 250 kilometers. 3) The third component, Institutional Strengthening, comprises three sub-components: (i) Support for the National Road Safety Council; (ii) Capacity enhancement of DoR for improved management of Strategic Road Network (SRN); and (iii) Support for periodic maintenance of the Core Road Network (CRN). 4) The fourth component, Contingency Emergency Response, aims to provide an immediate response to an eligible crisis or emergency, as needed.

Among the four components, this Consultancy Service is related to the second one i.e. Regional Road Connectivity, Upgrading of the KDP road from two lanes to four lanes. The DoR-DCID (hereinafter referred to as “the Client”) under the MoPIT, GoN is responsible for the procurement of component two which includes, "Detailed Design of Upgradation of KDP Road Section of Mahendra Highway and Bridges" in particular.

Mahendra Highway (Dhalkebar-Pathlaiya section, 109 Kms) was constructed in 1974 AD, however Kamala Dhalkebar section of same highway was constructed in 1970's. Both of these sections were upgraded to double lane standard in late 1990's. The bridges at Kamala Dhalkebar section are of double lane standard while the bridges at Dhalkebar-Pathlaiya section are of Intermediate lane standard. The bridges of Dhalkebar-Pathlaiya section are now bottlenecks to the traffic. The passenger and freight traffic have been increasing as a result of trade enhancement. The recent regional trade agreements for further enhancement of trade among the member countries, necessitates the standard of road needs to be upgraded to match with the Asian Highway Standards (Class I). In order to enhance road capacity and efficiency in the road transport, GON, DoR intends to upgrade the KDP section (130 Kms) of the Mahendra Highway under the proposed project from 2-lane to 4-lane road under SRCTIP Project.

The section of Kamala–Dhalkebar (21 Km) of Mahendra Highway was constructed in the year 1970, which was funded by the Government of India. The section from Dhalkebar- Pathlaiya (109 Km) was constructed later with assistance from the then USSR. Both of these sections were upgraded to two-lane standards only in 1990. The existing bridges at Kamala- Dhalkebar section are of two-lane standard while the bridges at Dhalkebar -Pathlaiya section are of intermediate lane (5.5 m width) standard. The bridges are the prime cause of the traffic congestion on that section of the highway.

To enhance the road capacity and efficiency in the road transport, a need for up-gradation of the KDP Road section, 130 Kms of Mahendra Highway was felt and DoR initiated the procurement process to upgrade the KDP Road section of the existing 2 –lane to 4-lane standard. List of Existing Bridges Associated with KDP are shown in **Table 1-1**. Bridges suitable for large wildlife crossings were identified based on the wildlife movement is shown in orange color coding namely serial number 53,56,58,62,64,66,69&71.

Table 1-1: List of Existing Bridges Associated with KDP

SN	Bridge Name	Chainage (Centre of Bridge)	Existing Bridge		Proposed					Type of River	Nature (Siltation)
			Span Length (m)	Total Length (m)	Span Length (m)	Total Length (m)	LBL (m)	HFL (m)	Vertical Clearance (m)		
1	Kamala	237.022	24*26.65	639.6	14+206+206+	640	100.81	106.12	8.349	Perennial	Aggrading
2	Kamala Canal	237.812	5*14.2	71	45	45	104.05 7	106.05 7	5.415		
3	Charnath	241.185	15*21.4	321	15*21.4	321	122.05	123.79	2.940	Ephemeral	Aggrading
4	Baluwa	244.825	7*16	112	32+32+32+16	112	134.04	136.53	3.830	Ephemeral	Aggrading
5	Jagadav Branch	250.492	26.6	26.6	20	20	161.66	162.44	1.780	Ephemeral	Aggrading
6	Jagadav	250.817	2*21.5 + 2*26.5	96	2*20.6	53.2	159.11	159.92	3.238	Ephemeral	Aggrading
7	Jalad	252.472	10*26.6	266	10*20.6	266	153.68	155.44	5.107	Ephemeral	Aggrading
8	Aurahi	254.605	12*26.6	319.2	12*26.6	319.2	163.9	165.38	3.700	Ephemeral	Aggrading
9	Basai	256.142	2*26.5 + 2*21.5	96	1.4+2*26.6+21	96	164.18	165.65	3.833	Ephemeral	Aggrading
10	Sukhajor	258.631	2*22	44	2*22	44	171.82	174.34	4.830	Ephemeral	Aggrading
11	Badahari	260.957	2*23.5+28	75	23.5+28+23.5	75	183.18	185.12	3.845	Ephemeral	Aggrading
12	Ratu	265.312	2*38.5+4*33+5*2.95	223.75	41+4*36+41	226	216.41	219.06	6.679	Ephemeral	Aggrading
13	Ratu Chahara	266.108	2*9.4	18.8	2*6	12	224.16	225.32	1.841	Ephemeral	Aggrading
14	Bhapsi	268.134	4*12.5	50	3*25	75	206.37	209.54	4.370	Ephemeral	Aggrading
15	Atabbe	269.363	3*9.5	28.5	28.5	28.5	205.65	207.15	2.910	Ephemeral	Aggrading
16	Janga Pul-1	270.717	6*12.5	75	5*25	125	207.56	210.01	3.650	Perennial	Stable
17	Janga Pul-2	270.993	3*12.55	37.65	3*6	18	206.32	207.82	5.728	Ephemeral	Aggrading
18	Gadhanta	271.36	5*12.5	62.5	3*25	75	209.65	211.53	3.000	Ephemeral	Aggrading
19	Belgachhi (Dhungre Khola)	274.798	4*9.5	38	2*20	40	195.21	197.32	3.110	Ephemeral	Aggrading
20	Tuteswor- 1	275.494	2*9.5	19	20	20	188.67	190.9	3.230	Ephemeral	Degrading
21	Tuteswor- 2	276.903	2*9.5	19	20	20	187.03	188.23	4.553	Ephemeral	Aggrading
22	Maraha	277.004	15+2*18+2*15+2*18+ 15	132	5*33	165	188.21	190.65 1	3.941	Ephemeral	Aggrading
23	Maraha Kholsi Pul	278.219	2*9.45	18.9	3*6	18	187.79	189.36	3.174	Ephemeral	Aggrading
24	Dholan	278.783	4*9.5	38	38	38	187.35	189.4	3.050	Ephemeral	Aggrading
25	Jarlahi (Kholsi Pul)	280.453	2*9.5	19	20	20	184.98	186.71	2.730	Ephemeral	Aggrading
26	Batuwa	281.883	3*9.5	28.5	28.5	28.5	177.3	179.77	3.470	Ephemeral	Aggrading
27	Bankhe	282.73	15+4*18+15	102	33+36+33	102	177.92	180.14	3.420	Ephemeral	Aggrading
28	Amuwa	285.648	2*9.2	18.4	25	25	164.06	167.09	4.030	Ephemeral	Aggrading
29	Phuljor	290.223	7*12.5	87.5	5*25	125	156.76	159.56	4.000	Ephemeral	Aggrading

SN	Bridge Name	Chainage (Centre of Bridge)	Existing Bridge		Proposed					Type of River	Nature (Siltation)
			Span Length (m)	Total Length (m)	Span Length (m)	Total Length (m)	LBL (m)	HFL (m)	Vertical Clearance (m)		
30	Kalinjor - 1	291.893	3*9.5	28.5	28.5	28.5	155.19	156.52	6.500	Ephemeral	Aggrading
31	Kalinjor - 2	292.761	3*21.1	63.3	3*22	66	150.97	154.23	5.273	Perennial	Stable
32	Betini	294.155	2*6	12	2*6	12	146.97	148.25	2.293	Ephemeral	Degrading
33	Dumdume	295.388	2*9.45	18.9	25	25	139.71	142.32	3.610	Perennial	Stable
34	Bastipur	296.328	2*9.5	19	3*6	18	140.22	141.19	2.091	Ephemeral	Aggrading
35	Lakhandei	300.671	15+4*18+2*15+4*18+15	204	33+36+2*33+36+33	204	136.39	138.81	3.920	Ephemeral	Aggrading
36	Chapani	301.712	3*22	66	3*22	66	136.62	139.94	4.520	Perennial	Aggrading
37	Bastol	302.553	2*10.35	20.7	6	6	141.92	142.76	2.214		
38	Sukhapokhari	305.624	2*9.5	19	3*6	18	136.88	137.51	2.342	Ephemeral	Aggrading
39	Rai Bridge	307.663	4*9.5	38	38	38	130.87	135.12	5.450	Perennial	Degrading
40	Dumajor	309.914	4*9.45	37.8	2*20	40	127.7	130.99	4.290	Ephemeral	Aggrading
41	Godari	311.444	2*9.45	18.9	20	20	128.45	130.79	3.340	Ephemeral	Aggrading
42	Bagmati East	312.07	11.3	11.3	25	25	126.12	128.12	5.560		
43	Bagmati	312.941	11*33.045	363.495	99+165+99	363	122.88	131.26	10.675	Perennial	Aggrading
44	Bagmati West	313.615	11.57	11.57	25	25	125.546	127.546	5.143		
45	Gairi	313.99	3*11.4	34.2	35	35	126.92	129.36	3.440	Ephemeral	Aggrading
46	Gairi Khola	314.83	11.5	11.5	3	3	137.15	137.87	1.666	Ephemeral	Partial Aggrading
47	Paurahi	317.792	3*22.17	66.51	3*22	66	121.25	124.11	4.060	Ephemeral	Stable
48	Lachkan	319.13	2*11.25	22.5	20	20	125.87	127.45	2.580	Ephemeral	Aggrading
49	Katha Ko Pul	323.567	4*11.4	45.6	25	25	121.91	123.42	2.510	Ephemeral	Aggrading
50	Chandi	325.262	5*32.95	164.75	5*33	165	119.81	122.61	6.263	Perennial	Aggrading
51	Dhou	327.332	2*11.25	2*11.25	3	3	132.56	132.96	1.511	Ephemeral	Aggrading
52	Jungle Tole	328.136	3*11.39	34.17	20	20	134.89	135.7	1.810	Ephemeral	Stable
53	Amu - 1	329.666	3*11.34	34.02	25	25	139.97	140.79	6.500	Ephemeral	Stable
54	Amu - 2	330.895	2*11.35	22.7	3*6	18	142.88	144.22	4.543	Ephemeral	Stable
55	Kathi	332.717	5*11.35	56.75	30	30	144.15	145.08	1.930	Ephemeral	Aggrading
56	Lamaha	333.842	2*33	66	2*33	66	134.21	137.82	7.519	Perennial	Stable
57	Kali Khola	334.396	3*11.3	33.9	33	33	133.81	136.3	4.349	Perennial	Degrading
58	Dhansar	339.381	8*20.5	164	4*41	164	145.3	147.35	6.500	Ephemeral	Aggrading
59	Lamopul	342.172	4*11.3	45.2	25	25	148.02	148.95	1.930	Ephemeral	Stable
60	Bhamara	343.395	32.89	32.89	33	33	145.97	151.63	8.121	Ephemeral	Aggrading

SN	Bridge Name	Chainage (Centre of Bridge)	Existing Bridge		Proposed					Type of River	Nature (Siltation)
			Span Length (m)	Total Length (m)	Span Length (m)	Total Length (m)	LBL (m)	HFL (m)	Vertical Clearance (m)		
61	Rampul	343.99	2*11.3	22.6	20	20	149.85	151.78	2.930	Ephemeral	Aggrading
62	Bakaiya	347.272	16*22.2	355.2	82.5+165+82.5	330	148.84	153.22	6.896	Perennial	Aggrading
63	Unasi	348.934	8*11.2	89.6	35	35	149.58	152.62	4.185	Ephemeral	Aggrading Degrading
64	Terhakilo	353.612	4*11.4	45.6	41	41	146.48	149.12	6.500	Ephemeral	Aggrading
65	Barahakilo	354.656	3*11.25	33.75	35	35	139.17	141.56	3.390	Ephemeral	Stable
66	Pasaha	357.337	5*33	165	5*33	165	139.2	141.63	6.500	Perennial	Aggrading
67	Pasaha Branch	357.46	2*11.1	22.2	3*6	18	142.53	143.64	4.322	Ephemeral	Stable
68	Bangandi	358.581	10*11.36	113.6	35	35	142.87	144.22	2.350	Ephemeral	Aggrading
69	Balganga	361.003	3*22.36	67.08	3*22	66	147.55	149.53	6.500	Ephemeral	Aggrading
70	Baijura	362.952	4*11.52	46.08	2*23	46	152.75	154.61	3.604	Ephemeral	Aggrading
71	Dudhaura	363.687	2*45.2465	90.493	2*45.25	90.5				Ephemeral	Aggrading
72	Dhungre - 1	364.553	11.2+11.6	22.8	3*6	18	159.58	160.59	2.598	Ephemeral	Aggrading
73	Dhungre - 2	364.776	11.2+11.4	22.6	3*6	18	157.09	159.01	4.797	Ephemeral	Stable
74	Tin Number	365.866	11.6+11.6+10.4	33.6	35	35	159.65	161.45	2.800	Ephemeral	Stable
75	Dui Number	366.391	2*11.6	23.2	3*6	18	160.96	161.92	3.565	Ephemeral	Stable
76	Ek Number	366.61	11.45	11.45	2*6	12	162.88	163.62	1.696	Ephemeral	Aggrading

Source: Detailed Design Report, 2023

HFL: Highest Flood Level

LBL: Lowest Bed Level

Bridges that have been adapted to function as wildlife crossings 

1.2 Location and Access

Proposed KDP road section is a part of Mahendra Highway. The proposed road section starts from Kamala (26°52'40.73"N and 86° 8'24.20"E) and ends at Pathlaiya (27°11'57.66"N and 84°58'50.76"E). The road stretch lies within Madhesh Province and covers 6 Districts, 16 Municipalities (including 1 sub-metropolitan city) and 78 wards as shown in **Table 1-2** below.

Table 1-2: Districts, Municipalities and Wards covered by the KDP Road Alignment

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

The Project location along with proposed road alignment is shown in **Figure 1-1**. Land use map is shown in **Figure 1-2**. Land Use Statistics of Project Area is shown in **Table 1-3**.

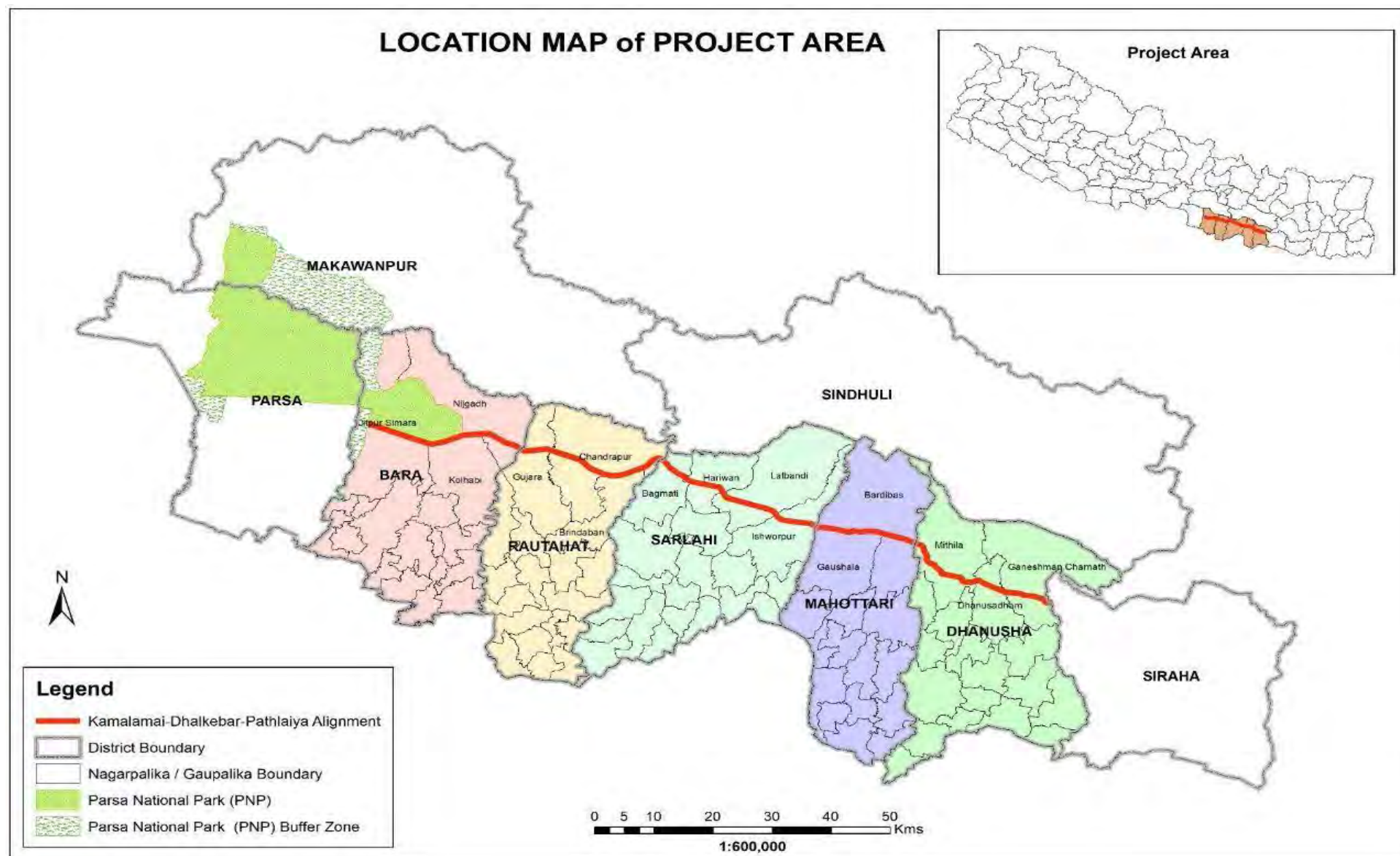


Figure 1-1: Proposed Road Alignment in Map of Nepal

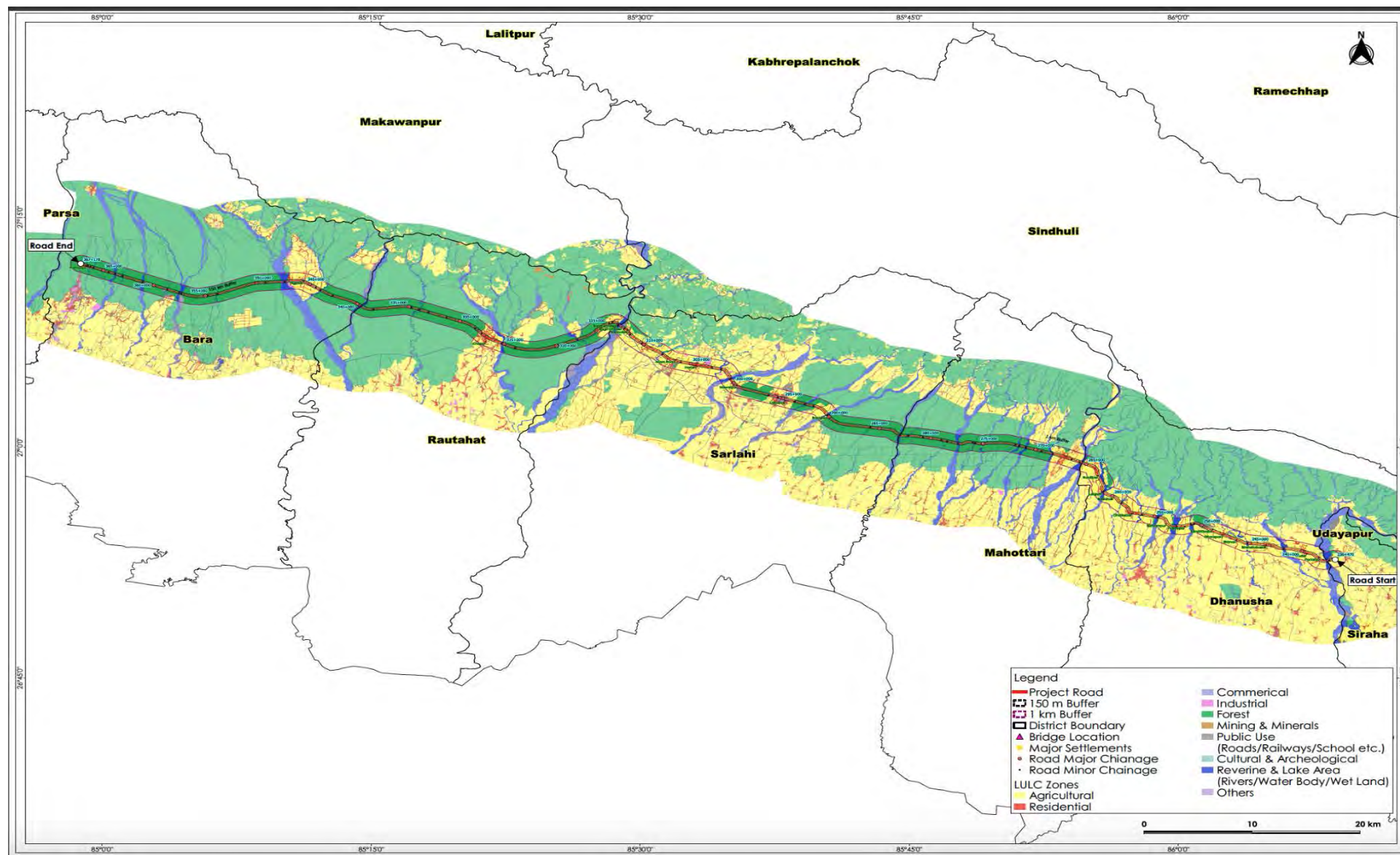


Figure 1-2: Land Use Map of Project Area with Critical Sections

Table 1-3: Land Use Statistics of Project Area

Land use Zone	Impact Area					
	25 m Buffer		150 m Buffer		1 km Buffer	
	Ha	%	Ha	%	Ha	%
Agricultural	97.14	14.92	949.76	24.28	8218.24	31.23
Residential	56.93	8.75	311.09	7.95	1109.79	4.22
Commercial	29.89	4.59	141.52	3.62	199.78	0.76
Industrial	1.6	0.25	12.42	0.32	112.47	0.43
Forest	317.1	48.71	1989	50.85	13890.8	52.78
Mining & Minerals	0.67	0.10	2.94	0.08	3.35	0.01
Public Use (Roads/Railways/School etc.)	124.5	19.13	296.19	7.57	771.47	2.93
Cultural & Archeological	1.35	0.21	5.96	0.15	8.04	0.03
Riverine & Lake Area (Rivers/Water Body/Wet Land)	19.83	3.05	184.34	4.71	1802.02	6.85
Others	1.9	0.29	18.03	0.46	203.11	0.77
Total Area (in Hectares)	650.9	100.00	3911.3	100.00	26319.1	100.00

Land use map showing reserve forests and Parsa National Park is shown as **Annexure II**.

1.3 Need for Biodiversity Management Plan (BMP)

Considering the ecological sensitivity of the project road, Biodiversity Management Plan is required to protect and conserve biodiversity and habitats near the project road, to apply the mitigation and the precautionary approach in the design and implementation of projects that may impact on the local biodiversity also to support Indigenous Peoples through the adoption of practices that integrate conservation needs and development priorities. Overall, offsets strategy in the project road is aimed to achieve a balance between the infrastructure development and the protection of the environment and communities affected by the project. It involves a combination of proactive planning by proposing underpasses, guiding fences, speed restrictions and development implementation of appropriate measures to minimize and offset negative impacts.

Following are the ecological features noticed in the project area which needs to be protected with true spirit.

Forest Areas:

Land use and landcover of the KDP road with in 150 m buffer i.e. direct impact area (as mentioned in the **Figure 1-2** and **Table 1-3**) reveals that, project road is passing through 50.85% of the Forest area followed by 24.28% Agricultural habitat, Residential 7.95%, Public Utilities 7.57%, Commercial 3.62%, River and lake areas 4.71% and others 1.08%. Majority of the project road is passing through the ecologically sensitive areas such as reserve forest. Rivers passing across the KDP road are Kamla, Jaladh, Aurahi, Rato, Bake, Phulijor, Kaliyo, Lakhandei etc.

Parsa National Park:

Towards the southern west of KDP Road, a section of 14 km stretch from Chainage km 350+00 to km 366+420) is running parallel to the Parsa National Park

Parsa National Park is a protected area in the Inner Terai lowlands of south-central Nepal. It covers an area of 627.39 km² (242.24 sq mi) in the Parsa, Makwanpur and Bara districts and ranges in altitude from 435 m (1,427 ft) to 950 m (3,120 ft) in the Siwalik Hills. Wide varieties of threatened and endangered species are reported in the Parsa National Park.

Associated community:

Apart from the Parsa National Park there are 17 Community Forests on LHS and 22 Community forests on either side of the project road. Major community forests include Sagarnath Forest Development Project 283+100 to 290+250, National Forest (Bagbani Center) 293+000 to 293+300, Shreejana Community Forest 316+050 to 320+300, Hatemalo Community Forest 327+900 to 329+900, Sahajnath Collaborative Forest 351+225 to 357+400, Halkhoriya Collaborative Forest 357+550 to 363+750. Details of community reserve forests adjoining the project road are mentioned in the Table 3-5. Wildlife movements of major Mammals such as Elephant & Tiger are noticed near the Parsa National Park and community forests.

To understand the wildlife movement near the Parsa National Park, Community Reserve Forests along the project road, and to identify impacts and formulate site-specific mitigation plan a proper Biodiversity Management Plan BMP is essential to prescribe the pragmatic mitigation measures during the execution of the subproject activities so that there is bare minimum or no impact to the biodiversity and to integrate one or more topic-specific management plans as well.

2. Methodology for Collection of Baseline Information on Wildlife

A team of international, national biodiversity experts, field level surveyors and assistants were involved in the bio-diversity study and covered various seasons for collection of baseline data on wildlife. Following are the survey dates:

1. January 25-27, 2022
2. February 07-14, 2023
3. May 31- June 05, 2023
4. January 3-4, 2024

Methodology adopted for collection of baseline information is formulated based on ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources and studies conducted by World bank were also referred.

2.1 Desktop Review

The project site location and immediate surroundings were studied as per the IUCN listed threatened species (Critically Endangered-CR, Endangered-EN and Vulnerable-VU Species)). Databases such as iBAT (Integrated Biodiversity Assessment tools), and range distribution maps were reviewed from IUCN Red list, crowd sourcing platforms such as eBIRD² (online database of bird observations providing real-time data and analysis of bird distribution and abundance), and Important Bird Area IBA³ to understand the presence and absence of the potential Critical Habitat (CH) trigger species and their habitat values.

Literature reviewed (given as **Annexure-I**) such as existing environmental studies, scientific literature published by research and academic institutes or other types of biodiversity assessments available for the project area and/or adjacent areas, national or regional plans (e.g., Strategic Environmental Assessments, National Biodiversity Strategies and Action Plans, management plans, Wildlife Management Plans if any, for the protected area and the Key Biodiversity Area within the area of influence & existing conservation programs or initiatives by Forest/Wildlife Department.

Identification of an Area of Analysis (AoA) for the determination of critical habitat: The AoA includes the project's area of influence as well as the surrounding ecological boundary that considers the extent of biodiversity values and where such values may be negatively impacted by project activities within the broader landscape.

Review outcomes of stakeholder engagement conducted to date and identify additional stakeholders associated with the area of interest and potential biodiversity values.

Develop a list of candidate critical habitat values. In tabular form, present for each candidate biodiversity value details on:

- Key information sources (e.g. IUCN Red List, expert sources);
- Rationale on potential to trigger critical habitat criteria, where rationale exists for inclusion in further assessment;
- Key information needs for biodiversity values where rationale and potential to trigger critical habitat criteria exists but existing data is inadequate to confirm status.
- Protected and internationally recognized areas
- International conventions like World Network of Biosphere Reserves, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

² <https://ebird.org/home>

³ <https://www.birdlife.org/projects/ibas-mapping-most-important-places/>

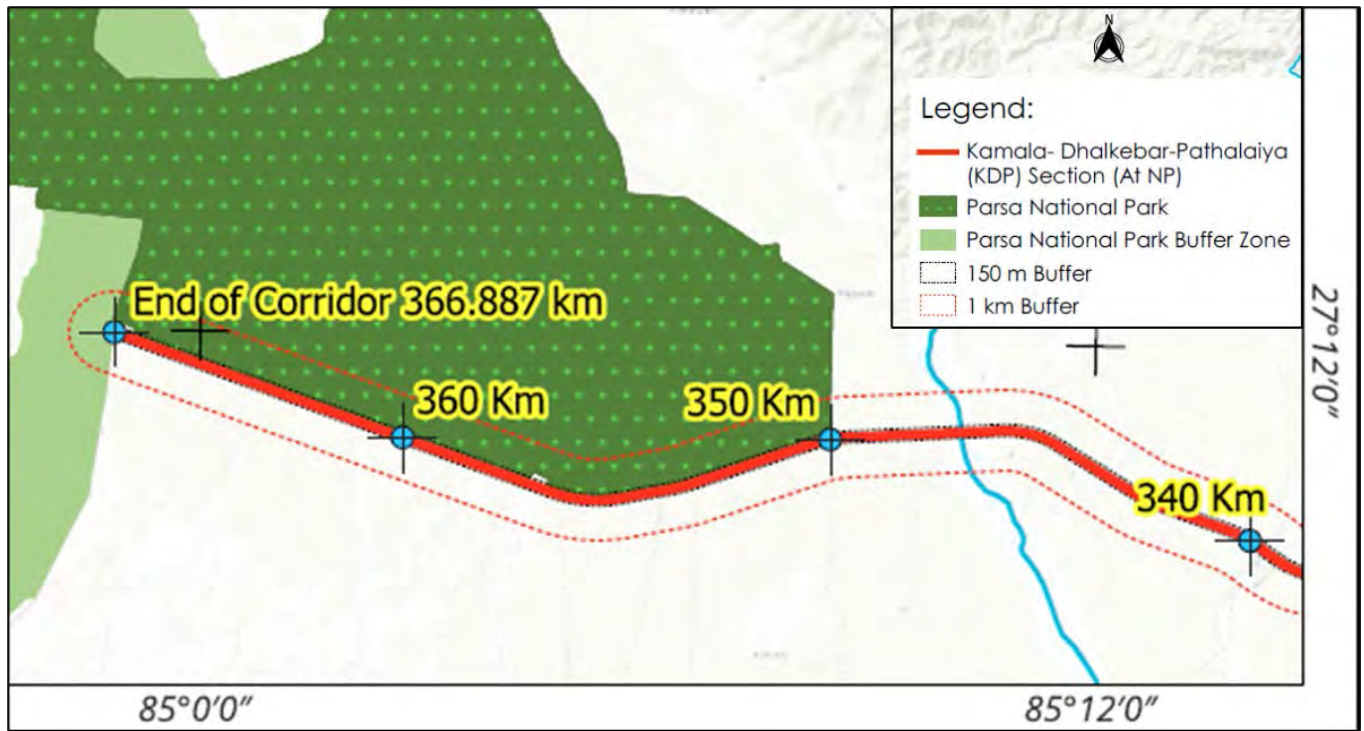


Figure 2-1: AoA of the Project Area (representative map)

2.2 Stakeholder Consultation

Consultation with stakeholders such as Local/Tribal dwellers; NGO organization working on Wildlife, Environment & Social aspects; District Forest Officer (DFO); Chief Wildlife Warden were carried out and consultation details were given in Chapter 4.



(1)



(2)

Figure 2-2: Consultation with Forest Authorities 1) With Warden of Parsa National Park 2) With DFO Rautahat

2.3 Walk Through Observation

The biological team of the consultant walked through the road alignment and forest area within ROW, DIA and IIA observing vegetation and wildlife and recorded site observation. Surveys were planned to reflect different seasons and conducted between 25 to 27th January 2022, 31st May to 5th June & February 7th to 14th 2023. Field assistants and surveyor were mobilized for field work and survey during the month of May and June.



Figure 2-3: Walkthrough Observation Near Parsa National Park Ch 361

2.4 Transect Survey

To assess the faunal presence in the project area, standard line transects method was adapted. In this method, the transect lines were chosen randomly perpendicular with the road axis. The length of the transect lines dependent on the habitat and the terrain. Randomly selected alternate transects has been made on both sides of the road. Map showing sampling locations is shown in **Figure 3-5**.

2.5 Bridges and Culvert Survey

Bridges and culverts, especially near the Parsa National Park and community and collaborative forest area were identified for their use by wild animals to cross the existing KDP road. These Bridges and culverts are normally located to mainly serve the hydrological functions and were never intended for utilization by the animals, however large and small animals (mammals, reptiles & amphibians) were using this bridges and culverts for road crossings. Foot Impression were collected all across the river crossings and culverts selected based on the site visit to cross check and confirm whether the existing culverts are being used by wild life. Following photographs are at bridge across the Dhansar river and Pashah river.



Figure 2-4: Bridge and Culvert Survey along the Project Road a) 337+700 b) Ch 353+300

2.6 Nocturnal Survey

On alternate days, nocturnal surveys by walking along the project road was conducted along the road to identify the presence of nocturnal species in the study area in general, as well as to study the movements of various faunal species at night. In the study section, the entire study stretch was monitored at different times between 7 PM in the evening and 5 AM in the morning. Alternate days were used for the study. All encounters in the study area were also recorded in a general checklist.



Figure 2-5: Nocturnal Survey along the Project Road near Ch 364+100

2.7 Road Kill/Man-Animal Conflict Surveys

No major road-kills were recorded during day and night surveys. As per the literature, in January 2021 a Tiger was killed on Pathlaiya-Hetauda section of East-West Highway which is 20 km from the KDP road section. In addition to these observations, the views of local people as well as forest department regarding human-animal conflicts in the project influence area have been recorded through direct consultation. Survey was conducted between 25 to 27th January 2022, 31st May to 5th June & February 7th to 14th 2023.

Road kills near the Parsa National Park are contributed by two highways namely Tribhuvan Highway and East-West Highway. The Pathlaiya-Amlekhgunj road section (Tribhuvan Highway) has the highest number of accidents and following are the road kill data reported near Parsa National Park.

Table 2-1: Road Kill Data along Pathlaiya-Amlekhgunj Road Section

S.N.	Year	Road Kills
1	2018-19	42
2	2017-18	36
3	2016-17	24

Road kills of wild animals include Spotted deer, blue bull, wild boar and jackal, among other wild animals, are killed in accidents every year, as per the record of the park.

<https://kathmandupost.com/climate-environment/2019/08/09/wildlife-deaths-by-road-accidents-on-the-rise-in-parisa-national-park>

2.8 Mammal Survey

Collected presence absence signs of elephants viz. footprint, conflict sign, dung signs and another feeding signs to know the habitat use. We had collected information on individual numbers, pattern of movement and prominent locations of active movement, crucial road crossings along the project road. Stakeholder consultations were conducted with forest department starting from higher official to ground level working staffs, consultations were made in the conflict villages & local forest dwellers. Photographs were collected from Forest and local people which was documented during the active road crossing period.

Visual observation of mammals both by eye and using 10x binoculars; registration of field signs of wild mammals, including animal tracks, faeces, digging, burrows, dead animals, etc. and photographing the

animals, their tracks and traces of their vital activity, typical habitats facilitated by geotagged photographs with GPS enabled camera SONY DSC-HX300 were done.

2.9 Reptile and Amphibian Survey

Attempts were made to assess the status of reptiles and amphibians in the study area (specification of the species, territorial distribution, including places of concentration, the state of habitats). The field survey conducted a mix of stationary point surveys and transects surveys which were focused on representative habitats across the proposed Project area.

2.10 Approach to Critical Habitat Assessment

ESS6 provides the following five criteria for recognizing critical habitat:

- a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches;
- b) Habitat of significant importance to endemic or restricted-range species;
- c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species;
- d) Highly threatened or unique ecosystems;
- e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

For critical habitat screening and assessment of the above criteria, Parsa National Park, Tiger movement zones were identified as per Nepal Tiger Census 2022 and as well as primary evidence during the survey. Elephant corridors were identified based on the scientific publications, evidence during the survey and consultations with forest department, NGOs and local people.

2.10.1 Delineation of Area of Analysis (AoA)

To assess critical habitat, an area of analysis is required. These boundaries may include catchments, large rivers, or geological features. Area of analysis considered is 1km radius to assess the applicability of the critical habitat criteria and thresholds to determine critical habitat for the species and/or ecosystems concerned.

Accordingly, considered the project area, 1 km radius covering forest area and its surroundings which are known to be habitat of IUCN-listed Threatened (critically endangered CR, endangered EN and Vulnerable VU) species as AoA. Following VECs were considered for AoA.

Table 2-2: Valued Environmental Components (VECs)

S. No.	Valued Environmental Components	Description
1.	Terrestrial & Tree Cover	Vegetation cover, number of trees falling in proposed project area
2.	Wetland and Aquatic ecosystems	Typology of water body (pond/lake etc.) in immediate influence area sub project sites. Study of Flood level on/ nearby to sub project region. Width of river/stream etc. intercepting the project site.
3.	Environmentally Sensitive Areas	National park and other biodiversity areas passing along, offset or within the proposed sub project, Wildlife crossings and other associated development interventions.

This assessment of critical habitat follows an approach developed by the World Bank in 2022 for interpretation of ESS6 critical habitat criteria to determine if the habitat has significant importance for species or the ecosystem. The assessment is conducted in four steps:

Step 1 involves compiling lists of Critically Endangered (CR), Endangered (EN) and Restricted Range (RR) species based on global and national data.

Step 2 involves screening these species based on their likelihood of occurrence.

Step 3 determines if the reduced list of species qualify as critical habitat features with occurrence of unique ecosystems and ecological functions also assessed. The following six guidelines are provided to facilitate the interpretation of the ESS6 critical habitat criteria:

- (i) Recognized areas of high biodiversity value (such as legally protected areas, Key Biodiversity Areas, Important Bird Areas, Alliance for Zero Extinction (AZE) sites, Ramsar Wetlands of International Importance and World Heritage Natural Sites) and importantly the reasons for which they are designated can provide useful indicators of potential critical habitat. A review of protected areas data should therefore be included into an assessment of critical habitat.
- (ii) ESS6 Criterion (a) requires an assessment against both global (IUCN) and national red list ratings. ESS6 footnote 13 states that where the threatened status of a species is listed differently on the (global) IUCN Red List and national/regional lists, assessment of the impact of net reduction should be based on the national/regional population. This is interpreted as a requirement to follow a precautionary approach and to prioritize assessment of species reduction (project impact) to the lesser population of a species (i.e. the national assessment) over the global assessment.
- (iii) By definition, Critically Endangered (CR) species face an extremely high risk of extinction and their continued survival in the wild is in a critical state. Therefore, if a surviving population of a CR species is present in the critical habitat AoA, the habitat should be considered to have significant importance for the species under ESS6 Criterion (a).
- (iv) Where a significant proportion of the national, regional or global population of a species has a likely presence within the AoA, the habitat is considered to have significant importance for the species under ESS6 Criterion (a), (b) or (c). Presence (or likely presence) of $\pm 1\%$ of the global or national population within the AoA is considered significant for this CHA.
- (v) ESS6 Criterion (b) can additionally be achieved for range-restricted species where the full extent of the critical habitat AoA overlaps a significant proportion ($\pm 1\%$) of a species' distribution range.
- (vi) ESS6 Criteria (d) and (e) are to be assessed on a case-by-case basis using specialist input and reliable data sources with consideration given to the presence of conservation initiatives, legally protected areas and internationally or regionally recognized areas of high biodiversity value and the reasons for which they are designated.

Step 4 investigates requirements for net gain^[1], and if such outcomes are feasible:⁴ Where critical habitats are adversely impacted by a project ESS6 requires net gain to be demonstrated for the biodiversity features for which the critical habitat is designated.

2.10.2 Analysis of Modified and Natural Habitats

Classification, Mapping and characterization of Modified and Natural Habitats: Undertake secondary & desktop analysis of available data to understand the habitat types in the entire project influence area (PIA) which is 50 m & the Corridor of Impact (COI) which is 300 m and Indirect impact of 2 km. In order to differentiate between the two habitats, ESS6 guidance note, and technical manual was referred.

Prepared a map by demarcate the modified and natural habitats within the PIA in general & COI in particular in the map and same is given in **Annexure II**.

2.11 Prominent Wildlife Crossings

Direct and indirect count method have been used to estimate wildlife road crossings for elephant, tiger and ungulates. Elephants along the project road have been counted integrating both direct and indirect evidence.

⁴ ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Indirect evidence was cross checked with consultations with different stakeholders including local residing villages, livestock grazers, forest product collectors, forest field level working personals, livestock market areas etc. Photographs and videos of each individual evidence were captured. Further, photographs were collected from National Park, Divisional Forest Offices and local grazers where elephant movement was close to the project road. Presence/absence signs of elephants viz. footprint, tree breach, conflict sign, dung signs and another feeding sign were collected to know the habitat use of wildlife along the river crossings, causeway bridges and important road cross section near the settlements. QGIS was used to prepare distribution map based on direct evidence to prepare habitat suitability and habitat use map of Asian elephant, tiger & ungulates in the study area.

2.12 Addressing NNL and Net Gain Issues

NNL or preferably Net Gain needs to be demonstrated where project activities result in residual impacts to natural habitats. The ESIA has undertaken the following approaches to identify NNL.

- Quantify the loss of natural habitat due to the project interventions
- Mitigation hierarchy shall be applied to first avoid, minimize and mitigate
- Compensation of trees that are to be felled for the project, in a ratio that is in synchronization as per Forest Act Regulation 2079, Environment Protection Rule (EPR), 2020, Government of Nepal were proposed.
- Native, non-invasive tree species as per suggestions of the forest and wildlife authorities will be selected for restoration of natural habitats.
- Based on the quantified loss, species-specific actions may also be suggested after due consultations with the stakeholders
- Indicators shall be listed in the ESMP / BMP for measuring the NNL/Net Gain along with monitoring programs, & awareness programs.

The project's mitigation strategy is designed to achieve net gains of those biodiversity values for which the critical habitat is assessed.

3. Baseline Information on Wildlife within Project Area

3.1 Status of Project Area

KDP Road section is passing along Parsa National Park (PNP) adjoining the southern boundary near Unasi bridge to Pathalaiya, i.e., a section of 14 km stretch, from Chainage km 350+00 to km 366+420) is running parallel to the Parsa National Park as shown in **Figure 3-1**.

Parsa National Park (PNP):

Parsa National Park (PNP) is located in central Nepal of Province 2,3 in Parsa, Bara, and Makwanpur districts. It adjoins Chitwan National Park (CNP) on its western side. PNP was initially established as **Parsa Wildlife Reserve (PWR)** in 1984 with an area of 499 km². Additionally, an area of 128.39 km² of Bara district was added to it including Halkhorla lake as one of the major wildlife habitats making a total area of 627.39 km² covering parts of Parsa, Bara, and Makwanpur districts Through the gazette of Bhadra 07, 2072 (August 24, 2015). With this extension, the status of Wildlife Reserve was upgraded to **National Park** on Ashadh 19, 2074 (July 03, 2017). Salient Features of Parsa National Park are shown in **Table 3-1**.

Table 3-1: Salient Features of Parsa National Park

Parsa WR Declaration	Parsa Wildlife Reserve declared on 18 th April, 1983 (2040 Baisakh 05, Monday) and gazetted on 21st May, 1984 (2041 Jestha 08); Area- 499 km ² . Districts Covered- Parsa and Makwanpur.
Community Involvement	Park and People Programme was launched in 1994
Buffer Zone Declaration	Declaration of Buffer Zone on 27th June 2005 (2062 Ashadh 13) Area- 286 km ² . Districts Covered- Bara, Parsa and Makwanpur
Area Extension	National Forest of 129 km ² in Bara district including Halkhorla Lake is added to the Park on 24th Aug, 2015 (2072 Bhadra 07)
Parsa NP Declaration	Parsa Wildlife Reserve has been converted into Parsa National Park by government decision on 8th May, 2017 (2074 Baisakh 25) and Gazetted on 3rd July, 2017 (2074 Ashadh 19); Area- 628 km ² ; Districts- Parsa, Bara and Makwanpur.
Park HQ	Aadhavar, Bara District, Bagmati Zone, Pradesh 2, Nepal
Biodiversity	Mammals- 37 species; Birds- 490 species; Reptiles- 13 species; Butterflies-31 species; Pisces- 8 species; Plants- 336 species
Endangered Species	Asian Elephant- 60 to 65; Tiger- 7; Gaur- 105; Rhinoceros- 5
IUCN Management Category	II

Source: Parsa National Park Office

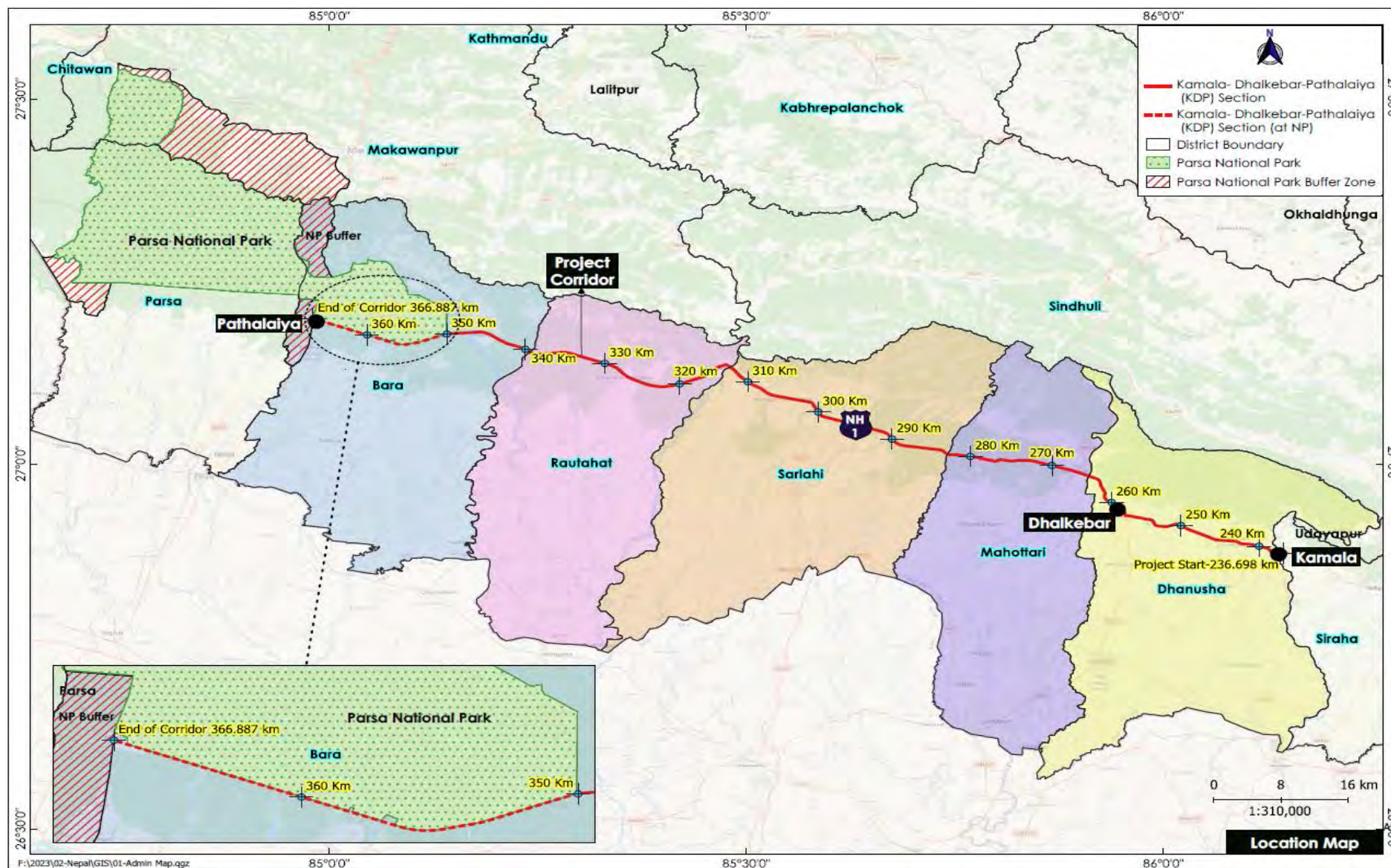


Figure 3-1: Project Road (14 km stretch) Passing Parallel to Parsa National Park

Ecological Significance:

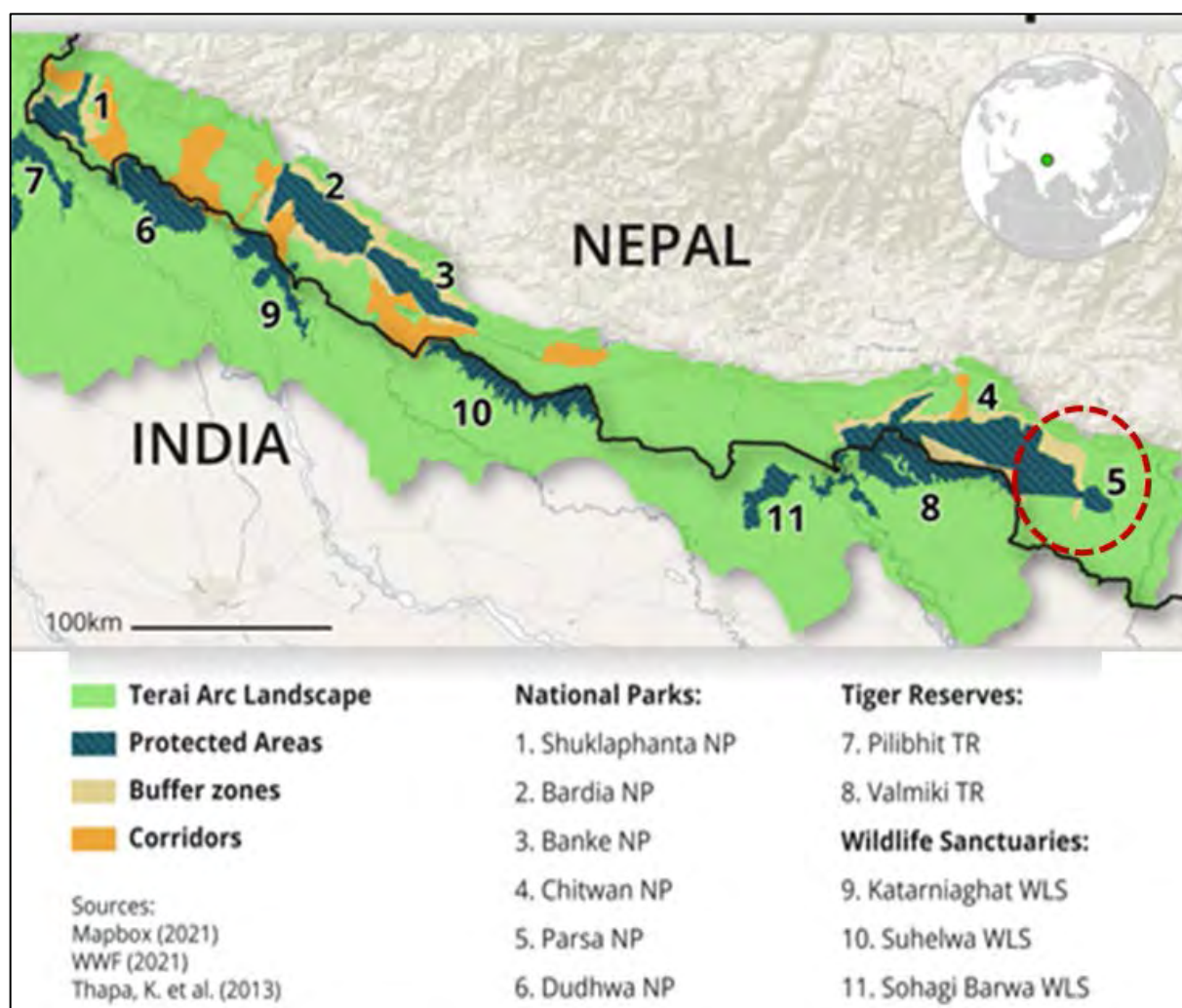
KDP Road section is passing along touching the southern boundary of Parsa National Park (PNP) is shown in Figure 3-1. PNP covers a part of Terai Bhawar area having 90% Sal forest (dominated by *Shorea robusta*) and 10% other mixed hardwood and riverine forest of Sissoo (dominated by *Dalbergia sissoo*) and Khair (*Acacia catechu*) forests with small area of grassland (as per PNP and its Buffer Zone Management Plan, FY 2075/76-2079/80). The strategic location of the Park provides opportunities to link the PAs of Nepal from north to south and east to west. PNP is connected with Chitwan National Park-CNP in the west, which is further extended westward and linked to Mahabharat forests in the north through Barandabhar forest, and to Indian PAs in the south through Valmiki Tiger Reserve-VTR. In the east, the PNP is connected to the national forests extending up to Bagmati River in Rautahat district. The Park also exhibits potential to link north through a stretch of forest near Lothar in Makwanpur. Together with VTR of India, CNP and PNP of Nepal as shown in **Figure 3-3**, a total of coherent 2,460 km² represents the Tiger Conservation Unit (TCU).



Source: Parsa National Park Office⁵.

Figure 3-2: Location of Parsa National Park and its Buffer Zone

⁵ PNP 2018, Parsa National Park and its Buffer Zone Management Plan, FY 2075/76-2079/80
Parsa National Park Office, Aadhar, Bara, Nepal



Source: Abhaya Raj Joshi 2022⁶

Figure 3-3: Ecological Connectivity of Parsa National Park with other Protected Areas

3.2 Forest Resources

The forests along the project road are of tropical nature as per climatological condition. Because of usual adequate rainfall and sun, these forests mostly remain evergreen. As per geographic condition, forests along the project road lie within Terai Mixed Hardwood Forest zone that mainly consists of Sal *Shorea robusta* trees with other associate trees. Riverine forests can be found along the banks of rivers and streams with dominant species of Sissoo (*Dalbergia sissoo*), Khair (*Senegalia catechu*) and Simal (*Bombax ceiba*). The road alignment passes along the boundary of Parsa National Park (forming the southern boundary of the National Park), the Forest area of Sagarnath Forest Development Project, 21 community forests, 9 collaborative forests and national forests as shown in **Table 3-2** and **Figure 3-4**. Land use map showing different forests and Parsa National Park is shown as **Annexure II**.

⁶ <https://india.mongabay.com/2022/05/tiger-movements-between-india-and-nepal-become-increasingly-restricted-even-as-numbers-rise/>

Table 3-2: List of Forests Along the Road Alignment

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

Left Side				Right Side			
S. N	Name of Forest	Chainag e		S.N .	Name of Forest	Chainage	
		From	To			From	To
Forests within Division Forest Bara							
12	Tamagadhi Collaborative Forest	339+700	342+400	20	National Forest	339+650	340+650
13	Adarsa Sadabahar Community Forest	342+400	343+810	21	Janjyoti Community Forest	340+650	343+810
14	National Forest	347+650	351+225	22	Nagmadi Community Forest	347+650	350+050
15	Sahajnath Collaborative Forest	351+225	357+400	23	Parsa National Park	350+050	363+750
16	Halkhoriya Collaborative Forest	357+550	363+750	24	Gadhimai Collaborative Forest	363+900	365+950
17	Pathlaiya community forest	363+900	365+950				

Source: Field Survey/Consultation 2022

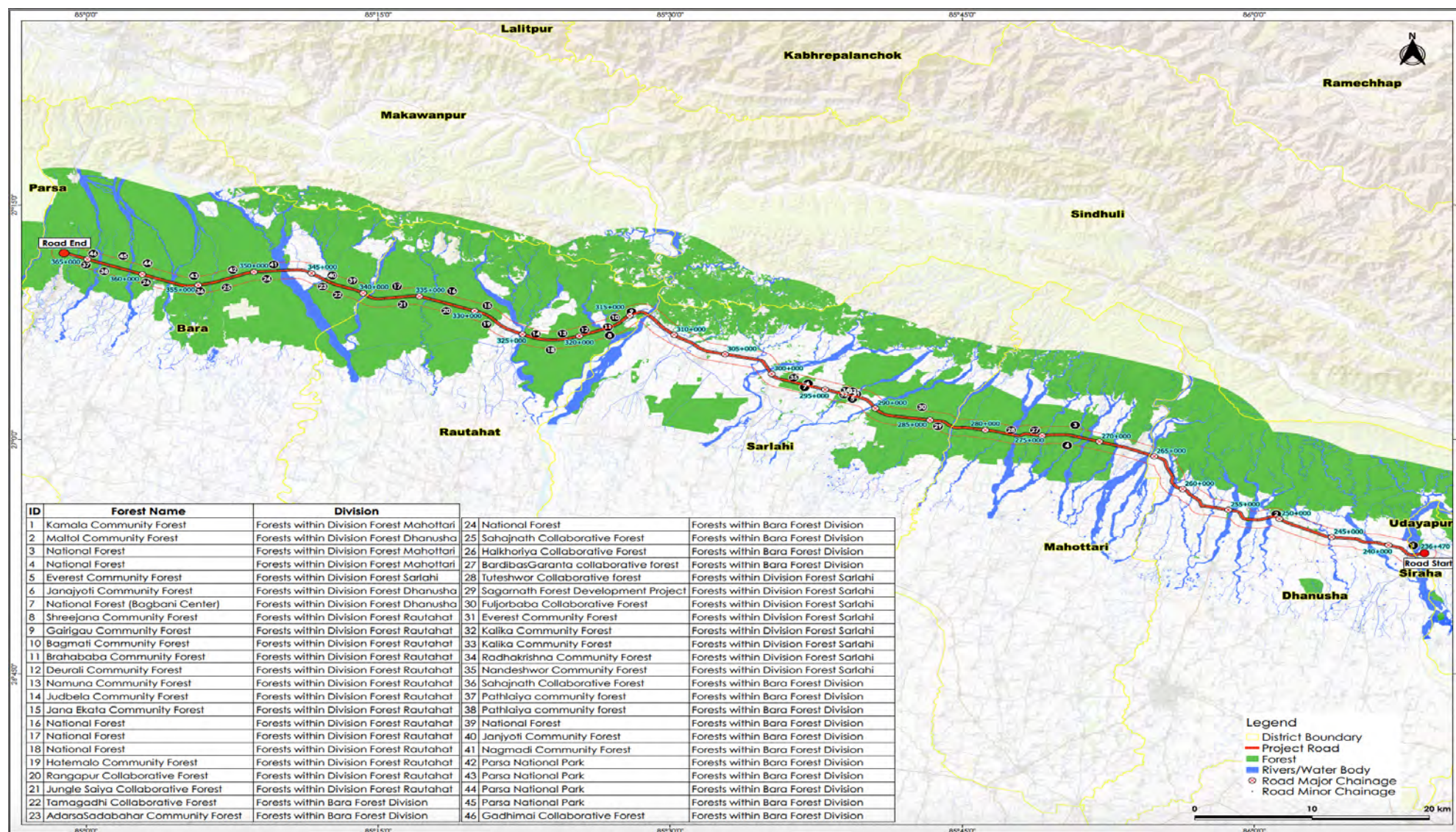


Figure 3-4: Forests along the Road Alignment

3.3 Vegetation Commonly Found Along Road Alignment

The quadrat survey locations are shown in **Figure 3-5**. Altogether 30 species were recorded within 41 quadrat samples of size 10m x 10m were laid along the road alignment within which vegetation analysis was done. Among them, Sal (*Shorea robusta*) had the highest number with density of 71.61/ha. It was also the most abundant species with occurrence of 41.46%.



Figure 3-5: Quadrat and Transect Survey Locations along the Project Road

Major tree species and shrub and herb species within the project area are given in **Table 3-3 and Table 3-4**.

Table 3-3: List of Major Tree Species within Project Area

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

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

Source: Field Survey/ Consultation 2022

Table 3-4: List of Major Shrubs and Herbs Species within Project Area

S.N.	Local Name	Scientific Name	Family	CITES	IUCN	GON
1.	Kanikeghas	<i>Euphorbia prostrata</i>	Euphorbiaceae	II		
2.	Parajivi	<i>Aerides multiflora</i>	Orcidaceae	II	LC	
3.	Harjor	<i>Cymbidium aloifolium</i>	Orcidaceae	II		
4.	Grey Orchid	<i>Vanda tessellate</i>	Orcidaceae	II	LC	
5.	Ketuki	<i>Agave americana</i>	Agavaceae		LC	
6.	Bhedekuro	<i>Syzygium nervosum</i>	Acanthaceae			
7.	Datiwan	<i>Achyranthes aspera</i>	Amaranthaceae			
8.	Kuro	<i>Bidens Pilosa Pilosa</i>	Asteraceae			
9.	Dhaiyaro	<i>Woodfordiafruticosa</i>	Lythraceae		LC	
10.	Asuro	<i>Justicia adhatoda</i>	Acanthaceae		LC	
11.	Dhursul	<i>Colebrookeaoppositifolia</i>	Lamiaceae		LC	
12.	Bhorla	<i>Pheneravahlii</i>	Fabaceae			
13.	Rudilo	<i>Pogostemonbenghalensis</i>	Lamiaceae			
14.	Dudhejhar	<i>Oxalis acetosella</i>	Oxalidaceae			
15.	Ankuriphul	<i>Oxalis corniculatcorniculata</i>	Oxalidaceae			
16.	Thakal	<i>Argemone Mexicana Mexicana</i>	Papavaraceae			
17.	Pire	<i>Persicariabarbata</i>	Polygonaceae		LC	
18.		<i>Aerides multiflora</i>	Orcidaceae	II		

Source: Field Survey/Consultation 2022

3.4 Important Species within the Project area as per Ethnobotany

Ethnobotanical aspect within the project area was found to be significant. Different ethnic communities with their own distinct traditional healing practices were quite unique. The list of some ethnobotanical significant plants along with their uses are given in **Table 3-5**.

Table 3-5: List of Important Shrubs and Herbs Species within Project Area

SN.	Plants	Local Name	Uses
1.	<i>Terminalia chebula</i>	Haritaki	Gastrointestinal disorders
2.	<i>Terminalia bellirica</i>	Bahera	Tonic and gastrointestinal disorders
3.	<i>Cybidium aloifolium</i>	Harajor	Fractures and sprain
4.	<i>Eclipta prostrata</i>	Bhringraj	Skin allergy
5.	<i>Dalbergia sissoo</i>	Sisham	Furniture and wood craft
6.	<i>Bambusa sp.</i>	Bamboo	Weaving

Source: Field Survey/ Consultation 2022

3.5 Trees Inventory within ROW

Tree Inventory within ROW showed that all together there are 28,120 trees (with girth/circumference 30 cm and above), Forest wise list of these trees within ROW of the road alignment is given in **Table 3-6**. Top 10 Dominant species include Sal (*Shorea robusta*) 24.99 % followed by Sindure (*Bixa Orellana*) 14.61%, Banjhi (*Anogeissus latifolia*) 10.35%, Eucalyptus (*Eucalyptus citriodora*) 6.70%, Asna (*Terminalia elliptica*) 5.69%, Kyamuna (*Syzygium nervosum*) 2.91%, Datruno (*Ehretia laevis*) 2.27%,

Padke (*Annona squamosa*) 2.18%, Pyari (*Buchanania latifolia*) 2.18% and Teak (*Tectona grandis*) 2.17%. The total trees Inventory within ROW is shown as **Annexure III**.

Table 3-6: Forest wise Number of Trees within ROW

S.N.	Name of Forest	Trees within ROW	S.N.	Name of Forest	Trees within ROW
1	Adarsa Sadabahar Community Forest	194	18	Kamala Community Forest	28
2	Bagmati Community Forest	435	19	Maltol Community Forest	109
3	Bardibas Garanta collaborative forest	355	20	Nagmadi Community Forest	11
4	Brahababa Community Forest	178	21	Namuna Community Forest	766
5	Deurali Community Forest	507	22	Nandeshwor Community Forest	176
6	Everest Community Forest	130	23	National Forest	4043
7	Fuljorbaba Collaborative Forest	876	24	Parsa National Park	2115
8	Gadhimai Collaborative Forest	187	25	Pathlaiya community forest	484
9	Gairigau Community Forest	77	26	Radhakrishna Community Forest	105
10	Halkhoriya Collaborative Forest	1754	27	Radhakrishna Community Forest	12
11	Hatemalo Community Forest	180	28	Rangapur Collaborative Forest	1296
12	Jana aakata Community Forest	78	29	Sagarnath Forest Development Project	2285
13	Janajyoti Community Forest	114	30	Sahajnath Collaborative Forest	2535
14	Janjyoti Community Forest	1096	31	Settlement Area	2536
15	Judbela Community Forest	643	32	Shreejana Community Forest	663
16	Jungle saiya Collaborative Forest	2615	33	Tamagadhi Collaborative Forest	1048
17	Kalika Community Forest	157	34	Tuteshwor Collaborative forest	432
Total Trees within ROW					28120

Source: Field Survey/Consultation 2022

3.6 Wildlife within Project Area

As per the primary survey field observation adopted by the methodology from section 2.1 to 2.9 and detailed consultations were conducted with wildlife department and local people, major wildlife found within the project area noted as per the primary survey is listed in **Annexure IV** List of wildlife species as per the secondary information, wildlife possible to occur in the study area as per the IUCN range distribution maps, scientific publications and wildlife management plans List of possible wildlife species around project site as per secondary data is given as **Annexure IV**.

3.7 Elephant Distribution

Asian elephant (*Elephas maximus*) is a mega-herbivore. Nationally assessed as Endangered as per both the Nepal Red list series⁷ and the IUCN Red list. Asian elephant is also listed on CITES Appendix I species and Nepal's Protected species as per NPWC Act 1973. In Nepal it is distributed in the lowlands in four isolated population eastern, central, western and far western regions of Nepal (DNPWC/MoFSC/GoN,2009). Project area falls under central and eastern parts of the elephant population in Nepal as shown in figure 12. Historic Population details of Elephant Near PNP.

⁷ Jnawali, S.R., et al. (2011), The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.

An attempt has been made to understand the historical distribution of Elephant near the KDP Road section (Pathaliya).

KDP Road section falls in the central region, eastern parts of the elephant population in Nepal, it is estimated that a population of 25 to 30 elephants are largely resident within the Parsa Wildlife Reserve and Chitwan National Park (ten Velde 1997; DNPWC 2008). Elephants in Parsa National Park are dispersing into Chitwan region in search of water and more suitable habitat during the dry months starting from February-May (Petra Furaha ten Velde 1997⁸). Movement of elephants outside the Parsa National Park and associated wildlife reserve was evident due to unsuitable habitat in all seasons, reduced supply of food and water, and encroachment by human beings (Puja Sharma 2019⁹).

There is a noticeable change in elephant distribution since 2007 can be well explained by the studies conducted by Narendra M. B. Pradhan Et al. was shown in the **Figure 3-6**.

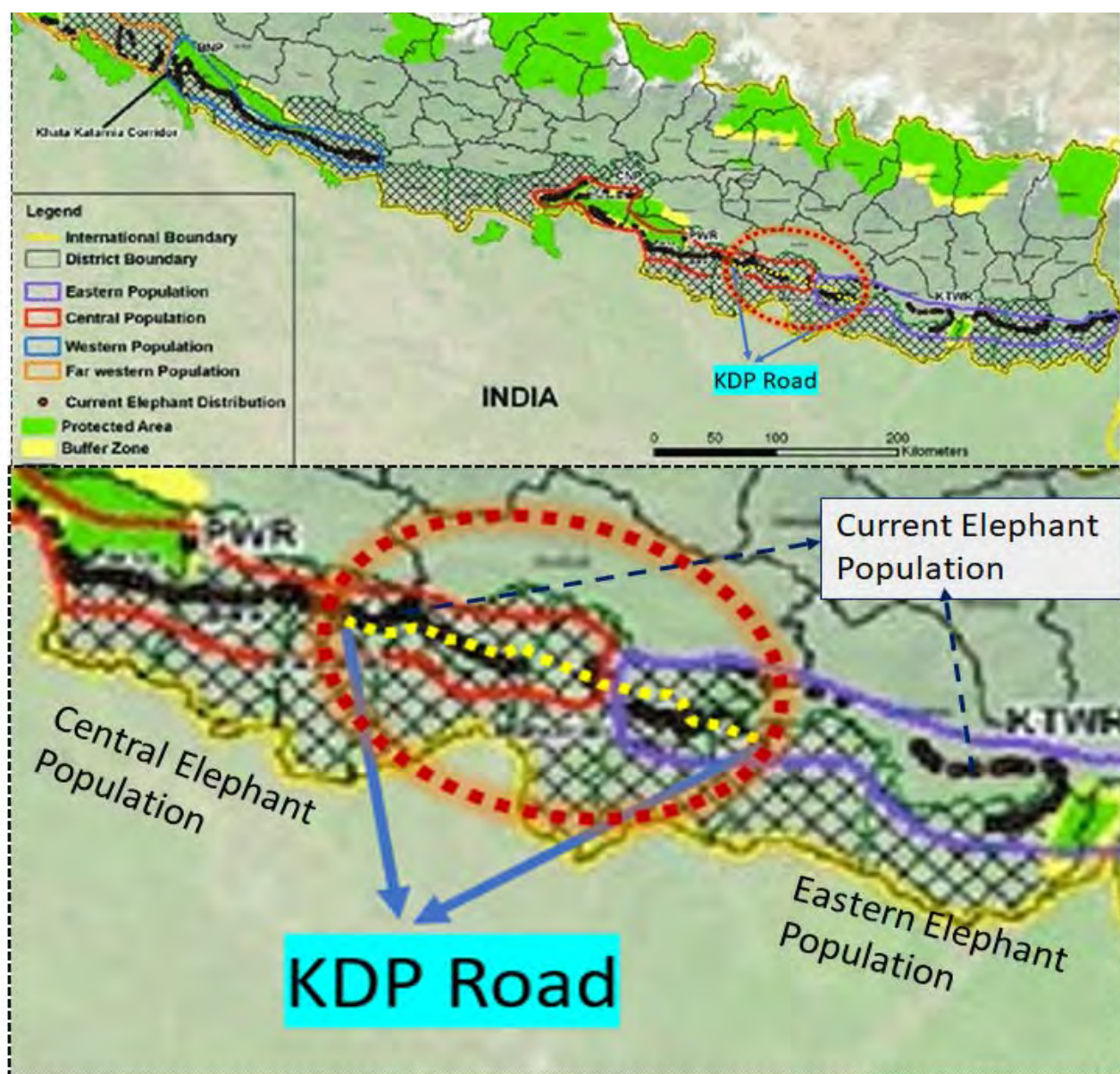
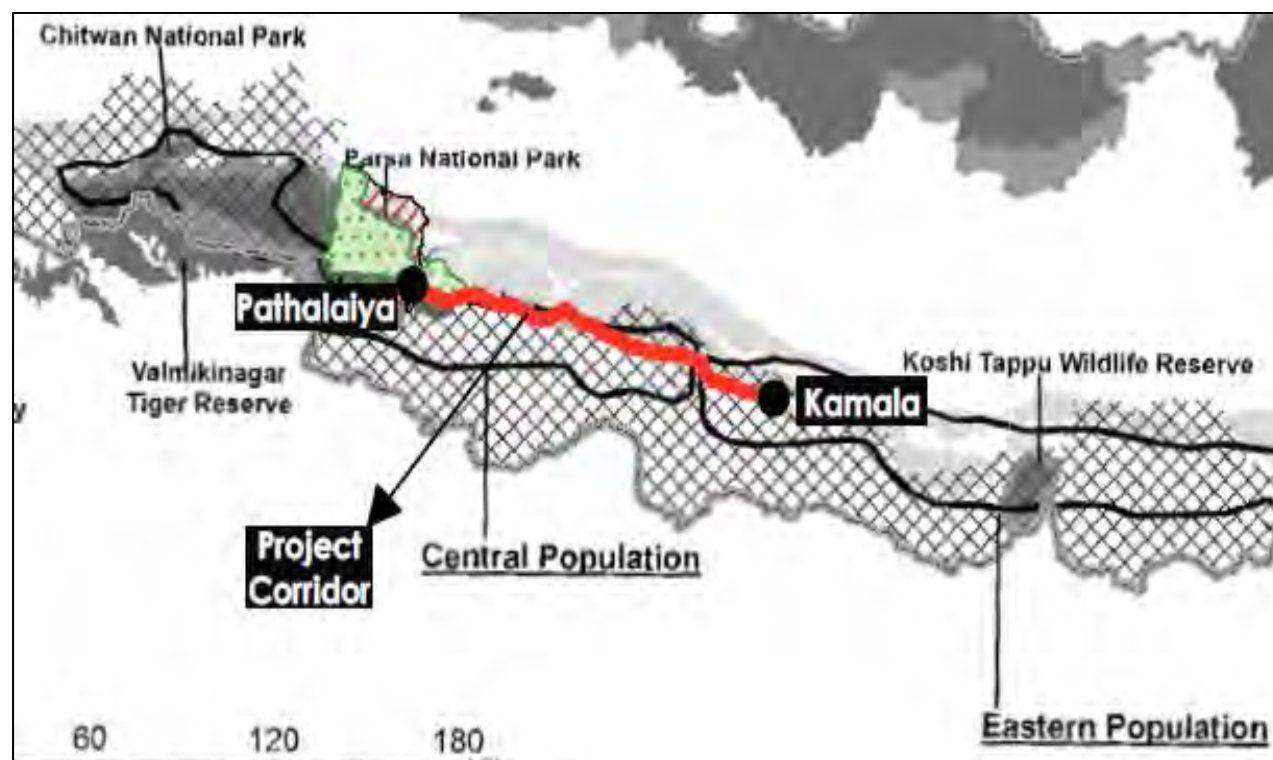


Figure 3-6: Elephant Distribution (brown dots) as in 2011 near the KDP Road Section

⁸ A Status Report on Nepal's Wild Elephant Population Petra Furaha ten Velde, 1997

⁹ Sharma, P., H. Adhikari, S. Tripathi, A.K. Ram & R. Bhattarai (2019). Habitat suitability modelling of Asian Elephant *Elephas maximus* (Mammalia: Proboscidea: Elephantidae) in Parsa National Park, Nepal and its buffer zone. *Journal of Threatened Taxa* 11(13): 14643–14654; <https://doi.org/10.11609/jott.4467.11.13.14643-14654>

The same trends were also noticed in the studies conducted by Kanchan Thapa in the year 2019, also reported active elephant movement near the KDP Road section i.e., central region of Nepal/ Parsa National Park and Chitwan National Park. Elephant distribution range near the KDP Road section (west) reported by Kanchan Thapa during 2019 was shown in the **Figure 3-7**.



Source: <https://doi.org/10.1371/journal.pone.0216504.g002>

Figure 3-7: Elephant Distribution Range near KDP Road Primary Data

Elephant movement was noted between the road stretch of km 363+100 to km 334+500. By connecting the information gathered by all possible sources estimated population was between 6-7 individuals which are partial migrants within the Parsa National Park and associated community reserves. Movement of elephant was noticed near the village Piluwa Village which is 300 m distance from the km 357+800, Tangia Basti 2.5 km distance from the km 351+000. Residential and migratory elephants move from Chitwan National Park towards the east in Bara and Rautahat and destroy crops massively.

3.8 Elephant Movement Mapping

Using the primary data collection by the project team, distribution map of elephant movements along the project road was prepared. Majority of the elephant movement was noticed between the chainage starting from Pathalaiya to Nijgadh area. Near the project road pattern of elephant movement is as follows,

1. Pathalaiya CH 365+600 to CH 349+100 along the Parsa National Park and nearby community reserves forests namely Shreejana Community Forest Hatemalo, Rangapur, Tamagadhi, Adarsa Sadabahar, Sahajnath, Halkhoriya, Pathlaiya and other community forest as discussed in Table 3:9. In general, a group of 5-7 elephant movement were recorded as per the primary survey findings supported by consultations with forest, local forest users and road commuters connecting the link between forest-local people and road users.

2. Second pattern of elephant movement was to be in monsoon season starting from June to September with a estimated group of 12-18 annually. This is a seasonal migration from the Chitwan National Park to Parsa National Park which is connected with the KDP road section from CH 365+600 to CH 349+100 and nearby community reserves forests.



Figure 3-8: Halkhoriya Wetland

Peak Road Crossing Seasons: Connecting the information collected from different stake holders, two peak seasons for road crossings were recorded which include one during maize or wheat maturing time (June – July) and the other during paddy maturing time (Sep. – Nov.). Most of the movements of elephants were reported to occur at night.

Within the Parsa National Park, there's a naturally occurring wetland with a pond of about 3 sq km known as Halkhoriya. The pond was regularly visited by elephants, especially during the dry season, (April to May) when water inside the Reserve forest under Parsa National Park was scarce. Halkhoriya is 3.8 km distance from km 358+100. Elephant Movement was more frequent in the dry season.

Elephant distribution map was prepared by integrating the primary evidence collected during the study period as shown in **Figure 3-9** below.

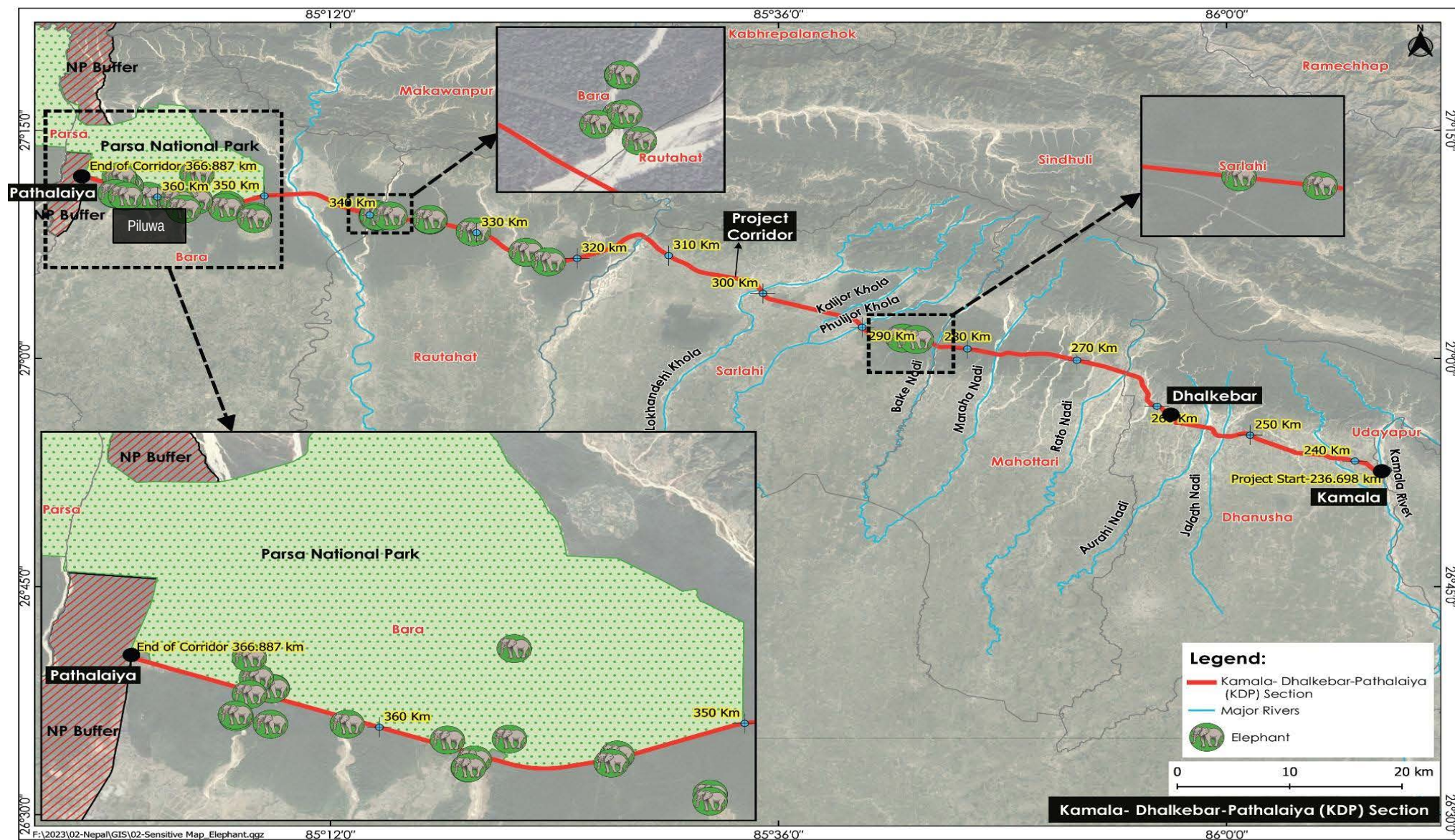


Figure 3-9: Distribution of Elephants along the Project Corridor along with zoomed portion of Pathalaiya section from CH 365+600 to CH 349+100

Based on the primary findings, main elephant crossing points were between the section CH 350 to 366 which is near the Parsa National Park and Halkhoriya wetland near to CH 358+100. Followed by the Dhansar river near CH 339+300 as per the consultations elephant movement near this chainage is of refugee population where no migration of the group (2 to 3 individuals) is envisaged.

	
Pugmark of Elephant 250 m from CH:363+100	Elephant movement 250 m from CH:363+500
	
Elephant Dung 400 m from CH:339+400	Elephant movement 300 m from CH:360+800
	
Elephant Dung 150 m from CH:353+500	Elephant Dung 10 m from CH:334+400

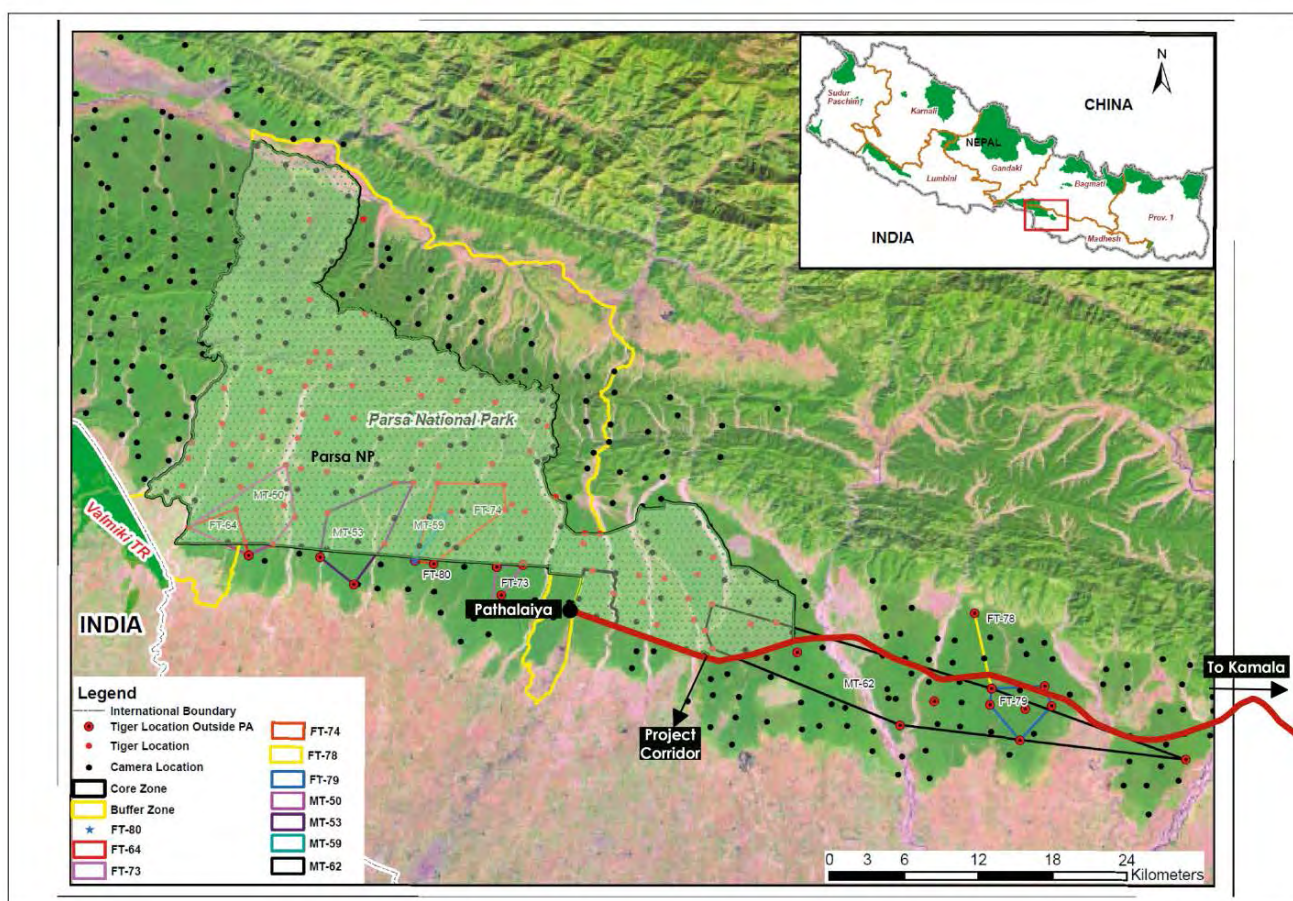
Figure 3-10: Evidence of Elephants along the Project during Primary Survey

3.9 Tiger and Ungulates Movement

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

3.9.1 Tiger Movement near KDP road

As per the Status of Tigers¹⁰ in Nepal (2022), 41 tigers were estimated with minimum individuals identified as 31 tigers in Parsa National Park and adjoining forests. Tiger population Near Parsa National Park was increased from 18 to 41 individuals from the year 2018 to 2022. With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. These locations were identified between the chainage 333+100 to 327+700, this section is outside the Parsa National Park where possibility of road crossing is evident. Map illustrating the distribution of tigers near the project road (Pathalaiya) as per the recent tiger census (2022) is shown in the **Figure 3-11**.



Source: Nepal Tiger census, 2022

Figure 3-11: Maps Illustrating Movement of Tigers near the Project Road

3.10 Evidence of Tiger and Leopards during Primary Survey

Survey was conducted with the help of forest department trained personnel walked along high probability tiger sign areas such as forest trails, fire lines and more prominently along the riverbeds, bridges, and streams. Considerable number of signs of tiger pugmarks, prey signs including dung/pellets, footprints, sightings and consultation was done with frequent livestock grazing and fodder collection. Distribution of tiger and prey animals along the project corridor is shown in **Figure 3-13**.

¹⁰DNPWC and DFSC. (2022). Status of Tigers and Prey in Nepal 2022. Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation. Ministry of Forests and Environment, Kathmandu, Nepal.

	
Pugmark of Tiger 150 m from CH 353+600	Pugmark of Tiger 2 km from CH 357+400
	
Pugmark of Tiger 200 m from CH 360+800	Pugmark of Tiger with cubs 450 m from CH 363+700
	
Pugmark of Tiger 3 km from CH 357+200	Pugmark of Tiger 110 m from CH 334+500
	
Pugmark of Tiger 250 m from CH 325+100	Pugmark of Leopard 500 m from CH 317+700

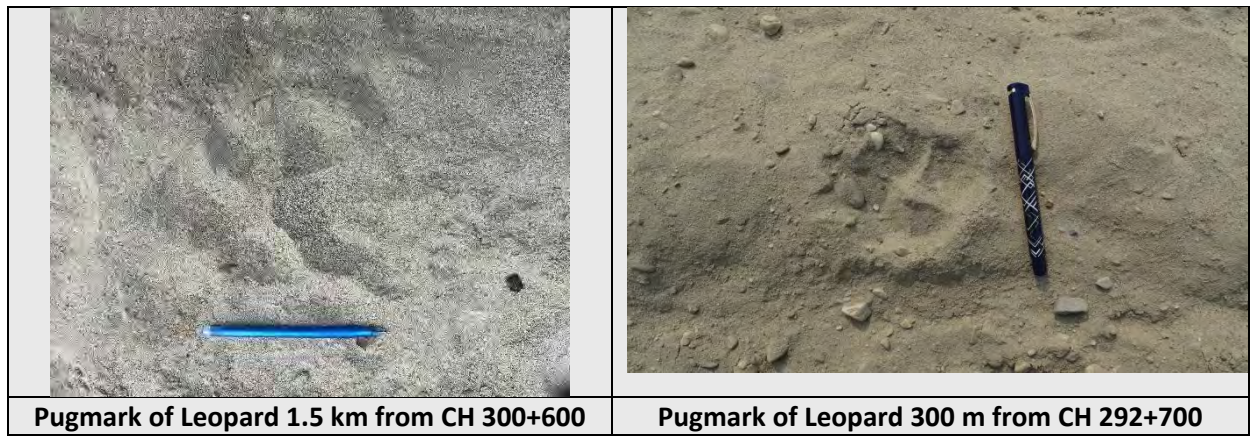


Figure 3-12: Evidence of Tiger and Leopards during Primary Survey

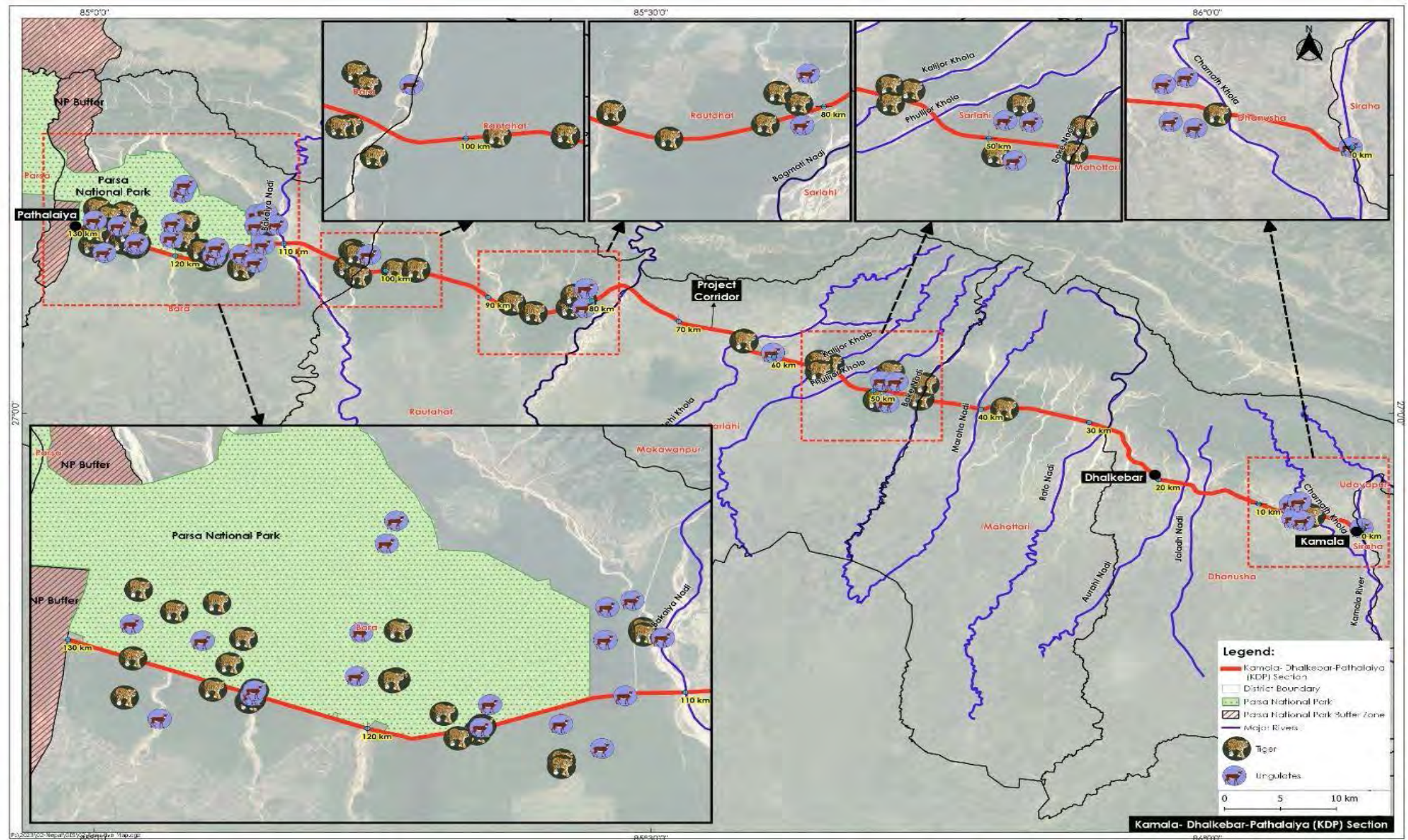


Figure 3-13: Distribution of Tiger and Prey Animals along the Project Corridor

3.11 Prey Animals and Ungulates:

Major prey species were recorded, which include spotted deer (*Axis axis*), Sambar (*Rusa unicolor*), Barking deer (*Muntiacus muntjak*), Blue bull (*Boselaphus tragocamelus*), Wild boar (*Sus scrofa*), and Gaur (*Bos grunniens*). Rhesus macaque (*Macaca mulatta*) and Grey langur (*Semnopithecus entellus*) were commonly sighted along the project road. Except for direct evidence of Barking deer & Gaur, direct evidence was noticed along the project road. Distribution of Ungulates along the project road are shown in **Figure 3-14**.

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

3.12 Arboreal animals:

Major arboreal animals reported near Parsa National Park¹¹ includes species such as Asian palm civet (*Paradoxurus hermaphroditus*), Rhesus monkey (*Macaca mulatta*) and Terai Grey Langur (*Semnopithecus hector*), Oriental garden lizard (*Calotes versicolor*), Monitor lizard (*Varanus bengalensis*), Green tree pit viper (*Trimeresurus albolabris*) & Golden skink (*Eutropis carinata*).

Out of which Two species namely Rhesus monkey (*Macaca mulatta*) and Terai Grey Langur (*Semnopithecus hector*) were noticed near the CH:364+200, CH:357+500, CH:349+200, CH:340+900, CH:336+400, CH:330+700.

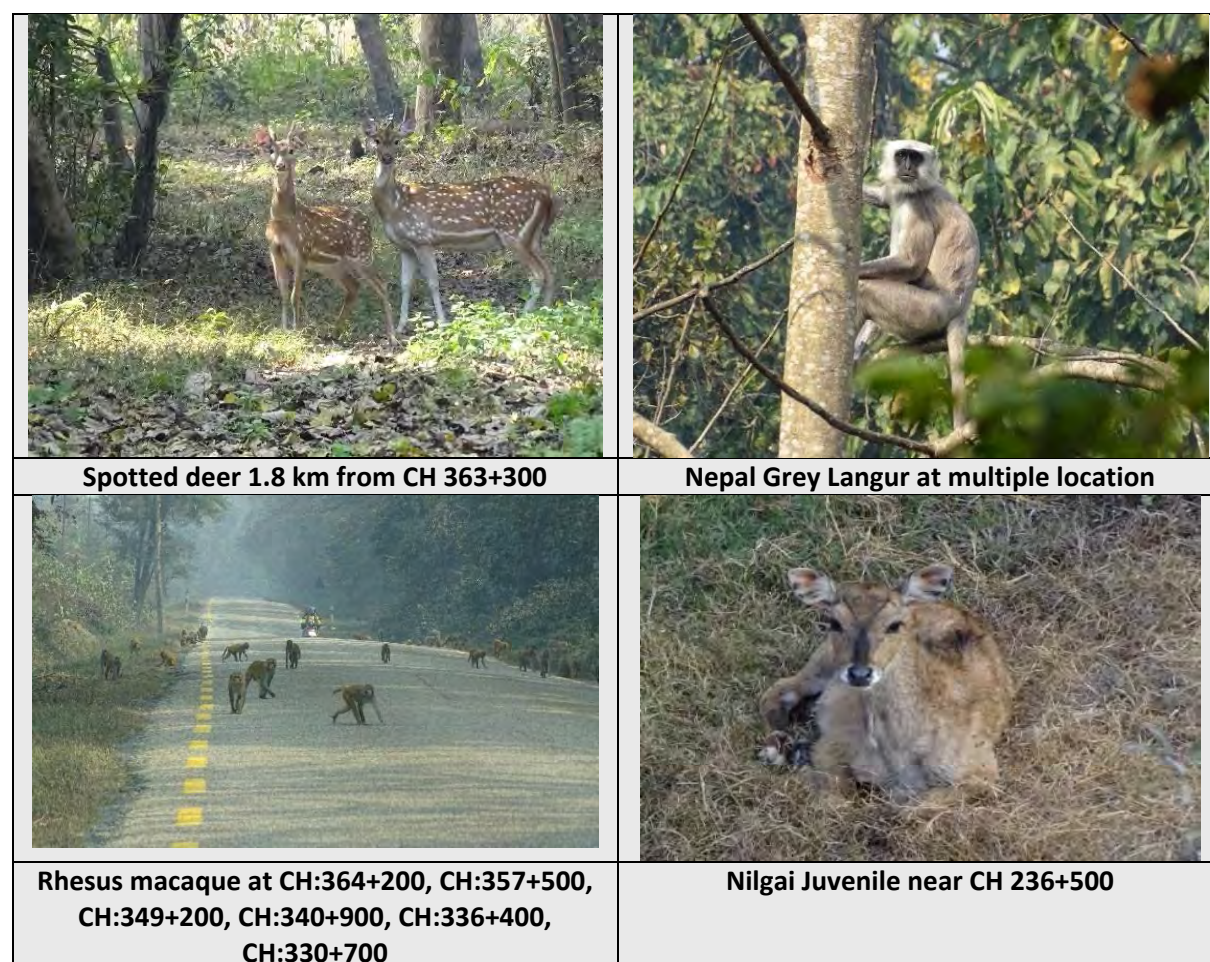


Figure 3-14: Prey Animal Directing Sightings along the Project Road

¹¹ Bhattarai S, Pokheral CP, Lamichhane BR, Regmi UR, Ram AK, Subedi N. 2018. Amphibians and reptiles of Parsa National Park, Nepal. Amphibian & Reptile Conservation 12(1) [General Section]: 35–48 (e155)

3.12.1 Assessment for avifauna

A total of 44 bird species were reported near the Parsa National Park and associated community reserves.

Common birds include Peafowl, Rose-ring Parakeet, Black drongo, Kalij Pheasant, Red Jungle Fowl, Oriental Turtle Dove, Spotted Dove, Slaty headed Parakeet, Verditer Flycatcher, Rufous Treepie, Coppersmith Barbet, Oriented Pied Hornbill, Pied Kingfisher, Alexandrine Parakeet, Common Kestrel, Asian Paradise -flycatcher, Small Minivet and Common Iora. Threatened species includes Steppe Eagle (*Aquila nipalensis*) and Alexandrine Parakeet (*Psittacula eupatria*).

3.12.2 Vultures

Himalayan griffon vulture (*Gyps himalayensis*), it is listed as Near Threatened as per the IUCN Red List. A pair of individuals' roosting behavior has been noticed near the dumping site at the bank of Puljor River near at Chainage 292+700, roosting site was noticed 350 m from the project road. Location of the vulture sighted is shown in the **Figure 3-15**.



Figure 3-15: Location of Himalayan Griffon Vulture (North of Puljor river)

3.12.3 Nesting of birds

No bird nests were found along the proposed right of way, suggesting that this area does not serve as a nesting site for local bird populations. Instead, bird nesting is primarily confined to the protected areas within the interior forest patches of Parsa National Park and nearby community forests.

4. Consultations with Different Stakeholders

Field visits and stakeholder consultations were undertaken during the wildlife assessment with NGOs, Forest/Wildlife Department both higher officials, ground level staff, indigenous peoples, ethnic groups, forest-dependent people whose livelihoods are dependent on forest to a greater or lesser extent and sustainable harvesting of NTFPs from community managed forests.

	
Consultation with wildlife conflict Piluwa village 300 m from CH 357+800	Elephant roaming areas near banana plants 430 m from CH 339+400
	
Consultation with Forest Stakeholders CH 331+300	Consultation with local dwellers near livestock markets Hariyon CH 302+700
	
Consultation with WWF, Nepal	Consultation with ground staff of Parsa National Park 250 m from CH:363+100

Figure 4-1: Consultation with Stakeholders Regarding Wildlife Movement

Table 4-1: Summary of Consultation Held with Government Departments& NGOs

S.N	Designation	Date of Consultation	Issues Discussed and Information Obtained
1	Dr. Maheshwar Dhakal, Director General, Department of National Parks and Wildlife Conservation, Govt. of Nepal	February 06, 2023	Applicable policies, regulations, Acts, Wildlife Working Plans, frame works and necessary support from Parsa National Park.
2	Dr. Kanehan Thapa, Head of Wildlife Program, WWF Nepal	February 06, 2023	Movement and Pattern of Tiger and Elephant near the Parsa National Park and along the subproject road. Published data on Tiger movement and Wildlife crossings technical specifications and their efficiency.
3	Mr. Roshan Thakur, Nepal Biodiversity Research and Conservation Centre, NGO	February 07, 2023	Seasonal Movement and Pattern of Elephant near the Parsa National Park and all along the subproject road. Prime areas of road crossings used by elephant, man elephant conflict village.
4	Mr.Surya Khadka Assistant Conservation Officer, Parsa National Park	February 08, 2023	Locations of Elephant crossings near the Parsa National Park. Collected few photographs of elephant crossings. Suggested elephant underpasses with adequate height near Parsa NP, speed restrictions and signage boards.
5	Technical Staff, Division Forest Office, Sarlahi	February 09, 2023	Movement of Elephant and Nilgai near the project road. Suggested speed restrictions and signage boards.
6	Mr.Ramchandra Khatiwada, Senior Conservation Officer, Parsa National Park	January 03, 2024	Mitigation measures suggested such as Speed restriction of 40 km per hour near the Parsa National Park, proposing solar fences, speed breakers, underpasses, construction of water holes and other mitigations measures including locations of compensatory afforestation.

4.1 Consultations with Parsa National Park

A meeting was organized at Parsa National Park office on January 3rd, 2024 chaired by Senior Conservation Officer Mr. Ramchandra Khatiwada. The objective of the meeting was to share findings and recommendation of draft Biodiversity Management Plan (BMP) prepared for upgradation of Kamala-Dhalkebar-Pathalaiya Road Project. In the meeting, suggestions have been received from the officials of Parsa National Park such as construction of water holes in the northern and southern part of KDP road upto Pathalaiya to Unasi bridge section which is connected with the Parsa National Park, speed limit upto 40 km/hr in the section of elephant crossing locations, installation of noise barriers and rumble strips and coordination among divisional forest office Bara, Traffic Police and KDP project offices for speed limit during night time in the animal crossing locations. The details are listed in **Annexure V**.



Table 4-2: Meeting with Parsa National Park officials by DoR-DCID, CEG-CIAS JV team

5. Habitat Assessments and Impacts

5.1 Critical Habitat Assessment

Based on the information collected in section above and further desk-based review has been carried out using IBAT screening, referring to the IUCN red list data and other relevant literature a critical habitat assessment (CHA) was carried out as per ESS6 of world bank.

ESS6 states the following:

- Criterion (a): Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches
- Criterion (b): Habitat of significant importance to endemic or restricted-range species
- Criterion (c): Habitat supporting globally or nationally significant concentrations of migratory or congregatory species
- Criterion (d): Highly threatened or unique ecosystems
- Criteria (e): Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d)

5.2 Assessment of Critical Habitat

The project road is passing abutting the PNP which enroot significant amount of wildlife movement near the PNP which is a notified sensitive area.

Critically Endangered, Endangered, and relevant subspecies were identified in the initial assessment as per the guidelines outlined in the IBAT Technical document, which are disseminated by various Wildlife, Forest, and Academic institutions. This assessment process involved scrutinizing whether these species were documented during surveys or if literature suggested their potential presence in proximity to the project site. Additionally, to ascertain the severity of their conservation status, information regarding their threat level was obtained from the primary data collection and most recent iteration of the global IUCN Red List.

5.2.1 Area of Analysis

Comparison with IUCN Red List Extent of Occurrence maps, site investigation information, and stakeholder consultation with forest/ wildlife department identified the potential of 1 Endangered species within 1 km project buffer/Area of Analysis.

A summary of Critical Habitat-Qualifying biodiversity Assessment in the Project area is shown in **Annexure VI**. A total of 38 species were screened as per the IBAT assessment report, Nepal red list which includes Reptiles 12 species, Birds 16 species and Mammals 10 species. Out of 38 species 2 species namely Asian elephant and Royal Bengal Tiger were reported near the project area. IBAT report is given as **Annexure VII**.

Apart from this prey animals for tiger, Sloth Bear, Striped Hyaena are also considered as they are Endangered in the Nepal red list. Barking Deer, Spotted Deer, Wild Boar, Nilgai & Gaur were also considered under Criterion (e) as these species are required as prey to support viable tiger populations, and therefore essential to maintain the ecological functions or characteristics that are needed to maintain the viability of the biodiversity values.

An attempt has been made to establish the status of the population at a global scale as per IUCN range distribution maps and local scale by site investigation studies, stake holder consultation with locals & forest/wildlife department. Movement of higher vertebrates is more evident for namely Asian elephant (*Elephas maximus*) and Royal Bengal Tiger (*Panthera tigris*). Species-level Critical Habitat-Assessment in the project road is shown in **Table 5-1** and a detailed assessment of all the species is given in **Annexure VI**.

Asiatic elephant (*Elephas maximus*): The Asian elephant is distributed across 13 range countries with a population of about 41,000 to 52,000 (Sukumar 2006; Williams et al. 2020). The number of Nepal's resident elephants is estimated in 227 individuals. Number of elephants known to be present near the project road ranges from 4-8 individuals, however during monsoon season it will be increase from 12-18 individuals. Therefore, the area can be considered as a refuge habitat of the Asian elephant. Nevertheless, prior precautionary measures will be taken to avoid any disturbance to the Asian elephant in the project area.

Tiger (*Panthera tigris*): The Tiger is a keystone species, crucial in maintaining the integrity of the ecosystems in which it thrives. Based on the most recent national estimates, the global Tiger population numbers between 3,726 and 5,578 individuals and is restricted to ten countries. Current surveys estimate a population of 235 tigers in Nepal (July 2022). With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. These locations were identified between the km 333+100 to 327+700, this section is outside the Parsa National Park.

Table 5-1: Species level Critical Habitat-Assessment in the project road

Biodiversity type (Species/ Site)	Critical Habitat criterion qualified ¹²					Justification
	(a)	(b)	(c)	(d)	(e)	
Asian Elephant	√	X	X	X	X	Number of elephants known to be present near the project road ranges from 4-8 individuals, however, during monsoon season it will increase from 12-18 individuals, which represents up to 8% of the national population. Therefore, the area is a refuge habitat of significant importance for Asian elephants. - From Km 130-100, it was noticed that the elephant movement is mostly seasonal during the larger trans-border migratory herds 12-18 individuals from the Chitwan National Park. - From Km 100-50, it was noticed that the elephant movement is mostly due to the Small and isolated populations of wild elephants' number ranging from 4-7 individuals. The assessment of critical habitat reveals the habitat within the project area has significant importance for the survival of Asian elephants in Nepal, and this species is therefore included as a critical habitat feature. Prior precautionary (avoidance) measures will be taken to avoid any disturbance to the Asian elephant in the project area.
Royal Bengal Tiger	√	X	X	X	X	With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. These locations were identified between the km 333+100 to 327+700, this section is outside the Parsa National Park. As per the site investigation, 8-10 sightings (pug marks) locations were identified near the different river crossings along the project road.

¹² √= likely attracting Criterion/ Criteria; x = not attracting Criterion/ Criteria; ? = possibly qualifies area as Critical Habitat. Based on available information.

						The assessment of critical habitat reveals Royal Bengal Tiger occur is several parts of the KDP route, representing more than 4 individuals and exceeds 1.7% of the national population. The habitat within the project area has significant importance for the survival of tigers in Nepal, and this species is therefore included as a critical habitat feature. Construction of the road could impact tigers through fragmentation or road kills, however these impacts can be addressed through provision of appropriate wildlife crossings.
Sloth Bear	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Vulnerable Sloth Bear preferring habitat of forest, savanna, shrubland, grassland, artificial/terrestrial, historical distribution includes a large portion of India, Bangladesh, and Sri Lanka, as well as the southern lowlands of Nepal and presumably Bhutan. No data available related to local and global population As per the IUCN range distribution map, Sloth bear is distributed near the project area. https://www.iucnredlist.org/species/13143/166519315 Hence the species is qualifying as a criterion (a) species. Therefore, it is identified that the project area is a critical habitat for the particular species and the habitat has significant importance for survival this species at the national level
Striped hyaena	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Near Threatened Striped hyaena preferring habitat of forest, savanna, shrublands, grasslands, wetlands (India). Species widely distributed from Africa, India, Himalayan foot hills and Nepal No data available related to local and global population As per the IUCN range distribution map, Striped hyaena is distributed near the project area. https://www.iucnredlist.org/species/10274/45195080 Hence the species is qualifying as a criterion (a) species. Therefore, it is identified that the project area is a critical habitat for the particular species.
Barking deer	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Barking deer preferring the habitats such as forest, savanna, shrubland, grassland, artificial/terrestrial. This species occurs in Sri Lanka, most of India, northern Pakistan, Nepal, Bhutan, Bangladesh and southern China No data available related to local and global population As per the IUCN range distribution map, Barking deer is distributed near the project area. https://www.iucnredlist.org/species/136551/22165292 https://doi.org/10.1111/csp2.12930 As the species supports tiger population in the Terai plains of Parsa National Park (Bhagawan Raj Dahal 1 Jan.2023). Hence the species is qualifying as a criterion (e) species. Therefore, it is identified that the project area is a critical habitat for the particular species and the habitat has significant importance for survival this species at the national level

Spotted deer	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Spotter deer preferring habitats such as forests, savannas, grasslands. No data available related to local and global population As per the IUCN range distribution map, Spotted deer is distributed near the project area. https://www.iucnredlist.org/species/41783/22158006 https://doi.org/10.1111/csp2.12930 As the species supports tiger population in the Terai plains of Parsa National Park (Bhagawan Raj Dahal 1 Jan.2023). Hence the species is qualifying as a criterion (e) species. Therefore, it is identified that the project area is a critical habitat for the particular species and the habitat has significant importance for survival this species at the national level
Wild boar	X	X	X	X	√	National Red List: Least Concern IUCN Red List Category: Least Concern Wild boar preferring the habitats such as forest, savanna, shrubland, grassland, wetlands (inland), desert. No data available related to local and global population As per the IUCN range distribution map, Wild boar is distributed in the project area. https://www.iucnredlist.org/species/41775/44141833 https://doi.org/10.1111/csp2.12930 As the species supports tiger population in the Terai plains of Parsa National Park (Bhagawan Raj Dahal 1 Jan.2023). Hence the species is qualifying as a criterion (e) species. Therefore, it is identified that the project area is a critical habitat for the particular species and the habitat has significant importance for survival this species at the national level
Nilgai	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Nilgai preferring the habitats such as forest, savanna, shrubland, grassland. Distributed in India and in the lowland zone of Nepal No data available related to local and global population As per the IUCN range distribution map, Nilgai is distributed in the project area. https://www.iucnredlist.org/species/2893/115064758 https://doi.org/10.1111/csp2.12930 As the species supports tiger population in the Terai plains of Parsa National Park (Bhagawan Raj Dahal 1 Jan.2023). Hence the species is qualifying as a criterion (e) species. Therefore, it is identified that the project area is a critical habitat for the particular species.
Gaur	√	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Vulnerable Gaur preferring the habitats such as forest, savanna, shrubland, grassland. Distributed throughout mainland south and southeast Asia and Sri Lanka No data available related to local and global population As per the IUCN range distribution map, Gaur is distributed in the project area. https://www.iucnredlist.org/species/2891/46363646 https://doi.org/10.1111/csp2.12930

						As the species supports tiger population in the Terai plains of Parsa National Park (Bhagawan Raj Dahal, 1 Jan. 2023). Hence the species is qualifying as a criterion (e) species. Therefore, it is identified that the project area is a critical habitat for the particular species and the habitat has significant importance for survival of this species at the national level
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Criterion as per ESS6:

Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches.

(b) Habitat of significant importance to endemic or restricted-range species.

(c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species.

(d) Highly threatened or unique ecosystems.

(e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

5.3 Impact on Wildlife movement

Some parts of PNP and adjoining forest outside the PNP represent the prime habitat of wild elephants. Elephants ranging in the central region of Nepal, mainly in Parsa, Bara and Rautahat, are residential. These elephants frequently visit to agriculture land and settlements causing significant intervention with agriculture and property; and cases of human attacks are also frequently reported (DNPWC 2008). Residential elephant herds are typically small in size (5-15 individuals per location) whereas larger trans-border migratory herds in the eastern Nepal have larger numbers (20-100 individuals per location) (Yadav 2004; Pradhan et. al. 2007, Shrestha 2007).

The movement of wild elephants (crossing the highway) is very frequent in the section along the PNP due to its connectivity to the PNP. The movement of elephants and other animals is significantly hindered due to increased frequency of high-speed vehicles. Due to elevated surface of the highway (2-5 m from the surface), elephants most of the time do prefer to cross highway through causeways. The larger herds cross the road from elevated normal road, if they do not find causeways on the way.

- From Ch 347+400 to 366+400 it was noticed that the elephant movement is mostly seasonal during the larger trans-border migratory herds from the Chitwan National.
- From Ch 272+00 to 243+500, it was noticed that the elephant movement is mostly due to the Small and isolated populations of wild elephants' number ranging from 4-7 individuals.

Information was collected on critical points for wildlife crossing by means of data collected from site visit survey, consultation with wildlife division Parsa National Park and published reports by World Bank¹³.

Table 5-2: Critical Points of Animal Crossings and Significance Noticed

S. No.	Critical Points of Animal Crossing	Significance
1	Dudhaura River Bridge Ch 363+600	During the primary survey wildlife movement of Elephant (Seasonal) of two numbers, one movement of Tiger and other 15- 17 individuals of ungulate (sambar deer, spotted) movement was noticed 500m from the bridge. This bridge can be proposed to develop as an underpass with wildlife friendly and climate resilient crossings.
2	Balganga River Bridge Ch 360+800	Wildlife movement of Elephant (Seasonal) of more than two were sighted, Tiger and other Ungulate movement was noticed using this river for movement from Parsa National Park to nearby community reserves. This can be proposed to

¹³ Study on Mapping of Elephant Corridor Across Fast Track Alignment April 2015. The World Bank

S. No.	Critical Points of Animal Crossing	Significance
		develop underpass with animal friendly with climate resilient wildlife crossings.
3	Pashah River Bridge Ch 357+070	Wildlife movement of Elephant (Seasonal) of single siting, Tiger with two numbers of cubs and other Ungulate movement was noticed using this river for movement from Parsa National Park to nearby community reserves. This can be proposed to develop underpass with animal friendly climate resilient wildlife crossings.
4	Bakaiya River Bridge Ch 347+200	Wildlife movement of Elephant (Seasonal) of two individuals, Tiger and other Ungulate movement was noticed using this river for movement from Parsa National Park to nearby community forests. This can be proposed to develop underpass with animal friendly climate resilient wildlife crossings.
5	Dhansar River Bridge Ch 339+300	Wildlife movement of Elephant (Regular)- two individuals with calf, Tiger and other Ungulate movement was noticed using this river for movement nearby community reserves. This can be proposed to develop underpass with animal friendly climate resilient wildlife crossings.

Source: Primary survey findings, World bank report: Study on Mapping of Elephant Corridor Across Fast Track Alignment.

5.3.1 Impact to Parsa National Park

In KDP section, around 14 km alignment borders the southern part of the Parsa National Park boundary with community and collaborative forests on the other side of the road. The road upgrading will not impact PNP directly. The Parsa National Park has recorded presence of endangered species, Asian elephants (*Elephas maximus*) and Royal Bengal tiger (*Panthera tigris*). Currently there is no dedicated wildlife crossing in this section. Two existing bridges allow for elephant passage. As discussed above elephants and other wildlife cross the road mostly via causeway. In designing the road upgrading, three wildlife crossings/corridors (including the two bridges which will be upgraded with guiding fences, noise barriers) have been included. Five more elephant crossings are proposed in KDP section where the community forest, collaborative forest and government managed forest area exist. These identified wildlife crossings will be installed with wildlife passes to ensure wildlife movement and transboundary migration is not impeded and to also avoid wildlife road kills.

5.3.2 Habitat Loss and Degradation

Road expansion result in changes in the habitat structure and value of the land within the RoW. The parts of the forests within RoW will be changed into pavements and the travel lanes. This expansion involves clearing vegetation, altering land use patterns, may impact ecosystems adjacent to the RoW. While the RoW specifies the land directly needed for the road construction itself, activities associated with road development were planned within the formation width. A total of 28,120 trees were enumerated within ROW are likely to be affected due to proposed widening and improvement for all the project road. No forest land/vegetation is involved beyond the RoW.

Vegetation loss within the existing RoW, may disrupt ecosystem services. Especially when large trees are cleared, hindering wildlife movement. While mitigation efforts like afforestation, wildlife crossings and canopy bridges will alleviate some of these impacts, the loss of vegetation remains a major concern, necessitating careful avenue plantation will be adopted with native species. As a compensatory measure for the loss of trees due to the project, plantation (afforestation) in a 1:10 ratio (planting of 10 new trees per one tree lost) will be carried out.

5.3.3 Reduced Habitat Connectivity

The major biological impacts from increasing road networks and their expansion are associated with loss of habitats, disruption of landscape processes through fragmentation, barriers to wildlife movements and loss of biodiversity, both for flora and fauna.

The highway existing average daily traffic (ADT) at Chapur-Nijgadh section is 14,828 and at Nijgadh-Pathlaiya section is 8,470. Due to widening of the existing road, projected traffic for the year 2046 at Chapur-Nijgadh section is 70,591 and at Nijgadh-Pathlaiya section is 36,970. Due to the widening, traffic movement will increase and will increase risk of collision of wildlife while crossing in the absence of appropriate wildlife underpasses.

5.3.4 Impact on Road User Safety due to Wildlife Movement at Night Time

Crashes between motor vehicles and large animals such as Elephants, Tigers may cause human deaths, injuries, and property damages. Human casualties contribute overwhelmingly to overall damages from wildlife interactions. The dominance of the cost of human casualties rationalizes the innate fear and respect towards large charismatic species displayed by those living with wildlife.

In case of absence of proper wildlife underpasses, guiding fences, lighting near conflict areas may cause accidents by hitting the wildlife passing the road during night time. Elephants on the road, particularly at night when they are difficult to see, present a significant safety risk to road users. Tigers injured in road accidents are more likely to prey on livestock and become man-eaters, which is also a safety risk.

5.4 Human-Wildlife Conflict

Existing situation:

Regardless of the specific present road expansion activity, Human-elephant conflict between Pathlaiya (27°11'46.74"N, 84°59'11.56"E), Piluwa (27° 9'38.44"N 85° 3'40.66"E), Dudhara (27°11'17.20"N 85° 0'40.45"E) Gumba (27° 8'46.28"N 85° 7'54.30"E) and Nijgadh (27°11'3.25"N 85°10'21.56"E), mostly in south of the highway is severe. Residential and migratory elephants from PNP migrate towards the east in Bara and Rautahat and destroy crops massively. Herds of elephants cross Bagmati river and travel to Sarlahi district to raid crops.

Crossing of the highway during the rice and maize harvest time is very frequent and crossing takes place mainly on evening to late night creating terror among the local people. They feed and trample standing crops, raid stored grains, damage infrastructures including wooden houses and also attack people.

Human-elephant conflict has increased in recent years mainly due to small space for these megafauna, degradation of available habitats and also due the increase in the elephant numbers. As reported by local people, there were no records of human casualties due to tiger or elephant attacks. However, at CH 351+0 km, Kakadi village (27° 8'16.12"N, 85° 7'55.86"E) which is 2.5 km from project road, one or two instances of tiger attack on livestock is reported.

Impact Due to the present road upgradation:

Road expansion initiatives often escalate conflicts between humans and wildlife due to influx of people during the construction period, the movement of construction vehicles.

During road construction, usual routes of elephants may be disrupted, leading to potential conflicts and safety hazards. Elephants often follow specific paths or foraging routes, and road construction can obstruct or alter these paths, causing displacement and agitation among the animals and nearby villages. This disruption may result in elephants wandering into nearby human settlements more frequently than earlier or more frequent road crossings, increasing the risk of accidents and property damage.

Human-wildlife conflicts present a chance to implement net gain measures, which benefit both communities and wildlife. These measures involve actions such as habitat restoration to reconnect

degraded forest lands, integrating wildlife-friendly infrastructure such as guiding fences, barriers and engaging local communities/wildlife department in conservation efforts. By implementing these strategies, we can mitigate conflicts, ensuring the safety of both humans and elephants.

5.5 Sound & Light Barriers

Artificial light, especially at night, can change animal's perception of resources, foraging, mate selection, and navigation and have cascading ecological and biodiversity impacts. Traffic noise can affect a wide range of birds, herpetofauna, and mammals. Human-sourced noise can affect wildlife communication, habitat occupancy, vigilance, predation efficiency predator avoidance behavior and various other types of behavior. These effects vary among wildlife species, leading to differential responses within wildlife communities, which could affect trophic and other interactions.

Current situation: With the present two-lane traffic, no adverse impact on wildlife movement due to noise generation is observed. During the primary survey reproductive behavior of Tiger is noticed 300 m from the chainage 361+003 Balganga bridge, which implies no major impact on reproduction behavior due to noise generated by existing traffic.

Situation due to upgradation:

Increased noise from road due to upgradation from two-lane to four lane increase the speed of vehicle movement generate more noise than the baseline condition will poses significant risks near the Parsa National Park and elephant crossing locations. This can disturb wildlife movement, causing stress, and disrupting natural behaviors. Moreover, the heightened noise near roads raises the risk of accidents, by startling animals near roads threatening both wildlife movement and accidents.

Based on the noise modelling, the noise level at wildlife crossing locations exceeds the prescribed noise standards as shown in the **Table 5-3**. Day-Nighttime (LDN) incremental noise level along KDP entire corridor at 15 m, 30m, 50 m, 100 m &150m for the year 2026 is shown in **Figure 5-1**. To protect from any adverse impact due to noise where noise level exceeds the noise standard it is recommended to installing noise barrier along highway at specific locations.

To mitigate these impacts, implementing sound barriers, restricting noisy activities during sensitive times, and are vital steps to minimize disruptions to wildlife and their habitats.

Table 5-3: Predicted day (LD), night (LN) & day-night (LDN) at wildlife crossing sections

Section	L _D Predicted dB(A)	L _N Predicted dB(A)	L _{DN} Predicted dB(A)
Bardibas-Nawalpur	66.9	67.5	70.2
Nawalpur-Chapur	67.1	67.6	70.4
Chapur-Nijgadh	67.2	67.7	70.5
Nijgadh-Pathlaiaya	69.3	69.8	72.6

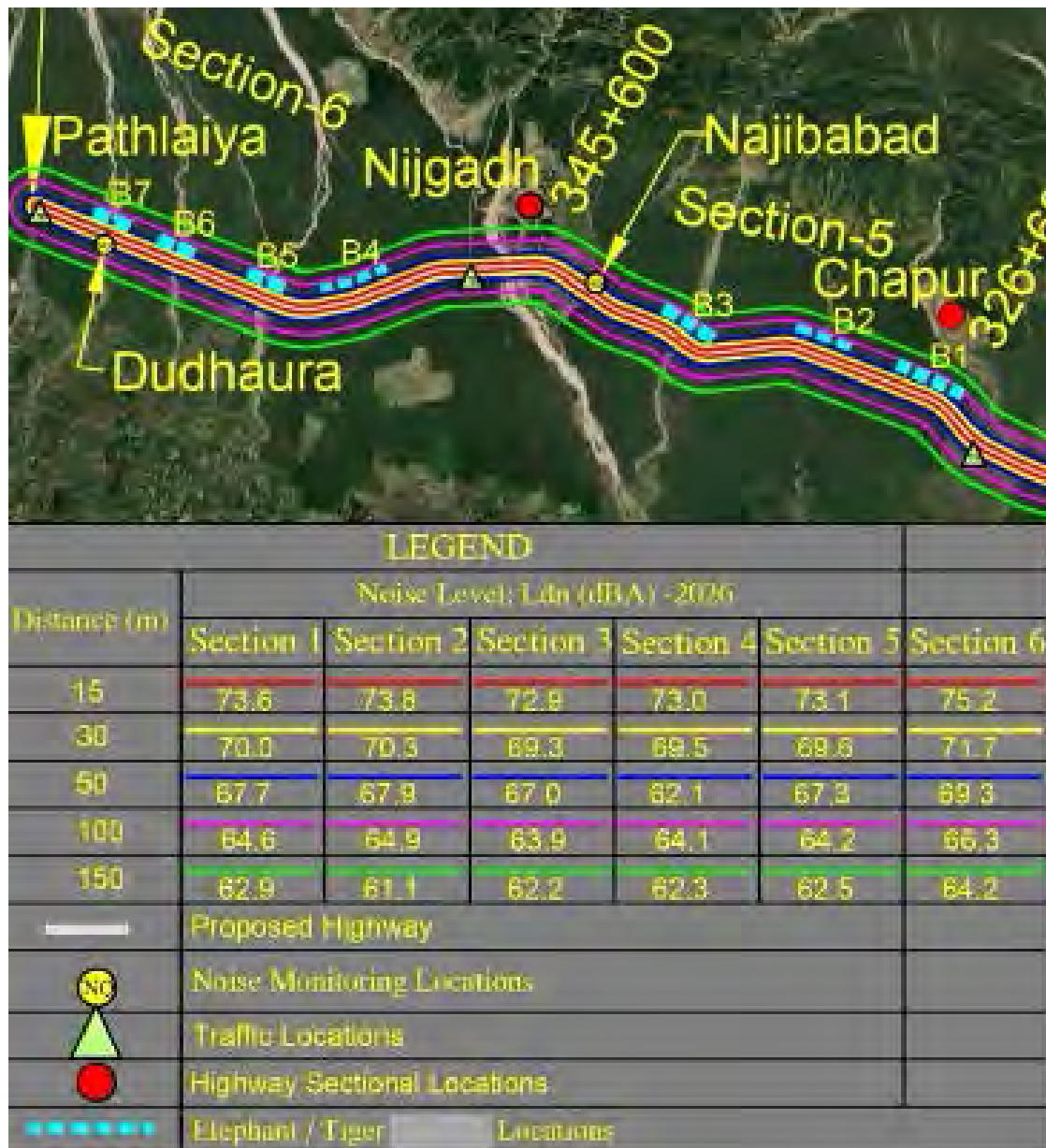


Figure 5-1: Day-Nighttime (LDN) incremental noise level along KDP entire corridor at 15 m, 30m, 50 m, 100 m & 150m: 2026

6. Mitigation Measures

6.1 Underpasses/Bridge Height for Elephant Crossing

The Asian Wild Elephant's height ranges from 2.45 to 2.75 m at the shoulder and weights from 3 to 4 tons. The following recommendations on the height of the bridge for elephant crossings are developed based on guidelines by different agencies and cases (Annex studies as referred to in **Annexure VIII**).

6.1.1 Suggestions on Minimum Recommended Dimension for Elephant Crossings for KDP Road

In KDP road, a total of 8 bridges were proposed to serve a dual purpose of drainage and wildlife crossings. Asian elephants require the highest vertical clearance and crossings that are designed to accommodate elephants will be suitable for a variety of smaller wildlife species. List of bridges proposed to additionally serve as elephant crossing are given in the **Table 6-1** and **Figure 6-2**.

Table 6-1: List of Bridges/Under Passes Proposed for Elephant Crossings

SN	Chainage (Center of Bridge)	Bridge Name	Existing Bridge		Proposed Structure			LBL (m)	HFL ¹⁴ (m)
			Total Length (m)	Span Length (m)	Total Length (m)	No of Span	Vertical Clearance (m)		
1	329+666	Amu - 1	34.02	3*11.34	25	1	6.5	139.97	140.79
2	333+842	Lamaha	66	2*33	66	2	7.5	134.21	137.82
3	339+381	Dhansar	164	8*20.5	164	4	6.5	145.3	147.35
4	347+272	Bakaiya	355.2	16*22.2	330	3	6.9	148.84	153.22
5	353+612	Terhakilo	45.6	4*11.4	41	1	6.5	146.48	149.12
6	357+337	Pasaha	165	5*33	165	5	6.5	139.2	141.63
7	361+003	Balganga	67.08	3*22.36	66	3	6.5	147.55	149.53
8	363+687	Dudhaura	90.493	2*45.2465	Bridge under Construction more than 6.5m vertical clearance				

6.2 Openness Index

The openness of underpasses influences the amount of light that penetrates the interior and the corresponding view of the opposite side of the structure perceived by wildlife. The formula for openness index is calculated as per below formula:

$$\text{Openness ratio} = \frac{\text{height of the opening} \times \text{width of the structure}}{\text{length of the underpass}}$$

- An underpass constructed in Kenya, which was readily used by African elephants and has since received sustained elephant use (Weeks, 2015), has an openness index of 2.25.
- Arch underpasses (average openness index = 5.5) in southern Bhutan were readily used by Asian elephants soon after construction (Chogyel et al. 2017).
- In India the recommended underpass openness index is 2.0¹⁰
- Minimum width of the underpass required for elephants is 5.5m (ADB)⁹

In the present proposed underpasses openness index ranges from 5.30 to 21.08 which exhibits a high degree of openness for the target species as shown in **Table 6-2**.

¹⁴ HFL: High Flood Level

Table 6-2: Openness Index of Bridges proposed as Underpass for Elephants

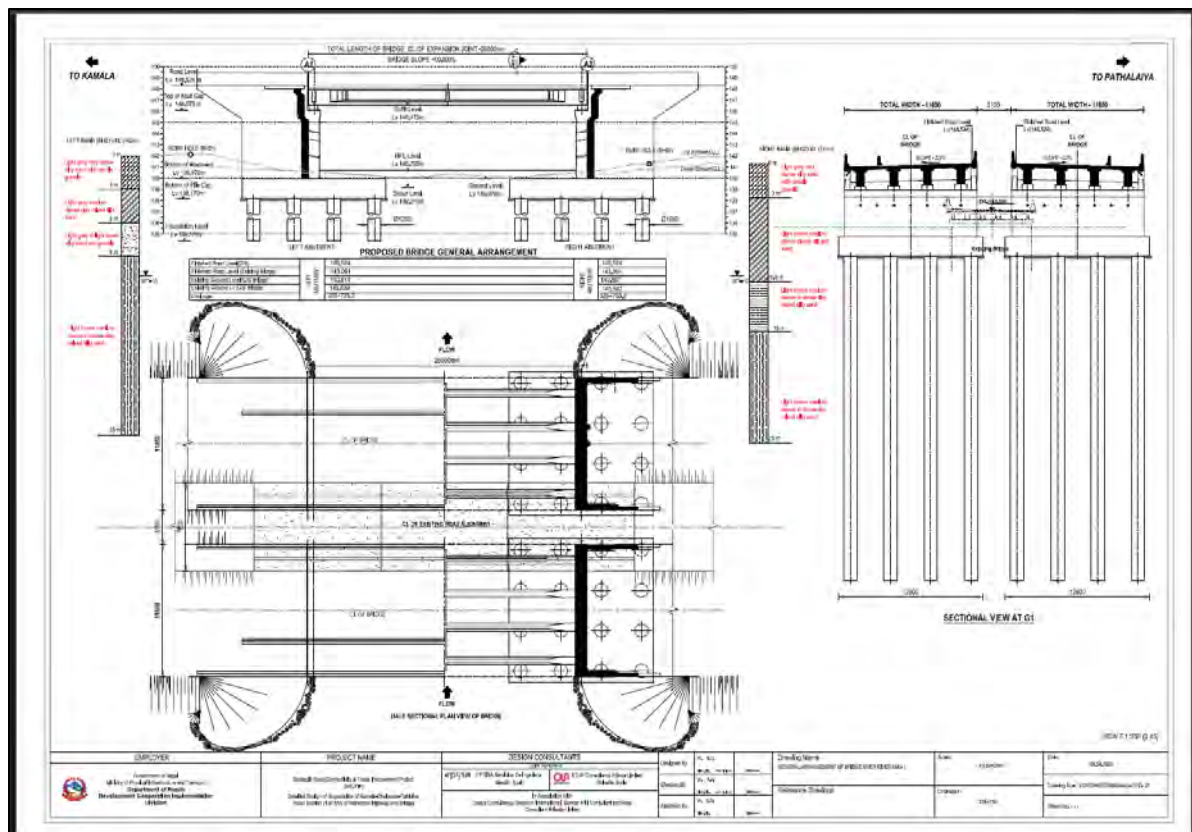
SN	Bridge Name	Chainage (Center of Bridge)	Existing				Proposed				
			Span Length (m)	Total Length (m)	Vertical Clearance (m)	Openness Index	Span (m)	Length (m)	Total Length (m)	Vertical Clearance (m)	Openness Index
1	Amu - 1	329+666	3*11.34	34.02	2.5	2.84	25	25	25	6.5	6.02
	Lamaha	333+842	2*33	66	7.5	24.75	2*33	66	66	7.5	9.17
3	Dhansar	339+381	8*20.5	164	6.5	13.33	4*41	164	164	6.5	9.87
4	Bakaiya	347+272	16*22.2	355.2	7	15.54	82.5+165+82.5	330	330	6.9	21.08
5	Terhakilo	353+612	4*11.4	45.6	1.1	1.25	41	41	41	6.5	9.87
6	Pasaha	357+337	5*33	165	6.5	21.45	5*33	165	165	6.5	7.94
7	Balganga	361+003	3*22.36	67.08	6.5	14.53	3*22	66	66	6.5	5.30
8	Dudhaura	363+687	Bridge under Construction, more than 6.5 m vertical clearance								

Here,

Height= Vertical Clearance of Bridge

Width= Span of Bridge (from abutment)

Length= width of bridge = 27 m in rural/forest section

**Figure 6-1: Sample Design of the proposed bridges (Amu 1)**

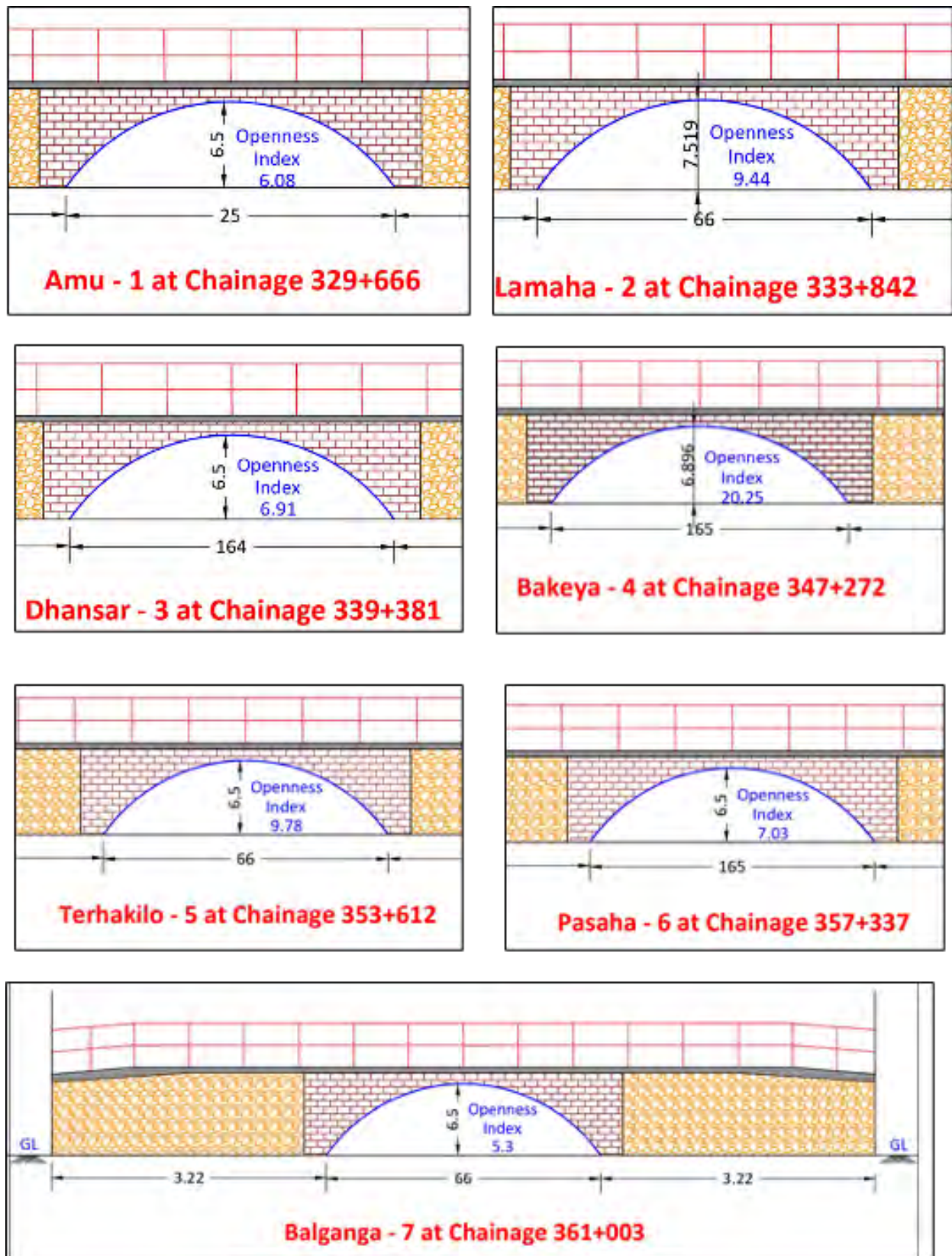


Figure 6-2: Length (m), Vertical Clearance (m) and Openness index of bridges proposed as Underpass for Elephants

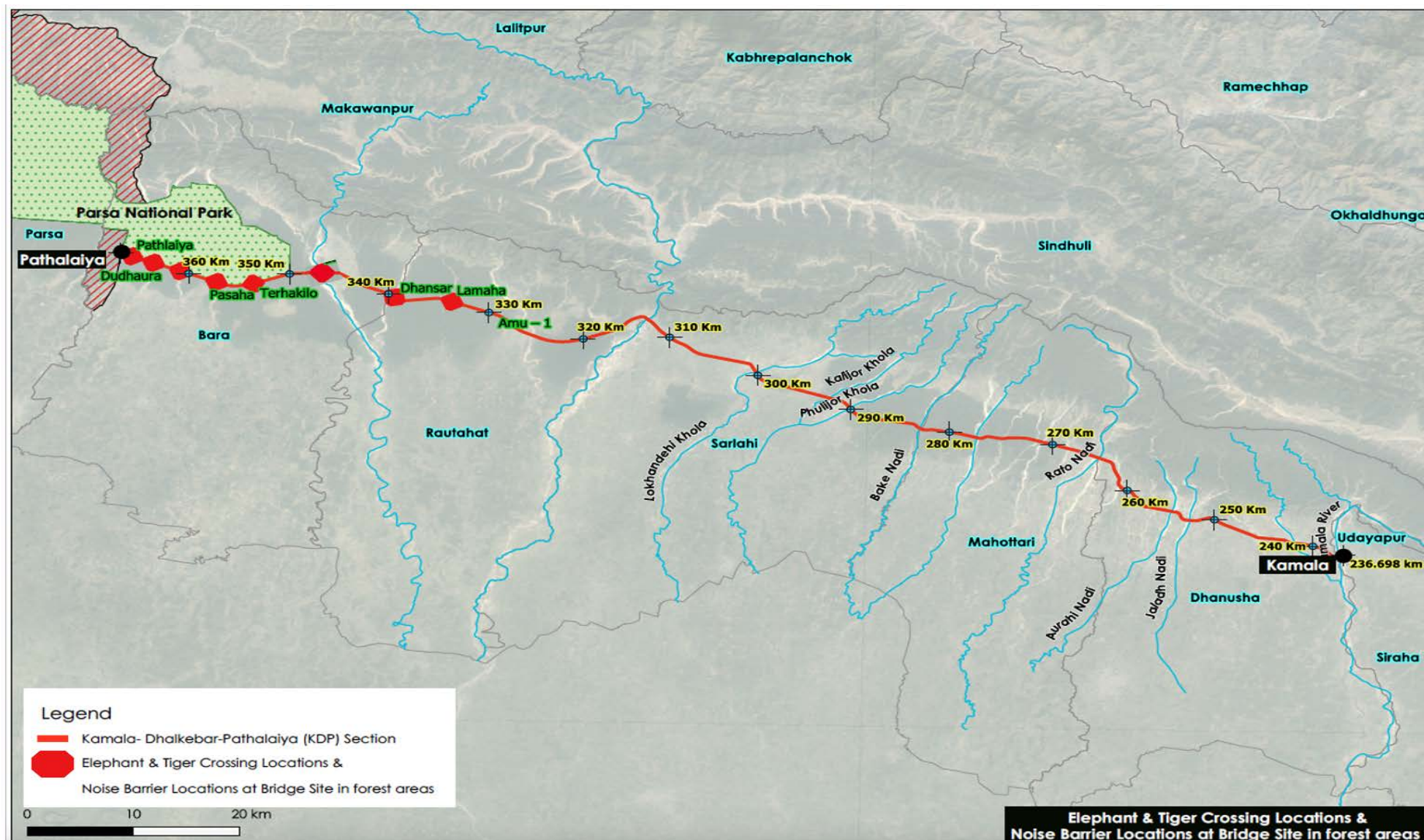


Figure 6-3: Map Showing Larger Wildlife Crossings Suggested.

Suggestion for Underpass Height: After observing the height of the underpass proposed by different agencies in different countries it is recommended that the minimum height of bridges for elephant crossing is **6.5 m**. Following are the justification points for recommending a minimum 6.5 m height bridge on KDP road.

- Asian Wild Elephant's maximum height was 2.75 m, double the height of elephant space is available for elephant crossing.
- Most of the agencies/countries are recommending a minimum height of 6.5 m including in Nepal
- Recently ADB has approved Upgrading Kakarbhitta-Laukahi Road (120KM) in Jhapa District was also recommending a minimum height of 6.5 m.
- WII, India recommended a minimum height of 6 to 8 m subjected to site-specific conditions.
- In the present proposal instances were recorded of elephants using the bridges above the height of 6.5 m
- Moreover, in the present proposal out of the 8 bridges proposed for elephant crossings, 5 bridges are already above the vertical clearance height of 6.5 m which means only 3 existing bridges are to be completely dismantled and reconstructed above of the height of 6.5 m
- If the minimum height of the bridge was increased above 7 m, all the 7 existing bridges are to be dismantled and reconstructed again which would not be an economically feasible and environmentally friendly option.
- Apart from providing a bridge height of 6.5 m, other best practices such as providing Noise barriers, Light barriers, guiding fences, annual maintenance of river depth, and other improvement proposals required to facilitate wildlife to walk along the banks and avoid crossing through the road will be proposed.

6.3 Elephant and Medium animal guiding fences

The solar fence was relatively better than the trench and reduced the severity of the HEC instances. Likewise, in a study on the effectiveness of fences in Kenya, Kioko et al. (2008) suggested that the success of electric fences, or any physical barriers, should be based on on-site or region specificity, maintenance intervals, and proximity measures to highly dense elephant presence areas. Solar fence will direct the elephants to cross the road through the proposed elephant underpasses. same has been recommended by the Conservation officer of PNP. A recommended minimum height of cables and horizontal railings for adult elephants is 8 ft (2.4 m) shall be maintained. Fence shall have a single electrified wire, 9000 V, with electrified braces and 'whiskers' placing the poles out of reach of trunks¹⁵. Fences used for elephants usually carry a voltage between 6,000 and 9,000 volts and a current of about 5 milliamperes. Touching an electric fence gives a powerful electric shock, but there is no physical harm to a person or an animal from the current The World Bank 2020. An electric fence is only a way of scaring elephants: it is a psychological barrier, not a physical barrier. 8 guiding fences for elephant crossings solar electric fencing are considered for 7 bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura and 10 for medium size animal crossings near the bridges/culverts at CH 271+514 (Gadhanta), 274+925 (Belgachhi /DhungreKhola), 275+630 (Tuteswor-1), 277+266 (Maraha), 278+913 (Dholan), 282+758 (Bankhe), 285+721 (Amuwa), 292+703 (Kalinjor – 2), 317+698 (Paurahi), 322+553 (existing causeway). Technical specifications of the solar fence will be followed prepared by the reference world bank document <https://pubdocs.worldbank.org/en/640461601077146570/ELECTRIC-GUIDE-For-fence25Sept2020.pdf>.

Guiding fencing in forest area on both LHS and RHS in the forest areas are same as **Figure 6-3** and **Figure 6-4**.

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https://www.researchgate.net/publication/333643991_A_New_Type_of_Elephant_Fence_Permeable_for_People_and_Game_but_Not_for_Elephant

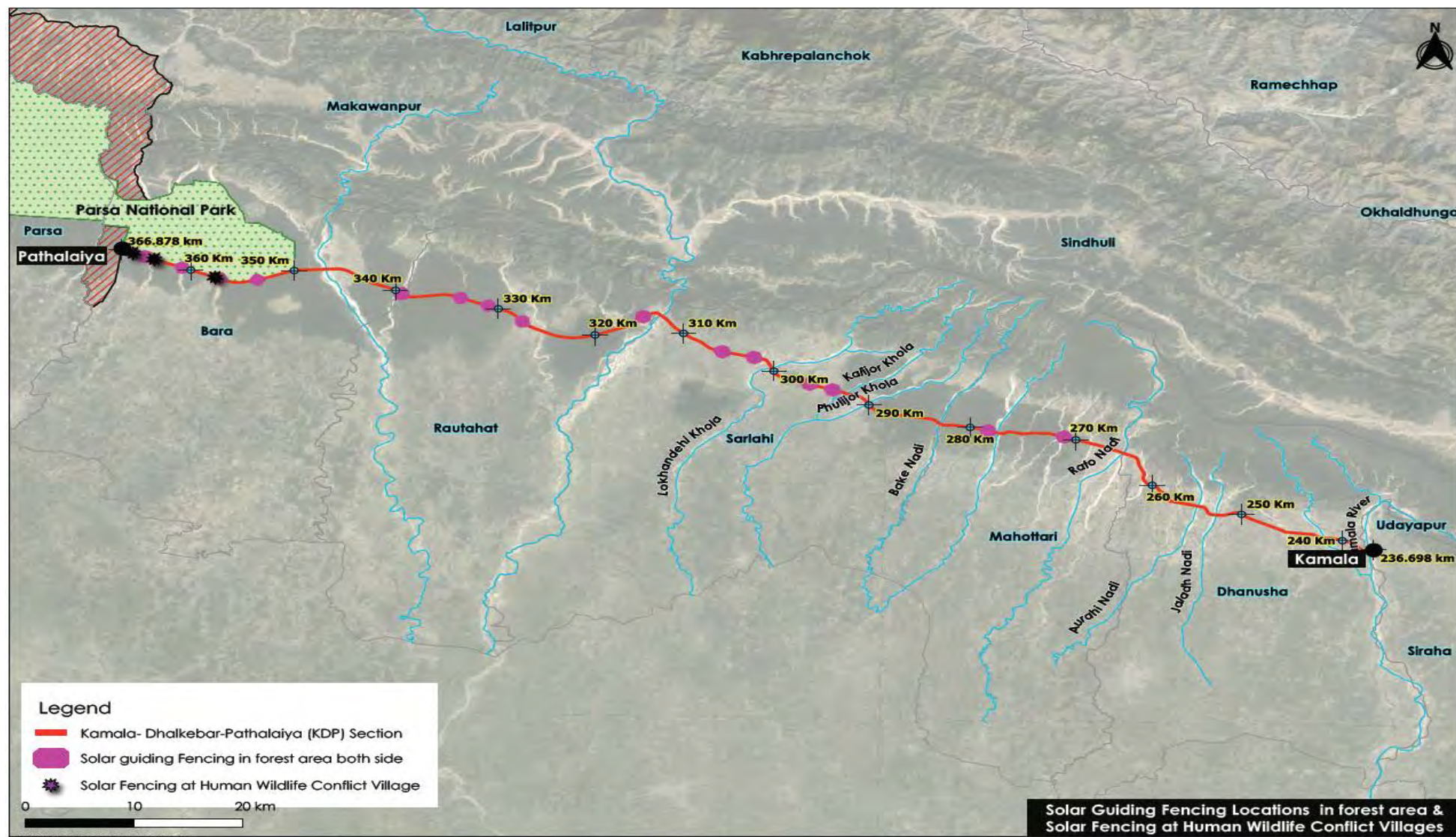


Figure 6-4: Locations of Guiding Electric Fencing (solar) near the Elephant and Medium Sized Animal Crossings



Figure 6-5: Solar Electric Fencing with Mesh Fence and Corner Supported by Jack Posts.

6.4 Physical barriers-elephant-proof trenches

Physical barriers, like solar fences combined with elephant-proof trenches, stone, or rubble walls, are installed as conflict mitigation interventions in Northeast India. Solar-fenced areas showed relatively lower encounter rates than areas with the trench, suggesting better efficiency of solar fencing than trench in the landscape¹⁶. Physical barriers are essential in managing Human Elephant Conflict (HEC) hence, installing and maintaining solar fences in the high conflict hotspots is crucial for this landscape.



(A) Solar fence in Agoratoli range of Kaziranga National Park, Northeast India.

(B) Elephant-proof trench in Bokial range of Nambor Doigurung Wildlife Sanctuary, Northeast India.

6.5 Modified Bridges and Culverts

Culverts and bridges can be modified for movement of wildlife. As most of the bridges narrow down the Right of Way to river course and the river depth and speed increases at the span of a bridge, it is necessary to provide shoulders on both sides under the bridge that facilitate animals to walk along the banks and avoid crossing through the road. But, if the wildlife habitat is on one side only, the passage may be provided to only one side of the culvert or bridge. The clear head under the shoulders of eight bridges will be (height of the underpass) minimum 6.5 m is for elephant crossings. Apart from these, 10 bridges/culverts are proposed for medium animal crossings with a minimum height of 4.0 m. The soil of the platforms or banks shall be above high seasonal water-mark and stabilized through natural means such as the bioengineering work. The platforms should be connected to the habitats with ramps of mild inclination (not more than 1:10). As most of the small mammals, amphibians, reptiles, and insects need vegetative cover for security,

¹⁶ Das G, Selvan K, Lahkar B and Gopi GV (2022) Effectiveness of physical barriers in mitigating human–elephant negative interactions in North-East India. *Front. Conserv. Sci.* 3:956568. doi: 10.3389/fcsc.2022.956568

bridges with under-crossings should extend to uplands beyond the scour zone of the stream, and should be high enough to allow enough light for vegetation to grow underneath. The modification will not reduce the culvert's or bridge's hydrologic capacity, structural safety or other functional aspects for which the culvert or the bridge is there.

6.5.1 Culverts near forest area

Wild animals particularly Porcupines, other rodents, reptiles such as snakes and monitor lizard and amphibians such as frogs pass under an intersecting roadway through a culvert. A culvert is a conduit covered with embankment around the entire perimeter. It may or may not convey water.

Additional features such as walkways or planks should be installed on the interior walls of the underpass, to encourage small and medium sized mammals to use culverts built on natural drainage sites.

Similarly guard rails or wooden planks may be installed to facilitate movement of small mammals and reptiles through the culverts as shown in **Figure 6-6** and list of culverts and its locations are given in **Annexure IX**.

Bridges and culverts across canals and streams within the main water way also facilitate fish movement. Conditions such as avoiding bridge piers or foundation within the main waterway channel to avoid the formation of large-scale turbulence or the erosion of the bed and banks of the waterways.



Figure 6-6: A Typical Underpass and Culvert near Reserve Forest Areas

6.6 Other Recommendations for Animal Movement

6.6.1 Rumble Strips

This forms the primary set of mitigation which keeps the vehicular speed in control and allows the driver to notice the crossing mammals or foraging birds and basking reptiles on the road. The locations of speed breakers/ rumble strips have been identified based on the survey findings and consultations held with forest officials and the list is given as **Annexure X**.

6.6.2 Roadside Reflectors and Mirrors

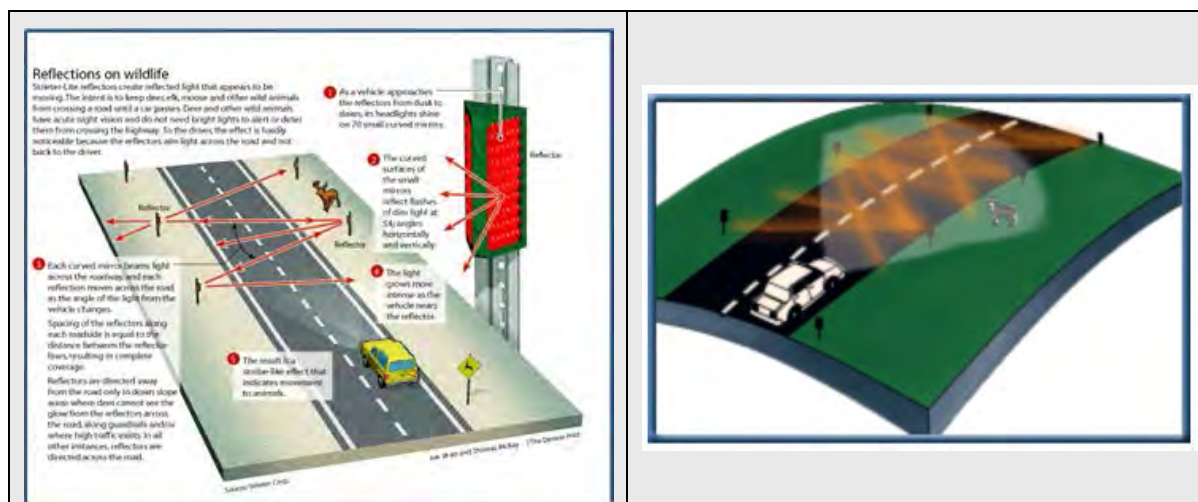


Figure 6-8: Roadside Reflectors and Mirrors

These are applied as potential wildlife vehicle crash countermeasures. These devices reflect the light from oncoming vehicle headlights and dispersed into adjacent roadside habitat areas or the road ahead and frighten, distract or alarm animals from crossing or coming on to the road. These are useful for ungulates, if any try to cross the road, rumble strips are required to be placed 50 m before and after forest area and shall reduce the vehicle speed to 40 kmph to avoid collision of vehicles and animals.

6.6.3 Signage

The sign boards (informatory cum cautionary) shall be placed 100 m before the speed breakers/rumble strip. This will inform the driver of potential animal crossings and increase effectiveness of speed breakers put ahead. These sign boards must include both information and cautionary note and signage indicating (i) the wildlife/forest area and animal crossing sections ahead (ii) maximum speed limit (30kmph) (iii) no honking (both day and night) and use of dipper at night since such a sudden change in illumination saturates their retinas temporarily blinding nocturnal animals and causing their abrupt movement. Information on key species conservation will also be included in the signage allocations.

6.6.4 Variable Message Sign (VMS)

Dynamic message sign can be used to display messages to drivers. The signs may be permanent, or can be changed or tailored to suit requirements of the drivers' or the road conditions or wildlife in the landscape.

6.6.5 Solar fencing as Human Wildlife Conflict Mitigation

Solar fencing offers a short-term solution for mitigating human-wildlife conflict, particularly with elephants, along the project road. By utilizing electrified wires powered by solar energy, it creates a barrier that deters elephants from encroaching onto roads or settlements. This technology provides a temporary yet effective measure to protect both humans and wildlife while infrastructure development progresses. Its quick deployment and adaptability make solar fencing a valuable tool in addressing immediate challenges posed by elephant movements during the construction period.

The implementation of the Solar Electric Fencing near 3 village Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS around the settlement is recommended. The electric fences are only effective at preventing crop raiding Banikoi et al. (2017). The other measures employed against wildlife damages is guarding near the villages prone in wildlife conflict. Guarding is most frequently practiced during nighttime during peak season of crop harvesting season from October to January. The locations of solar electric fences are shown in below **Figure 6-9**.



Figure 6-9: Solar Electric Fencing Locations

6.6.6 Bio-fencing:

Apart from the implementation of the Solar Electric Fencing near 3 problematic villages namely Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS. Biofencing is also suggested around the settlement as a long-term approach towards addressing the Human Wildlife Conflict near the project road. Bio-fencing is indeed a viable long-term approach to mitigating human-wildlife conflict near project roads or settlements which reserving ecological connectivity and promoting sustainable development.

Bio-fences are lines of trees or shrubs planted on the boundaries of farms or human settlements that provide protection against wildlife¹⁷ IUCN, World Bank Bangladesh 2016. For elephants, bio-fencing technique involves grow cane/rattan (with sharp spines on the stem) on human settlement boundaries to deter elephants from entering human habitations and crop fields. This technique is environment friendly, cost-

¹⁷ <https://portals.iucn.org/library/sites/library/files/documents/2016-068.pdf>

effective and more useful than fences made of wood, barbed wire, or stone masonry; and effectively prevents elephants from intruding into villages. To protect these bio-fences, such regular monitoring is essential and crucial. Cactus species such as *Cylindropuntia ramosissima*, Screw pine (Ketuki), thorny plant varieties and *Bambusa Vulgaris* (common bamboo)¹⁸.



6.6.7 Promoting Non-preferred Crop Cultivation

Under natural conditions, elephants mostly prefer plants, like paddy, grass, jackfruit, mango, and banana. Some unpalatable crops, for example chilly, citrus, bitter gourd, okra, taro and teasel gourd are considered as non-preferred crops for elephants as they do not like these crops because of their tastes. The positive impact of non-preferred crop cultivation needs to be extensively channeled through the Department of Agricultural Extension so that farmers of the human-elephant conflict areas can adopt this technique and reduce crop and economic losses.

Promoting the growth of non-preferred crops by elephants in and around the 3 villages namely Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS away from road projects can potentially decrease elephant movement near the road and human settlements.

By strategically planting vegetation that elephants find less appealing, can steer elephant herds away from high-risk zones. This approach leverages the elephants encourage them to stay in more suitable habitats, reducing the likelihood of conflicts with humans and infrastructure.

6.6.8 Installation of Arboreal Mammal Canopy Bridges

For arboreal and small animals, a canopy bridge (ropes or net) or other walkway will be provided. To facilitate the move from tree to tree. Its height will be at 7 m or more from the ground.

Where canopy integrity is disrupted by highway construction, it can affect arboreal mammal species that are often specialized in their use of forest habitats. Road impacts further add to impacts associated with agriculture, logging, and other activities (Soanes and van der Ree 2015). An array of wood pole bridge and the rope bridge designs¹⁹ is available to promote connectivity for arboreal mammals where canopy disruption is a concern. These designs range from simple ropes strung over highways, to more elaborate rope and cable bridges suspended above roads from poles or trees, to poles erected adjacent to roadways upon which gliding mammals can land (Soanes and Van der Ree 2015). These bridges are relatively inexpensive and thus provide a cost-effective means to help maintain forest canopy integrity and allow animals to cross highways without having to venture to the ground. Many taxa, ranging from arboreal primates to squirrels and martens, may benefit from canopy bridges. Canopy bridge locations and spacing

¹⁸ <https://timesofindia.indiatimes.com/city/dehradun/bio-fencing-to-keep-jumbos-away-from-tracks-in-terai/articleshow/97215878.cms>

¹⁹

https://www.researchgate.net/publication/359226608_Functionality_of_two_canopy_bridge_designs_successful_trials_for_the_endangered_black_lion_tamarin_and_other_arboreal_species

should be tied to the home range sizes and concentrated use areas for target species (Rajvanshi et al. 2001), as well as the degree of canopy integrity remaining in areas after road construction.



© Image for representation purpose only



Source: https://dor.gov.np/uploads/circular/circular_1505633979_65.pdf and https://dor.gov.np/uploads/circular/circular_1505633979_65.pdf

Figure 6-10: Typical Arboreal Mammals Canopy Bridge

Six canopy bridges are proposed in which four canopy bridges are proposed near the Parsa National Park covering 14 km stretch and other two are proposed near the associated reserve forest which are more than 30 km from the Parsa National Park. Installation of 6 Arboreal Mammal Canopy Bridges are suggested at CH:364+200, CH:357+500, CH:349+200, CH:340+900, CH:336+400, CH:330+700.

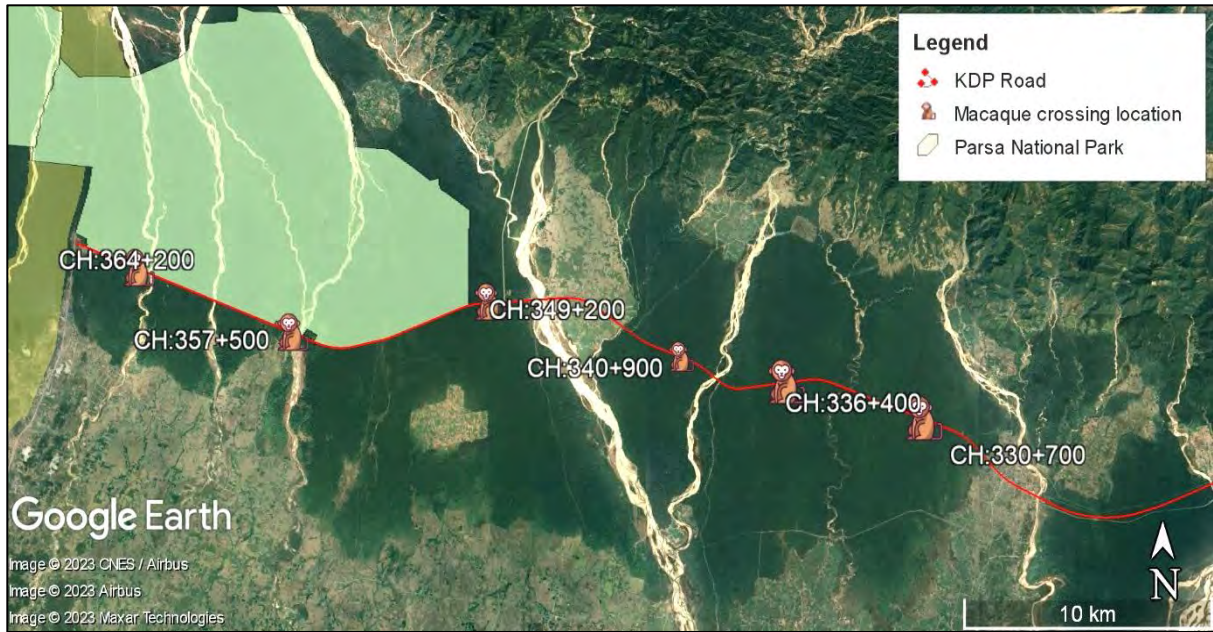


Figure 6-11: Location of Proposed Arboreal Mammal Canopy Bridges

Single rope bridges:

The single-rope and double-rope will be installed connected around the trunk using a branch as support to avoid any possible bridge slipping. If the trunk was too wide (e.g., *Ficus sp.*) or had multiple branches preventing a good bridge installation, the bridge was attached to a thick and healthy branch. Rope ends were wrapped around the trunk or branch a minimum of three times, and then secured with plastic zip ties. The number of plastic zip ties varied based on rope thickness (a minimum of 5 and a maximum of 12 zip ties). The zip ties were cut flush, and the ends of the rope burned with a lighter to avoid fraying. The ladder-bridge was connected to the main tree trunk utilizing a branch for support. Each zipline end (four in total) was wrapped a minimum of two times. The two ends were secured with two 3/4 or 1" metal clamps at the back of the trunk. An additional three metal clamps were used to keep the zipline together around the trunk. The distance between the last pipe of the bridge and the trunk was no larger than one meter.



Source: <https://doi.org/10.1163/14219980-20211109>

Figure 6-12: Single rope bridge and double rope bridge for arboreal animal crossing

10 rope bridges are proposed in which four canopy bridges are proposed near community forests at 351+225, 342+400, 327+900, 320+300, 316+050, 296+550, 293+000, 292+150, 283+100, 268+650.

6.6.9 Sound & Light Barriers

Noise affects different species to different degrees. Disturbance to wildlife movement when noise load exceeds 40 dBA, so it's sensible to design a wildlife crossing that has noise- and vibration-dampening characteristics. In the present project road, near forest areas Equivalent Noise Level Day was 50.38 dB, Equivalent Noise Level Night (LeqN) was 46.11 dB. So, it is required to propose sound and noise barriers near the forest areas particularly near the Parsa National Park.

Noise barriers are generally seen to be an effective means by which the propagation of noise can be mitigated. Capped barriers are barriers with a specially designed cap section at the top of the barrier. Its function is to reduce the potential of sound waves travelling over the top of the barrier. Acoustic screening of 2-m high T-shaped, multiple edge and double barriers compared with a simple plane reflecting barrier of identical height ranged from 1.4 to 3.6 dB(A)²⁰.

Use of innovate barrier designs such as a T-top barrier (with absorptive material placed on top of the horizontal portion) are recommended which has the potential to reduce barrier heights compared to conventional noise barriers (Watson, 2006).

T-top barriers as noise barriers can effectively reduce noise generation in areas adjacent to road/highways. These barriers, typically made of concrete or other sound-absorbing materials, feature a distinctive T-shaped design that helps to deflect and absorb sound waves emitted from vehicular traffic. By strategically placing T-top barriers along roadways, particularly in sensitive areas such as wildlife habitats, can significantly reduce the propagation of noise pollution.

T-top Noise barriers are proposed near the Dudhra River Bridge Ch 363+600, Balganga River Bridge Ch 360+800, Pashah River Bridge Ch 357+070, Bakaiya River Bridge Ch 347+200, Dhansar River Bridge Ch 339+300 where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves.

The total Length of Noise Barrier is total of bridge Length on RHS & LHS and 10 m on either side of the bridge. Noise barriers are recommended at Eight (08) bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura.



Source: Douglas Barrett, Sanchez Industrial Design, Inc.

Figure 6-13: Typical Noise Barrier near Protected Areas

²⁰ <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/noise-barrier>

Foliage:

Dense plantations along the road near the reserve/community forest areas with native species such as *Shorea robusta* (local name ‘sal’) are recommended in general and it shall be developed as specified in the 7.6.9 *Shorea robusta* Regeneration Program near elephant, medium animal crossings and culverts as referred in **Figure 6-7** to reduce the noise by 10 dB(A). Apart from this fast-growing species such as *Acacia catechu* (Khair), *Dalbergia sissoo* (sissoo), *Diospyros melanoxylon*, *Anogeissus latifolia* (bakli) would be ideal to create noise buffer using a wide range of trees species foliage shape and size. A combination of trees and shrubs will achieve the necessary attenuation of light and sound.

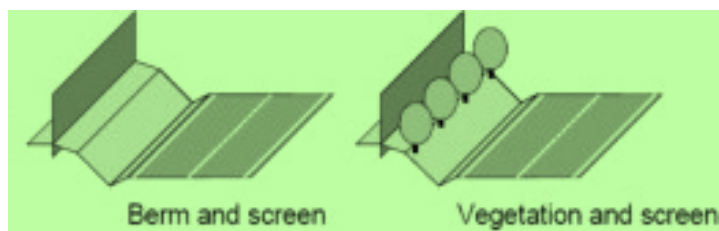


Figure 6-12: Typical Foliage Barrier

Noise and Light barriers are proposed, all along the under passes proposed for elephant crossings as mentioned in **Table 6-1** and dense plantation was proposed near box culverts proposed near protected areas and associated community forest blocks.

6.6.10 Management of Avifauna

Managing avifauna for road projects includes avoiding disruption during breeding seasons, and creating safe passageways to minimize the impact on bird populations. The following steps help protect bird life while allowing road development to proceed responsibly.

Table 6-3: Steps for protection of bird life

Issues	Impact	Mitigation Measures
Noise	Noise disrupts for intimidates shy species	Noise barriers asper section 6.6.7
Light	Migrants species difficult to navigate	Light barriers asper section 6.6.7 Use low wattage flat lens, low retroreflective elements
Walking birds	Non-flying birds incur mortality risk	Underpasses for wildlife crossings asper section 6.5.
Scavengers	Raptors are killed while foraging on road kills	Reduce road kills Remove roadkill from road
Frugivores	Fruiting median plants attracts birds across traffic	Planting non-fruiting varieties near the road
Habitat loss	Highway facilities	Proper land use planning
Lethal structures	Birds fly into associated structures,	Attach visibility markers Underground powerline/telephone lines

6.6.11 Wildlife Monitoring

Wildlife crossing structures (e.g., underpasses, box culverts), together with roadside dense plantation, are the most implemented mitigation tools used to reduce wildlife road mortalities and to restore or maintain population connectivity across roadways. Long-term population monitoring data, particularly before and after crossing construction, when paired with crossing structure interaction data, can be important to contextualize and evaluate crossing structure effectiveness. Long-term population monitoring dataset near the crossing structure to evaluate the effectiveness of wildlife crossing is proposed near the protected areas.

Camera Traps:

Camera traps provide data on species location, population sizes and how species are interacting. Camera traps were positioned 0.5 m to 1.0 m above the ground facing into or at an angle across the opening of structures. Eight camera trap locations were proposed near the elephant/tiger crossing locations near the CH 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves. Continuous recording shall be there for cameras and it shall be connected to PNP monitoring cell. Budget provisions were given for camera traps in the wildlife monitoring section of estimated budget for BMP.

6.6.12 *Shorea robusta* Plantation Program

Shorea robusta (local name ‘sal’) was dominated forests near the project road which have been subject to selection felling, encroachment, uncontrolled grazing and annual forest fires for the past 30–50 years, and the forest cover in Nepal has declined by about 1.3% per annum²¹. Selected area as discussed in the section 7.8 Prominent sites for plantation were identified by forest department for *Shorea robusta* regeneration program. These areas will be fenced and protected from fire and grazing. A control area will be fenced and protected in the same forest. Bushes and advanced growth will be cleaned from the harvested areas with only the smallest seedlings remaining (height less than 50 cm). The removal of *Lantana camara* and *Eupatorium odoratum* shall be in the treated areas 14 months after the felling. Permanent plots will be measured one growing season after the felling, and again 12 months later.

6.6.13 Set up a Rapid Response Wildlife Management Unit

Wildlife-road conflict has profound negative impacts on both wildlife populations and society. In crisis or emergency situations (e.g. forest fires, sudden increase in poaching, armed conflicts, oil spill, etc.), precious time is often important to act on the situation. A Rapid Response Unit (RRU) is proposed constituted with a staff of Parsa National Park, Wildlife Biologist, Environment Engineer to respond in the event of a emergency situations and take appropriate steps till the situations comes to normal. Regular patrolling is required to monitor the wildlife movement, frequency and to note change in routes by elephants and other mammals.

6.7 No Net loss/ Net gain approach

Attempt has been made ‘measures to avoid, minimize, or mitigate potentially adverse impacts and risks.’ Nonetheless, some residual impacts cannot be fully mitigated, and—on a precautionary basis—it is recognized that this Project may have some residual impacts of vegetation loss.

6.7.1 Wildlife Crossings

Mitigation measures such Underpasses/Bridge for Elephant Crossing, with a minimum height of bridge for elephant crossing is 6.5 m with adequate openness index ranges from 5.30 to 20.25 which exhibits a high degree of openness for the target species. Eight (08) bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura were proposed for elephant, tiger and ungulate crossings and ten (10) bridges/culverts at CH 271+514 (Gadhanta), 274+925 (Belgachhi /DhungreKhola), 275+630 (Tuteshwar-1), 277+266 (Maraha), 278+913 (Dholan), 282+758 (Bankhe), 285+721 (Amuwa), 292+703 (Kalinjor – 2), 317+698 (Paurahi), 322+553 (existing causeway) were proposed for medium size animal crossings like tiger and ungulates.

Currently, along the 130 km KDP road, there are no dedicated wildlife crossings. Currently, six existing bridges allow for the passage of elephants. Of these bridges, only 2 are located in the 14 km section along PNP. The future KDP road will include 8 wildlife crossings which allow for passage of elephants and 10 for the medium sized animals. All those wildlife crossings will meet sufficient vertical clearance and

²¹ <https://www.sciencedirect.com/science/article/abs/pii/S0378112796039114>

openness. Six canopy bridges are proposed in which four canopy bridges are proposed near the Parsa National Park and other two are proposed near the associated reserve forest which are more than 30 km from the Parsa National Park. Installation of 6 Arboreal Mammal Canopy Bridges are also suggested at the same location near CH:364+200, CH:357+500, CH:349+200, CH:340+900, CH:336+400, CH:330+700.

T-top Noise barriers are proposed near the Dudhra River Bridge Ch 363+600, Balganga River Bridge Ch 360+800, Pashah River Bridge Ch 357+070, Bakaiya River Bridge Ch 347+200, Dhansar River Bridge Ch 339+300 where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves. Total length of noise barrier is total of bridge Length on RHS & LHS and 10 m on either side of the bridge.

The implementation of the Solar Electric Fencing, Bio fencing near 3 village Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS present a chance to implement net gain measures, which benefit both communities and wildlife. By implementing these strategies, we can mitigate conflicts, ensuring the safety of both humans and elephants.

Apart from the implementation of the Solar Electric Fencing near 3 problematic village namely Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS. Bio fencing is also suggested around the settlement as a long-term approach towards addressing the Human Wildlife Conflict near the project road. Bio-fencing is indeed a viable long-term approach to mitigating human-wildlife conflict near project roads or settlements which reserving ecological connectivity and promoting sustainable development.

Other best practices such as providing annual maintenance of river depth other improvement proposals required to facilitate wildlife to walk along the banks and avoid crossing through the road are proposed. Camera traps were positioned 0.5 m to 1.0 m above the ground facing into or at an angle across the opening of structures. Eight camera trap locations were proposed near the elephant/tiger crossing locations near the CH 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura where significant movement of elephants and tigers are noticed between the Parsa National Park and associated community reserves. Continuous recording shall be there for cameras and it shall be connected to PNP monitoring cell. Budget provisions were given for camera traps in the wildlife monitoring section of estimated budget for BMP. Wildlife movement monitoring and setting up a Rapid Response Wildlife Management Unit is proposed during construction and operation phase with appropriate budget.

6.7.2 Compensatory Afforestation

As per the recommended compensatory afforestation rate for the removal of 28,120 trees within the RoW, total 2,81,200 trees will be planted in which a net gain of 2,53,050 trees will be achieved. The compensatory afforestation will require a total area of 290 ha. Net gain of 261 ha will be obtained through afforestation program. Compensatory afforestation plan is proposed with approximate budget of NPR 293.8 million (2.22 million US\$). As a preventive mitigation measure, all the trees in the ROW were not considered for tree cutting, only the trees listed in the formation width will be considered for tree felling. As a compensatory measure for the loss of trees due to the project, plantation (afforestation) in a 1:10 ratio (planting of 10 new trees per one tree lost) will be carried out as guided by the Directives of Use of National forest area for national-priority project, 2071 and 2074 and it has been stipulated in the EPR 2020. The project shall plant this compensatory afforestation on land provided by DFO and shall take care of the plantations for five years and then hand them over to DFO. Otherwise, Project will do Memorandum of Understanding (MoU) with DoF/DFO and all compensatory afforestation program will be done by DoF/DFO and maintain newly planted saplings for the following five years, to ensure minimum survivability of 70%, and to audit this survivability at least once a year.

Afforestation sites will be in the denuded or degraded forest areas near the project area, river side. The compensatory afforestation is proposed to be done mainly in those forest blocks where degraded land and

forest blanks are available for planting. List of potential sites for compensatory afforestation are given in the **Table 6-4**.

During the identification of sites for afforestation, priority will be given to planting in large, continuous habitat areas, with due consideration of areas that might enhance habitat for wildlife. The areas of animal corridors, feeding areas, and other important habitats were identified by the DoF/DFO and planned as high priority planting areas. The indigenous species recommended are *Shorea robusta*; *Mallotus philippensis*; *Anogeissus latifolia*; *Terminalia elliptica*; *Cleistocalyx operculata*; *Albizia odoratissima*; *Tectona grandis*; *Semecarpus anacardium*; *Bombax ceiba*; *Syzygium cumini*; *Senegalia catechu*; *Haldina cordifolia*; *Terminalia bellirica*; *Terminalia chebula*; *Ficus auiculata* and *Butea monosperma*.

Source: https://dor.gov.np/uploads/circular/circular_1505633979_65.pdf

6.8 Prominent sites for plantation

Community Forests:

Community forestry (CF)²² is expressed as the “control and management of the forest resources by the rural people who use them for their domestic purposes and as an integral part of subsistence and peasant farming systems (Gilmour & Fisher, 1991). The Community forestry (CF) policy in Nepal can be traced back to 1976, when the government formulated the National Forest Plan, which recognized villagers' rights to collectively manage the forest on which their livelihoods depended (Chettri, Larsen, & Smith-hall, 2012). Despite the limited number of CF programs implemented in the Terai region (part of the project road), the CF-managed forests were found to have had better forest coverage than forests under state control (Nagendra, Pareeth, Sharma, Schweik, & Adhakari, 2008).

In Nepal, CF refers to swathes of national forest where tenure rights are given to local communities, called forest user groups (FUGs), for its development, conservation, and management to meet their local needs in a sustainable manner. Based on their own objectives and the condition of the forest, local communities manage the forest by designing and implementing operational plans with support from the Forestry Department (Ojha et al., 2010).

The suitable land required for compensatory afforestation has been identified near the degraded Community Forest areas abutting the project road. Beside these sites, eroded and flooded river banks along the road alignment can also be used for compensatory plantation supported with adequate river protection works. These areas have been identified through consultation with Division and sub-Division Forest offices and field observations. List of potential sites for compensatory afforestation are given in the **Table 6-4**.

Table 6-4: Potential sites for Compensatory Afforestation

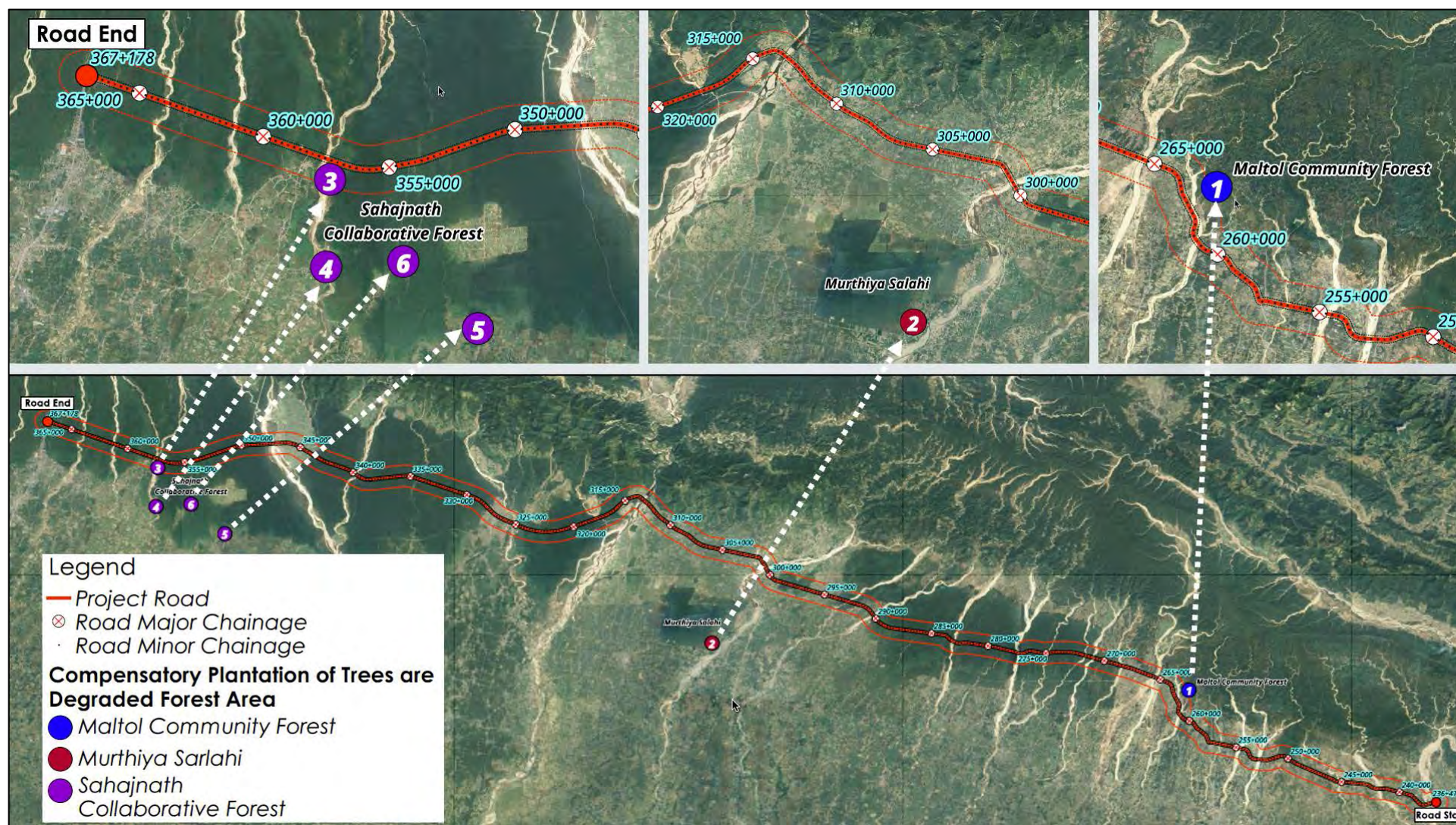
S.No.	Name	GPS Location
1.	Lalgadh Community Forest	26°58'23.55"N, 85°56'18.13"E
2.	Near Janakinagar	27° 0'45.46"N, 85°32'18.10"E
3.	Jaitapur Post plantation area 1	27° 9'36.33"N, 85° 4'24.75"E
4.	Jaitapur Post plantation area 2	27° 7'38.87"N, 85° 4'19.22"E
5.	Kakadi plantation area	27° 6'16.23"N, 85° 7'46.77"E
6.	Bodhwan Post plantation area	27° 7'46.16"N, 85° 6'4.73"E

Soil type near the selected potential sites for plantation include alluvial soil which is the dominant soil type near the project region, followed by clayey soils vary in fertility and texture. These are believed to be formed by the deposition of sediments carried by rivers, making it fertile and suitable for plantation. Location of the possible sites for compensatory afforestation is shown in **Figure 6-14**.

²² URL: <http://dx.doi.org/10.5539/enrr.v4n4p142>



Strengthen the tree plantation in CF degraded areas with minimum potential to incentivize local forest management, the forest near the project road will have positive impact on the local biodiversity in shaping overall motivation to contribute for collective forest management and biodiversity conservation. Tentative location of the possible sites for compensatory afforestation as per the consultations made with forest department is shown in **Figure 6-14**.



7. Achieving No Net Loss and progressing towards a Net Gain

Adoption/implementation of all the mitigation measures assessed and proposed under this BMP will ensure in achieving no net loss and progressing towards a net gain. For this project, wildlife movement and vegetation (trees) are key performance indicators (KPI) that can be affected due to road upgradation. At existing condition, there is two lane road under operation and there are no any dedicated wildlife crossings. Though upgradation of road from two lane to four lanes can impose higher impact to wild life movement, with 8 bridges modified as under passes for large size animals (e.g. elephants) and 10 bridges/culverts modified as under passes for medium sized animals (e.g. tigers and undulates), and other speed control measures like speed limitations and rumble strips, it is expected that upgraded road will facilitate the wildlife movement better than the existing scenario. In the case of vegetation also, though at earlier stage the impact due to loss of trees (cutting of trees while widening the road section) will be higher, the impact will be compensated and there will be more trees (no net loss, net gain) in the later stage through compensatory plantation in the ratio 1:10 and care for 5 years and other avenue tree plantation activities as proposed. Detail approach in achieving no net loss and progressing towards a net gain from this project is elaborated in following sections.

7.1 Identifying priority biodiversity values in the project

Identifying priority biodiversity values in the KDP road involved mapping critical habitats and compiling species inventories, with a focus on endangered or threatened species and those indicating ecosystem health. Unique habitats which are vital in ecosystems providers such as Parsa National Park, Community forests, rivers and riverbanks are prioritized to maintain habitat connectivity and consider local cultural values.

Stakeholder engagements were made involving consultation with local communities, NGOs, government agencies, and scientific experts. Their input helped in the development of prioritization criteria, ensuring ecological significance, conservation status, and community concerns are addressed to guide effective conservation strategies. The original Project Site and Landscape condition with Parsa National Park and wildlife presence on one side, community forest on the other side, rivers and nearby settlements is shown in **Figure 7.14**.

7.1.1 Species-specific Interventions and Establishment a baseline maps

Implementing species-specific interventions is crucial to mitigate the impacts on wildlife. Measures such as constructing wildlife crossings, installing fencing to guide animals away from roads, reducing speed limits, managing vegetation, and conducting monitoring finally to reduce the risk of collisions between wildlife and vehicles. By incorporating these interventions, road projects can promote safer transportation infrastructure while conserving biodiversity and preserving habitats for wildlife. Original project site and landscape with locations of forests, rivers, prime villages, wild life movement are shown in **Figure 7-1**.

7.1.2 Elephant and Tiger baseline maps

Elephant baseline maps were prepared by providing essential information about the distribution, and population densities of elephant populations near the KDP road. These maps are typically generated through Primary surveys that is field observations which were cross check with secondary range distribution maps. These elephant baseline maps are valuable tools for conservation planning, as they helped in identify priority areas near the protection, potential corridors for connectivity between populations, and areas where human-elephant conflicts are likely to occur. Additionally, they serve as a baseline for monitoring changes in elephant populations over time and evaluating the effectiveness of conservation interventions.

Number of elephants known to be present near the project road ranges from 4-8 individuals, however during monsoon season it will be increase from 12-18 individuals. Therefore, the area can be considered

as a refuge habitat of the Asian elephant. Elephant movement near the project road was shown in the **Section 3.8** and **Figure 3.8**.

As per the recent tiger census 2022, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. These locations were identified between the chainage 333+100 to 327+700, this section is outside the Parsa National Park where possibility of road crossing is evident. Tiger Movement near KDP road was showed in the section **3.9.1** and **Figure 3.12**.

7.2 Project intervention plans to map biodiversity data and apply the mitigation hierarchy.

Project site and landscape with application of the mitigation hierarchy covering avoidance, minimization and restoration actions is shown in **Figure 7.15**.

7.2.1 Step 1 - Avoidance

7.2.2 Speed Limit:

Speed limit of 40 km per hour is proposed near the 14 km stretch of Parsa National Park as suggested by the Chief Conservation Officer and other officials of Parsa National Park. The speed limit is proposed between the Chainage km 350+00 to km 366+420.

7.2.3 Step 2 – Minimization

7.2.4 Rumble Strips

Primary set of mitigation which keeps the vehicular speed in control and allows the driver to notice the crossing mammals or foraging birds and basking reptiles on the road. The locations of speed breakers/ rumble strips have been proposed near the prominent wild animal crossings identified based on the survey findings and consultations held with forest officials and the list is given as **Annexure X**.

7.2.5 Step 3- Mitigation

7.2.5.1 Installation of Arboreal Mammal Canopy Bridges

Six canopy bridges are proposed in which four canopy bridges are proposed near the Parsa National Park and other two are proposed near the associated reserve forest which are more than 30 km from the Parsa National Park. Installation of 6 Arboreal Mammal Canopy Bridges are also suggested at the same location near CH:364+200, CH:357+500, CH:349+200, CH:340+900, CH:336+400, CH:330+700.

7.2.5.2 Underpass for Elephant, Tiger and Ungulates

Eight (08) bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura were proposed for elephant, tiger and ungulate crossings and ten (102) bridges/culverts at CH 271+514 (Gadhanta), 274+925 (Belgachhi /DhungreKhola), 275+630 (Tuteshwor-1), 277+266 (Maraha), 278+913 (Dholan), 282+758 (Bankhe), 285+721 (Amuwa), 292+703 (Kalinjor – 2), 317+698 (Paurahi), 322+553 (existing causeway) were proposed for medium size animal crossings like tiger and ungulates.

7.2.5.3 Elephant and Medium animal guiding fences

An electric fence is a psychological barrier, not a physical barrier. 8 guiding fences for elephant crossings solar electric fencing are considered for 7 bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura and 10 for medium size animal crossings near the bridges/culverts at CH 271+514 (Gadhanta), 274+925 (Belgachhi /DhungreKhola), 275+630 (Tuteshwor-1), 277+266 (Maraha), 278+913 (Dholan), 282+758 (Bankhe), 285+721 (Amuwa), 292+703 (Kalinjor – 2), 317+698 (Paurahi), 322+553 (existing causeway). Guiding fencing in forest area on both LHS and RHS in the forest areas are same as **Figure 6-3** and **Figure 6-4**.

7.2.5.4 Human Wildlife Conflict Mitigation

The implementation of the Solar Electric Fencing near 3 village Pathlaiya (CH:365+700 to CH:366+800), Piluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS around the settlement is recommended. The electric fences are only effective at preventing crop raiding Banikoi et al. (2017).

7.2.5.5 Sound Barriers

Total Length of Noise Barrier is total of bridge Length on RHS & LHS and 10 m on either side of the bridge. Noise barriers are recommended at Eight (08) bridges namely 329+666 Amu – 1, 333+842 Lamaha, 339+381 Dhansar, 347+272 Bakaiya 353+612 Terhakilo, 357+337 Pasaha, 361+003 Balganga & 363+687 Dudhaura.

7.2.6 Step 4- Compensation

7.2.6.1 Compensatory Afforestation

The compensatory afforestation will require a total area of 319 ha. Net gain of 287 ha is obtained through afforestation program. Afforestation sites will be in the denuded or degraded forest areas near the project area, river side. Location of the possible sites for compensatory afforestation is shown in **Figure 6.13**.

The suitable land required for compensatory afforestation has been identified near the degraded Community Forest areas abutting the project road. Beside these sites, eroded and flooded river banks along the road alignment can also be used for compensatory plantation supported with adequate river protection works.

Overall, an offsets strategy in the project road is aimed to achieve a balance between the infrastructure development and the protection of the environment and communities affected by the project. It involves a combination of proactive planning by proposing underpasses, guiding fences, speed restrictions and development implementation of appropriate measures to minimize, offset negative impacts and Net gain of 261 ha additional forest area will be development through afforestation program.

Project site and landscape with application of the mitigation hierarchy is shown in **Figure 7-2**.



Figure 7-1: Original Project Site and Landscape

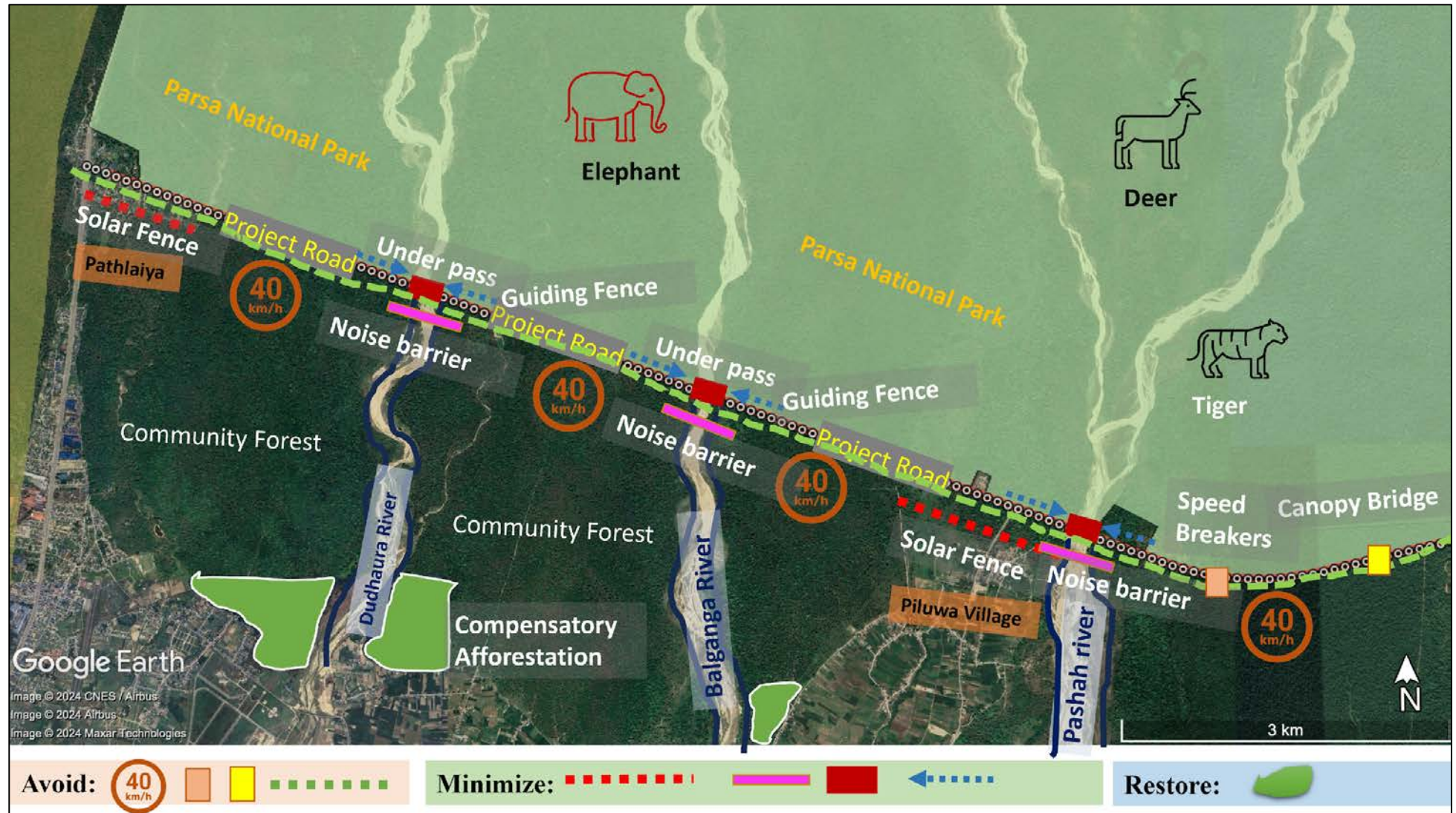


Figure 7-2: Project site and landscape with application of the mitigation hierarchy.

8. Institutional Framework & Responsibilities

Institutional frameworks are required for the governance and coordination of safeguarding the critical habitat species shall be achieved by DoR in the short term and long-term preservation of the pristine environment of PNP and nearby community reserve forests.

Roles and responsibilities – 1) stakeholder and 2) individual roles and responsibilities for implementing the tasks in the BMP.

Table 8-1: Stakeholders and their Roles

Stakeholder	Role	Commitment
Forest Resource Management Division - Parsa National Park	Manager of lands on behalf of the Government of Nepal. Forestry planning and management. Partner in the reforestation and forest protection program.	MoU requires between DoR and Parsa National Park in developing community forestry agreements and replanting for biodiversity gains.
Local Communities/Community Forest User Groups	The communities will need to participate in planning and implementation. The impacts and benefits on the people living and working in the area need to be well understood. Communities need to be able to maximize their benefits.	Communities are interested and are keen to discuss the income generating opportunities and work
Divisional Forest Offices	Divisional Forest Departments responsible for spatial plans & management programs in forestry lands. Support of BMP and integration of plans in catchment.	Further consultation required as per the Action Plan to identify the specific roles and responsibilities.
Local Municipal Authorities	Responsibilities for infrastructure and other community services on community (non-forest) land. Support of community development activities.	Committed to engaging with communities to support the goals of the BMP
Geo-Environmental and Social Unit of DoR	Responsible for conservation of forest and managing the environment by enhancing sustainable growth of forest and water sector to manage biodiversity, flora and fauna.	Further consultation required as per the Action Plan to identify the specific roles and responsibilities.

8.1 Institutional Framework

During the Construction Phase DoR will coordinate with the respective divisional forest offices and Parsa National Park for compensatory plantation and carry out activities in partnership with Divisional Forest Offices, Parsa National Park and the local community. The BMP is implemented through PIU in coordination with the project office. The DoR will engage SC biodiversity expert who will support the implementation by providing technical skills and regular monitoring.

Team will be set up for monitoring and evaluation of BMP implementation and strategic adjustments in the program if it fails to meet its main biodiversity offsetting targets. A term of reference for the panel of experts will be included in the Environmental and Social Management Plan.

Roles and Responsibilities of team for BMP implementation are given below:

8.1.1 Biodiversity Expert

- Ensure this BMP is included as part of the Environmental Management Plan for this project, including scheduling of tasks, inspections, monitoring, evaluation, reporting, etc.

- Ensuring the financial resources are available to implement the BMP.
- Ensuring the BMP is integrated into the wider project program (land acquisition, resettlement, construction, community consultation, etc.).
- Reviews are carried out and recommendations made regarding biodiversity coverage in Contractor environmental management plans.
- Monitoring changes to relevant legislation is monitored and where appropriate, recommending any necessary changes to monitoring or management arrangements.
- Supervise consultants as required.
- To ensure that the biodiversity requirements in this plan are incorporated into final designs and specifications.
- To ensure that appropriate clauses referring to protection of biodiversity and this biodiversity plan are included in contractual scopes of work and bid documents.
- To ensure that Contractors include the requirements from this BMP into their job specific Environmental Management Plans required under the Environmental Management Plan, and that these plans are complied with at all times.
- Review and update the BMP.

8.1.2 Construction Manager

Key responsibilities for the Construction Manager from DoR in relation to this BMP are as follows:

- To ensure that the biodiversity requirements in this plan are incorporated during construction.
- To ensure that appropriate clauses referring to protection of biodiversity and this biodiversity plan are included in contractual scopes of work.
- To ensure that Contractors include the requirements from this BMP into their job specific Environmental Management Plans required under the Environmental Management Plan, and that these plans are always complied with.
- To ensure that biodiversity issues are included in the regular inspections required under the Environmental Management Plan.
- To ensure that the contractor/consultant workforce receives information on biodiversity and the requirements in this plan in any compulsory environmental inductions required prior to working on the Project.
- To ensure breaches of the biodiversity requirements in this plan are included as environmental incidents, investigated accordingly and the required incident reports forwarded to the relevant persons.

8.1.3 Panel of Experts

- Independent review and advice to DoR and Implementation team
- Monitoring and evaluation of BMP
- Strategic advice on developing activities
- A full term of reference for the Panel of Experts shall be included in the ESMP

8.1.4 Contractors – All Packages

- Contracts issued during the construction phases and subsequence stages and for any other major works required during project development are to include the biodiversity requirements by the following measures.
- Any environmental management plan to be produced by the Contractor must include the requirements of this biodiversity plan.
- Comply with all aspects of the BMP.
- Implement aspects of the BMP such as forest protection measures, wildlife conflict management, incident reporting etc.
- Participate in all relevant training programmes about biodiversity conservation.

8.1.5 Patrol Teams

Teams based in the area facilitation, made up of Parsa National Park, Divisional Forest Department, and / or BMP facilitation team, if required, with the purpose of patrolling

- Discourage poaching and illegal harvesting or land clearance.
- Monitor and report poaching and illegal harvesting or land clearance.
- Monitoring and reporting wildlife movement, especially elephants

8.2 Capacity and Training

This BMP shall be implemented as part of the implementation of the ESMP. However, DoR do not have biodiversity specialists or ecologists in-house and will rely on external consultants and other specialists to implement key aspects of the BMP and provide further training.

A Team will be engaged to carry out many of the BMP tasks, on behalf of DoR:

- Induction training on the BMP to Contractors and consultants
- Consultation and engagement with stakeholders
- Assistance to DoR in the development and maintenance of GIS databases for ICM
- Biodiversity surveys and monitoring of the BMP outcomes
- Species management
- Restoration planting guides
- Training staff, communities and NGOs in seed sourcing and plant nursery operation
- Other specialists will be engaged as required to complete other tasks, such as wildlife handling following an incident.

9. Monitoring and Evaluation

Monitoring is required to show that DoR and its contractors meet the criteria of the BMP, i.e., implementation monitoring; are all actions done as prescribed, required to monitor the impact their own management has on biodiversity values, i.e., validation monitoring. Evaluating the implementing actions in the BMP resulting stable population of threatened wildlife species.

9.1 Management Purposes

Maintain an administrative system that monitors the implementation of each action in the BMP and checks against timelines.

- Develop baseline data and compare with regular monitoring updates to determine the direct and indirect impacts of project development on the species of most conservation concern and their habitats.
- For most species, it will not be possible to obtain baseline data that are more accurate than absence/presence statements.
- For Elephants and Tigers, which can be counted individually if directly sighted and indirect evidence.
- Installation of camera trapping near the road/bridge crossings, to obtain a minimum population estimate for the area.

9.2 Management Actions

BMP Manager sets up and maintains a database in which all actions in the BMP and their associated implementation times lines are monitored. Where actions can be quantified (e.g., number of trees replanted; number of community agreements on joint land management) this should be recorded.

- Monitor the presence of populations of the most endangered species such as Elephant & Tiger
- Camera traps should be installed in all important areas to monitor the presence of terrestrial species.
- Cameras are maintained by patrol teams, and photos collected on a monthly basis and shared with the BMP Manager.
- Conduct annual interview surveys with communities to determine changes in attitudes towards threatened wildlife and activities that could be detrimental or beneficial.
- Monthly inspections of the retained vegetation areas around the access road and construction sites during construction.

10. Task Lists and Budget

Following are the key components included in the Biodiversity Management Plan with tentative budget details.

Table 10-1: Tasks and Estimated Budget for BMP

S.N.	Activity	Details	Phase	Amount (NPR)
1.	Compensatory Plantation (with cost of caring for five years)	Location to be finalized in coordination with DFOs	During construction	293,828,152
2.	Underpasses for wildlife including natural guiding fences and construction of water holes	Forest sections	During construction	Included in BOQ, to be managed by contractor
3.	Installation of Canopy Bridges for arboreal mammals	Forest Sections	During Construction	900,000
4.	Wildlife monitoring from wildlife experts	Parsa NP, DFOs, Project office	Before and during construction	1,656,000
5.	Implement effective anti-fire strategies (Forest Fire Management)	CFUG team	During Construction/operation	660,000
6.	Wildlife monitoring through camera trapping	Forest sections of Elephant crossing locations	During Construction/operation	2,965,000
7.	Training and Capacity Building including Forest and Biodiversity Management	DFOs, CFUG groups, affected community, women	During Construction	8,800,000
8.	Speed Breakers/ Rumble Strips	Forest Sections	During Operation	Included in BOQ, to be managed by contractor
9.	Noise & Light barriers (Power Coated Aluminum Noise Barrier 100 mm thickness) @ NPR 5,000 per sq m	Forest Sections	During Operation	Included in BOQ, to be managed by contractor
10.	Sedimentation control measures for wildlife underpasses	Forest Sections	During Construction/operation	Included in BOQ, to be managed by contractor
11.	Install prohibition signs on the use of roads	Forest Sections	During Construction/operation	Included in BOQ, to be managed by contractor
Total				308,809,152

11. Way Forward

11.1 Net Gain for Critical Habitat CH species

Magnitude of the Effect: During the construction period, temporary disturbance for the elephant and tiger movement near the Parsa National Park is envisaged. However necessary mitigation measures like Underpasses for elephant, medium animal, small mammals, and reptiles crossings, Providing noise barriers near ecologically sensitive areas, imposing speed restrictions, regular wildlife monitoring and promoting indigenous species plantation in the degraded reserve forests will certainly sustain the population of elephants, tigers and ungulates.

Time Frame Required to Reach a Net Gain of CH: Habitat near the project road is suitable more to elephant and tiger populations, over a reasonable period if the habitat is protected and conserved. Restoration and offsetting shall be carried out within degraded forest areas to ensure Net Gains/ No Net Losses of the species populations over the lifetime of the Project.

Geographic Extent of the Effect: Parsa National Park is connected with Chitwan National Park-CNP in the west, which is further extended westward and linked to Mahabharat forests in the north through Barandabhar forest, and to Indian PAs in the south through Valmiki Tiger Reserve-VTR. Wildlife mitigation and conservation efforts proposed near the project will provide an opportunity for the elephant and tiger population in the Parsa National Park and the terai region of Nepal in general.

Achieving No Net Loss and progressing towards a Net Gain with application of the mitigation hierarchy covering avoidance, minimization and restoration actions is shown in **Figure 7.2**. Overall, an offset strategy in the project road is aimed at achieving a balance between the infrastructure development and the protection of the environment and communities affected by the project. It involves a combination of proactive planning by proposing underpasses, guiding fences, speed restrictions and development implementation of appropriate measures to minimize, and offset negative impacts and Net gain of 261 ha of additional forest area through afforestation program.

The implementation of the Solar Electric Fencing, Bio fencing near 3 village Pathlaiya (CH:365+700 to CH:366+800), Puluwa (CH:357+300 to CH:358+400.), Dudhaura bridge settlement CH:363+700 LHS present a chance to implement net gain measures, which benefit both communities and wildlife. By implementing these strategies, we can mitigate conflicts, ensuring the safety of both humans and elephants.

11.2 Involving National Action Plans

- Implementation of BMP by the Department of Roads shall be guided and supported by Parsa National Park, Department of National Parks and Wildlife Conservation.
- **Elephant Conservation Action Plan 2009-18, Department of National Parks and Wildlife Conservation:** Implementation of district level strategic management intervention work plan in the critical forests' corridors, community forests of both resident and migrating elephant herds in all the districts of the project road corridor covering central and eastern population of Nepal.
- **Tiger Conservation Action Plan for Nepal (2016-2020), Department of National Parks and Wildlife Conservation:** Improve and restore critical tiger habitats and corridors, Manage grasslands and wetlands that are vital for tiger and its prey species and Strengthen tiger and prey-base monitoring and research in all the districts of the project road corridor. Much of this responsibility lie within the Department of National Parks and Wildlife Conservation for the protected areas and buffer zones, and the Department of Forests for outside protected areas.
- Utilizing strong, synergistic collaborations among government and conservation partners with the formation of high-level coordination committees, both for funding and joint implementation of conservation programs near the project corridor.

- The effective coordination among relevant stakeholders shall be maintained through the existing government system and a mechanism set for the implementation of particular conservation activities near the project corridor.

ANNEXURE-I

List of Literature Reviewed

1. Study on Mapping of Elephant Corridor Across Fast Track Alignment April 2015. The World Bank
2. <https://ebird.org/home>
3. <https://www.birdlife.org/projects/ibas-mapping-most-important-places/>
4. ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
5. PNP 2018, Parsa National Park and its Buffer Zone Management Plan, FY 2075/76-2079/80
Parsa National Park Office, Aadhavar, Bara, Nepal
6. <https://india.mongabay.com/2022/05/tiger-movements-between-india-and-nepal-become-increasingly-restricted-even-as-numbers-rise/>
7. Jnawali, S.R., et al. (2011), The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation. Kathmandu, Nepal.
8. A Status Report on Nepal's Wild Elephant Population Petra Furaha ten Velde, 1997
9. Sharma, P., H. Adhikari, S. Tripathi, A.K. Ram & R. Bhattarai (2019). Habitat suitability modelling of Asian Elephant *Elephas maximus* (Mammalia: Proboscidea: Elephantidae) in Parsa National Park, Nepal and its buffer zone. Journal of Threatened Taxa 11(13): 14643–14654; <https://doi.org/10.11609/jott.4467.11.13.14643-14654>
11. DNPWC and DFSC. (2022). Status of Tigers and Prey in Nepal 2022. Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation. Ministry of Forests and Environment, Kathmandu, Nepal.
12. √= likely attracting Criterion/ Criteria; x = not attracting Criterion/ Criteria; ? = possibly qualifies area as Critical Habitat. Based on available information.
13. Study on Mapping of Elephant Corridor Across Fast Track Alignment April 2015. The World Bank

14. https://www.researchgate.net/publication/333643991_A_New_Type_of_Elephant_Fence_Permeable_for_People_and_Game_but_Not_for_Elephant
15. Das G, Selvan K, Lahkar B and Gopi GV (2022) Effectiveness of physical barriers in mitigating human–elephant negative interactions in North-East India. *Front. Conserv. Sci.* 3:956568. doi: 10.3389/fcsc.2022.956568
16. <https://portals.iucn.org/library/sites/library/files/documents/2016-068.pdf>
17. <https://timesofindia.indiatimes.com/city/dehradun/bio-fencing-to-keep-jumbos-away-from-tracks-in-terai/articleshow/97215878.cms>
18. https://www.researchgate.net/publication/359226608_Functionality_of_two_canopy_bridge_designs_successful_trials_for_the_endangered_black_lion_tamarin_and_other_arboreal_species
19. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/noise-barrier>
20. <https://www.sciencedirect.com/science/article/abs/pii/S0378112796039114>
21. Based on the conversation rate of Nepal Rastra Bank on 18th March-2024
22. URL: <http://dx.doi.org/10.5539/enrr.v4n4p142>

Annexure II

Kabhrepalanchok

Legend

Project Road

150 m Buffer

1 km Buffer

District Boundary

Bridge Location

Major Settlements

Road Major Chianage

Road Minor Chianage

LULC Zones

Agricultural

Residential

Commerical

Industrial

Forest

Mining & Minerals

Public Use

(Roads/Railways/School etc.)

Cultural & Archeological

Reverine & Lake Area

(Rivers/Water Body/Wet Land)

Others

Airports

Labour Camp Sites

Construction Camps

Quarry and Borrow Pits

Postal Highway

BP Highway BP_Highway

Madanbandari Highway

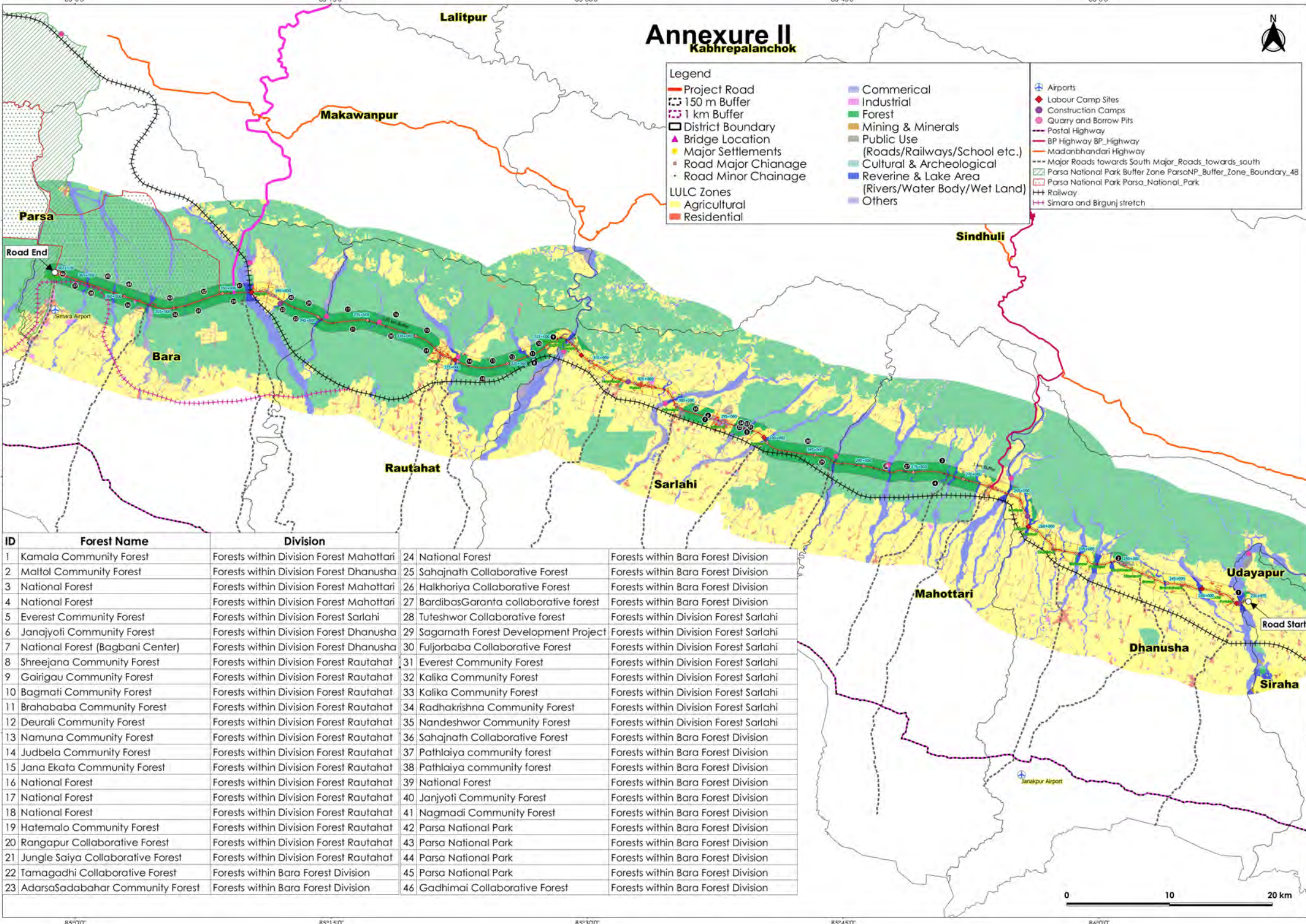
Major Roads towards South Major_Roads_towards_south

Parsa National Park Buffer Zone ParsaNP_Buffer_Zone_Boundary_48

Parsa National Park Parsa_National_Park

Railway

Simara and Birgunj stretch



ID	Forest Name	Division
1	Kamala Community Forest	Forests within Division Forest Mahottari
2	Mallol Community Forest	Forests within Division Forest Dhanusha
3	National Forest	Forests within Division Forest Mahottari
4	National Forest	Forests within Division Forest Mahottari
5	Everest Community Forest	Forests within Division Forest Sarlahi
6	Janajyoti Community Forest	Forests within Division Forest Dhanusha
7	National Forest (Bagbani Center)	Forests within Division Forest Rautahat
8	Shreejana Community Forest	Forests within Division Forest Rautahat
9	Gairigau Community Forest	Forests within Division Forest Rautahat
10	Bagmati Community Forest	Forests within Division Forest Rautahat
11	Brahababa Community Forest	Forests within Division Forest Rautahat
12	Deurali Community Forest	Forests within Division Forest Rautahat
13	Namuna Community Forest	Forests within Division Forest Rautahat
14	Judbela Community Forest	Forests within Division Forest Rautahat
15	Jana Ekata Community Forest	Forests within Division Forest Rautahat
16	National Forest	Forests within Division Forest Rautahat
17	National Forest	Forests within Division Forest Rautahat
18	National Forest	Forests within Division Forest Rautahat
19	Hatemalo Community Forest	Forests within Division Forest Rautahat
20	Rangapur Collaborative Forest	Forests within Division Forest Rautahat
21	Jungle Saiya Collaborative Forest	Forests within Division Forest Rautahat
22	Tamagadhi Collaborative Forest	Forests within Bara Forest Division
23	AdarsaSadabhar Community Forest	Forests within Bara Forest Division
24	National Forest	Forests within Bara Forest Division
25	Sahajna Collaborative Forest	Forests within Bara Forest Division
26	Halkhoriya Collaborative Forest	Forests within Bara Forest Division
27	BardibasGaranta collaborative forest	Forests within Bara Forest Division
28	Tuteshwar Collaborative forest	Forests within Division Forest Sarlahi
29	Sagarnath Forest Development Project	Forests within Division Forest Sarlahi
30	Fuljorbaba Collaborative Forest	Forests within Division Forest Sarlahi
31	Everest Community Forest	Forests within Division Forest Sarlahi
32	Kalika Community Forest	Forests within Division Forest Sarlahi
33	Kalika Community Forest	Forests within Division Forest Sarlahi
34	Radhakrishna Community Forest	Forests within Division Forest Sarlahi
35	Nandeshwor Community Forest	Forests within Division Forest Sarlahi
36	Sahajna Collaborative Forest	Forests within Bara Forest Division
37	Pathlaiya community forest	Forests within Bara Forest Division
38	Pathlaiya community forest	Forests within Bara Forest Division
39	National Forest	Forests within Bara Forest Division
40	Janjyoti Community Forest	Forests within Bara Forest Division
41	Nagmadi Community Forest	Forests within Bara Forest Division
42	Parsa National Park	Forests within Bara Forest Division
43	Parsa National Park	Forests within Bara Forest Division
44	Parsa National Park	Forests within Bara Forest Division
45	Parsa National Park	Forests within Bara Forest Division
46	Gadhimai Collaborative Forest	Forests within Bara Forest Division

ANNEXURE-III**Tree list in the RoW**

S.N.	Tree Species	Scientific Name	No. within ROW	Avg.	Average Circumference (m)	Habit
				Ht.		
				(m)		
1	Amala	<i>Phyllanthus emblica</i>	13	12.54	75.38	small tree
2	Amaro	<i>Spondias pinnata</i>	14	11	109.86	Tree
3	Amba	<i>Psidium guajava</i>	7	6.86	51.86	small tree
4	Ashare	<i>Lagerstroemia indica</i>	293	8.24	68.09	Tree
5	Ashoka	<i>Saraca asoca</i>	80	9.56	85.41	Tree
6	Asna	<i>Terminalia elliptica</i>	1432	16.31	112.34	Tree
7	Athiyar	<i>Acacia pennata</i>	8	12.25	100.88	Woody shrub
8	Aule	<i>Dactylorhiza hatagirea</i>	374	11.57	81.67	Herb
9	Badar	<i>Artocarpus lakoocha</i>	29	14.21	116.14	Tree
10	Badkaule	<i>Casearia graveolens</i>	51	8.22	61.84	small tree
11	Bakaino	<i>Melia azedarach</i>	69	7.76	62.37	Tree
12	Ban bohari	<i>Cordia dicotoma</i>	1	17	141	Tree
13	Banarsatta	<i>Sapium insigne</i>	28	9	72.57	Tree
14	Banjhi	<i>Anogeissus latifolia</i>	2654	13.7	93.72	Tree
15	Bar	<i>Ficus benghalensis</i>	64	11.02	206.36	Tree
16	Barro	<i>Terminalia bellirica</i>	333	16.4	127.33	Tree
17	Bayer	<i>Zizyphus mauritiana</i>	16	7.13	85.63	Tree
18	Bel	<i>Aegle marmelos</i>	84	9.7	75.02	Tree
19	Bhalayo	<i>Semecarpus anacardium</i>	227	11.37	84.56	Tree
20	Bhalukath	<i>Derris elliptica</i>	9	7.67	55.33	Tree
21	Bhellar	<i>Trewia nudiflora</i>	157	7.57	68.15	Tree
22	Bhimal	<i>Grewia optiva</i>	2	10	59.5	Tree
23	Bhurkot	<i>Hymenodictyonf laccidum</i>	14	18.57	166.64	tree
24	Bijaya Sal	<i>Pterocarpus marsupium</i>	1	17	107	Tree
25	Birendra phool	<i>Jacaranda mimosifolia</i>	3	10.67	169.33	Tree
26	Botdhairo	<i>Lagerstroemia parviflora</i>	510	13.75	96.77	tree

27	Chamre	<i>Schima wallichii</i>	135	15.47	117.72	Tree
28	Chhatiwan	<i>Alstonia scholaris</i>	38	11.92	120.95	Tree
29	Chilaune	<i>Schima wallichii</i>	11	9	55	Tree
30	Dabdabe	<i>Garuga pinnata</i>	70	11.81	99.04	Tree
31	Datrungo	<i>Ehretia laevis</i>	701	11.68	78.7	Tree
32	Deri	<i>Derris elliptica</i>	25	7.36	60.64	Vine
33	Dhaap	<i>Colebrookea oppositifolia</i>	8	15.375	119.13	Shrub
34	Dudhe	<i>Euphorbia hirta</i>	244	8.77	66.35	Herb
35	Eucalyptus	<i>Eucalyptus citriodora</i>	1543	14.82	143.83	Tree
36	Galka		42	5.6	67.93	
37	Gayo	<i>Bridelia retusa</i>	2	9	56.5	Tree
38	Gulayo		9	13.44	81.11	Tree
39	Gulmohar	<i>Delonix regia</i>	50	13.22	114.1	Tree
40	Gutel	<i>Trewia nudiflora</i>	23	9.48	66.52	Tree
41	Hade	<i>Aporosa octandra</i>	278	14.21	118.4	Tree
42	Haldu	<i>Adina cordifolia</i>	72	16.71	128.52	Tree
43	Halude	<i>Curcuma aromatica</i>	18	13.22	94.89	Herb
44	Harro	<i>Terminalia chebula</i>	27	13.3	93.96	Tree
45	Ipil ipil	<i>Leucaena leucocephala</i>	27	11.37	74.04	small tree
46	Iron wood	<i>Memecylon umbellatum</i>	167	10.24	67.68	tree
47	Jamun	<i>Syzygium cumini</i>	158	13.43	108.6	Tree
48	Jhingad	<i>Lannea coromandelica</i>	11	13.73	121.73	Tree
49	Jingar		1	12	108	
50	Kadam	<i>Neolamarckia cadamba</i>	103	17.95	145.19	Tree
51	Kade	<i>Amaranthus spinosus</i>	6	9.17	62.67	Herb
52	Kadipatta	<i>Morus alba</i>	9	4	44.33	Shrub
53	Kalikath	<i>Myrsine semiserrata</i>	279	10.48	66.87	Tree
54	Kalkiphool	<i>Callistemon citrinus</i>	1	13	100	Tree
55	Kalo sirish	<i>Albizzia lebbek</i>	4	11.5	155.5	Tree
56	Kapoor	<i>Cinnamomum camphora</i>	2	8.5	83	Tree
57	Kapra	<i>Morus alba</i>	1	8	79	Tree
58	Kariodha	<i>Feronia limonia</i>	5	5.8	53.8	Tree

59	Karma	<i>Adina cordifolia</i>	177	11.9	103.58	Tree
60	Karma	<i>Adina cordifolia</i>	1	18	180	Tree
61	Kasambar		28	18.18	148.07	
62	Katahar	<i>Artocarpus heterophyllus</i>	15	9.73	89.67	Tree
63	Katus	<i>Castanopsis indica</i>	1	11	78	Tree
64	Khair	<i>Acacia catechu</i>	157	12.44	90.75	Tree
65	Khal	<i>Diospyros malabarica</i>	2	11	127.5	Tree
66	Khamari	<i>Gmelina arborea</i>	1	9	128	Tree
67	Khasru	<i>Quercus semecarpifolia</i>	35	6.47	62.77	Tree
68	khirra	<i>Holarrhena pubescens</i>	6	16.33	125	Tree
69	Khirro	<i>Sapium insigne</i>	273	8.86	60.64	Tree
70	Kimbu	<i>Morus alba</i>	4	9	62.5	Tree
71	Koiralo	<i>Bauhinia variegata</i>	1	7	42	small tree
72	Koriya/Bhorla	<i>Bauhinia vahlii</i>	134	7.28	68.01	Gigantic vine
73	Kumbhi	<i>Careya arborea</i>	28	11.96	87.25	Tree
74	Kusum	<i>Schleichera oleosa</i>	95	12.64	95.27	Tree
75	Kutmero	<i>Litsea monopelata</i>	1	30	95	Tree
76	Kyamuna	<i>Syzygium nervosum</i>	786	11.82	84.07	Tree
77	Litchi	<i>Litchi chinensis</i>	19	7.68	63.89	Tree
78	Mahasun	<i>Curcuma aromatica</i>	237	7.05	73.46	Herb
79	Maidal kada	<i>Xeromphis spinosa</i>	4	6.5	49.25	Tree
80	Mango	<i>Mangifera indica</i>	293	11.33	137.41	Tree
81	Malu	<i>Bauhinia vahlii</i>	50	18.14	138.64	Gigantic vine
82	Moringa	<i>Moringa oleifera</i>	3	8	40.67	Tree
83	Neem	<i>Azadirachta indica</i>	64	8.14	78.08	Tree
84	Odal/Odeni	<i>Sterculia villosa</i>	5	15.2	68.8	Tree
85	Padke	<i>Annona squamosa</i>	542	17.22	108.45	Tree
86	Padke siris	<i>Albizia julibrissin</i>	8	8.875	50.75	Tree
87	Paineti/Chilaune	<i>Schima wallichii</i>	9	8.78	58.44	Tree
88	Pakhir/Seto babul, Epil-Epil	<i>Leucaena leucocephala</i>	1	10	350	Tree
89	Parijat	<i>Nyctanthes arbor-tristis</i>	9	6.89	60.78	Tree
90	Peepal	<i>Ficus religiosa</i>	186	11.13	224.8	Tree
91	Phalame	<i>Buchanania latifolia</i>	12	6.92	65.5	Tree

92	Pithari	<i>Stereospermum personatum</i>	432	14.99	99.8	Tree
93	Pyar	<i>Buchanania latifolia</i>	676	13.12	78.13	Tree
94	Rajbrikshya	<i>Cassia fistula</i>	114	12.43	76.84	Tree
95	Rubber plant	<i>Ficus elastica</i>	1	7	48	Tree
96	Rudrakshya	<i>Elaeocarpus sphaericus</i>	2	6	69.5	Tree
97	Sandan	<i>Desmodium oojeinense</i>	2	15.5	91	Tree
98	Sadhan	<i>Desmodium oojeinense</i>	17	12.06	58	Tree
99	Saijan	<i>Moringa oleifera</i>	8	5.25	80.13	Tree
100	Saj	<i>Terminalia alata</i>	18	13.22	129.72	Tree
101	Sal	<i>Shorea robusta</i>	7123	15.58	109.29	Tree
102	Salifa	<i>Annona squamosa</i>	17	7.35	65.59	Tree
103	Salla	<i>Pinus roxburghii</i>	1	18	109	Tree
104	Sapota	<i>Manikara zapota</i>	371	14.34	191.31	Tree(Cultivated)
105	Sarifa	<i>Annona squamosa</i>	23	6.17	43.17	Tree
106	Satisal	<i>Dalbergia latifolia</i>	199	13.09	91.3	Tree
107	Seto siris	<i>Albizia procera</i>	8	12	109.38	Tree
108	Simal	<i>Bombax ceiba</i>	135	17.37	161.44	Tree
109	Sindure	<i>Bixa orellana</i>	4276	8.65	70.89	Tree
110	Siris	<i>Albizia lebbeck</i>	65	17.2	144.4	Tree
111	Sissoo	<i>Dalbergia sissoo</i>	360	13.32	104.37	Tree
112	Shamee	<i>Ficus benjamina</i>	31	8.97	143.74	Tree
113	Syal parso	<i>Morus alba</i>	2	13	82	Tree
114	Tanki	<i>Bauhinia purpurea</i>	1	8	42	Tree
115	Tatari	<i>Dillenia pentagyna</i>	49	14.08	141.67	Tree
116	Teak	<i>Tectona grandis</i>	458	11.42	84.53	Tree
117	Tejpatta	<i>Cinnamomum tamala</i>	1	11	50	Tree
	Total		28120			

Source: Field Survey/Consultation 2022

**Annexure IV- List of Possible Wildlife Species Around Project Site
(Primary and Secondary Data)**

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON	Primary	Secondary
Mammals								
1.	Chital	<i>Axis axis</i>	Cervidae		LC	VU	*	*
2.	Nilgai	<i>Boselaphustragocamelus</i>	Bovidae		LC	VU	*	*
3.	Rhesus monkey	<i>Macaca mulatta</i>	Cercopithecidae	II	LC	LC	*	*
4.	Tera i Grey Langur	<i>Semnopithecus hector</i>	Cercopithecidae	I	NT	LC	*	*
5.	Northern Palm Squirrel	<i>Funambulus pennanti</i>	Sciuridae		LC	LC	*	*
6.	Indian Bush Rat	<i>Golundaellioti</i>	Murinae		LC	LC	*	*
7.	Eurasian Wild Boar	<i>Sus scrofa</i>	Suidae		LC	LC	*	*
8.	Indian Crested Porcupine	<i>Hystrix indica</i>	Hystriidae		LC	DD	*	*
9.	Bengal Fox	<i>Vulpes bengalensis</i>	Canidae		LC	VU	-	*
10.	Common Leopard	<i>Panthera pardus</i>	Felidae	I	VU	VU	*	*
11.	Tiger	<i>Panthera tigris</i>	Felidae	I	EN	EN	*	*
12.	Elephant	<i>Elephas maximus</i>	Elephantidae	I	EN	EN	*	*
13.	Golden Jakal	<i>Canis aureus</i>	Canidae	III	LC	LC	-	*
14.	Barking Deer	<i>Muntiacus vaginalis</i>	Cervidae		LC	VU	*	*
Birds								
1.	Indian Peafowl	<i>Pavocristatus</i>		III	LC		*	*
2.	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC		*	*
3.	Rose-ring Parakeet	<i>Psittaculakrameri</i>	Psittacidae		LC		*	*
4.	Black drongo	<i>Dicrurusmacrocerus</i>	Dicruridae		LC		*	*
5.	House Crow	<i>Corvus splendens</i>	Corvidae		LC		*	*
6.	Common Tailorbird	<i>Orthotomussutorius</i>	Cisticolidae		LC		*	*
7.	House Sparrow	<i>Passer domesticus</i>	Passeridae		LC		*	*
8.	Common Myna	<i>Acridotheres tristis</i>	Sturnidae		LC		*	*
9.	Asian Koel	<i>Eudynamysscolopaceus</i>	Cuculidae		LC		*	*

[illegible]

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON	Primary	Secondary
Mammals								
1.	Asian black-spined toad	<i>Duttaphrynus melanostictus</i>	Bufonidae		LC		-	*
2.	Indian bull frog	<i>Hoplobatrachus tigerinus</i>	Dicroglossidae	II	LC		-	*
3.	Common Indian tree frog	<i>Polypedates maculatus</i>	Rhacophoridae		LC		-	*
4.	Indian softshell turtle	<i>Aspideretes gangeticus</i>	Anguillidae	I	EN		-	*
Reptiles								
1.	Common garden lizard	<i>Calotes versicolor</i>	Agamidae		LC		*	*
2.	Yellow-bellied house gecko	<i>Hemidactylus flaviviridis</i>	Gekkonidae		LC		-	*
3.	Keeled indian mabuya	<i>Eutropiscarinata</i>	Scincidae		LC		-	*
4.	Bengal Monitor Lizard	<i>Varanus bengalensis</i>	Varanidae	I	NT		-	*
5.	Indian gamma snake	<i>Boiga trigonata</i>	Colubridae		LC		-	*
6.	Asiatic rat snake	<i>Ptyas mucosa</i>	Colubridae	II	LC		*	*
7.	Buff-striped keelback	<i>Amphiesmastolatum</i>	Natricidae		LC		-	*
8.	Spectacled cobra	<i>Naja naja</i>	Elapidae	II	LC		-	*
Fish (Recorded from Bagmati and Kamala River)								
1.	Indian Mottled Eel	<i>Anguilla bengalensis bengalensis</i>	Anguillidae		NT		-	*
2.	Chaguni	<i>Chagunius chagunio</i>	Cyprinidae		LC		-	*
3.	Catla	<i>Catla catla</i>	Cyprinidae		LC		-	*
4.	Gurdi	<i>Labeogonius</i>	Cyprinidae		LC		-	*
5.	Rohu	<i>Labeo rohita</i>	Cyprinidae		LC		-	*
6.	Mungri	<i>Clarius batrachus</i>	Clariidae		LC		-	*
7.	Indian spiny eel	<i>Macroglyptothorax panchulus</i>	Mastacembelidae		LC		-	*
8.	Tengra	<i>Mystus tengra</i>	Bagridae		LC		-	*
9.	Pothi	<i>Puntius sophore</i>	Cyprinidae		LC		-	*
10.	Olive barb	<i>Systomus sarana</i>	Cyprinidae		LC		-	*

S.N.	Common Name	Scientific Name	Family	CITES	IUCN	GON	Primary	Secondary
Mammals								
11.	Bhote/ Spotted snakehead	<i>Channa punctatus</i>	Channidae		LC		-	*
12.	Guntea loach	<i>Lepidocephalusguntea</i>	Cobitidae		LC		-	*
13.	Mrigal	<i>Cirrhinus cirrhoscirrhosis</i>	Cyprinidae		LC		-	*

Source: Field Survey/Consultation 2022

GON: Govt of Nepal assessment; PD: Primary data; SD: Secondary data; * presence; - absence

ANNEXURE-V

Consultations with Parsa National Park

A meeting chaired by Senior Conservation Officer Mr. Ramchandra Khatiwada was held on January 3rd, 2024 (2080/09/18) regarding the draft Biodiversity Management Plan (BMP) prepared for upgradation of Kamala-Dhalkebar-Pathlaiya Road Project.

Attendees:

1. Mr. Ramchandra Khatiwada - Senior Conservation Officer
2. Mr. Dil Bahadur Rana Magar *Ni. Ganapati, Sabuj Gan*
3. Mrs. Archana Shrestha *Senani Sabuj Gan*
4. Mr. Santosh Kumar Bhagat - Conservation Officer, Parsa National Park
5. Dr. Chandrakala Rana Magar - Veterinary Doctor, Parsa National Park
6. Mr. Laxman Kumar Mahato – Ranger, Parsa National Park
7. Mr. Bishal Kuswar – *Si. Ge.* Parsa National Park
8. Mr. Ram Tahal Yadav – Eng., Kamala-Dhalkebar-Pathalaiya
9. Mr. Paras Ghimire
10. Mr. Yubraj satyal – Environmental Expert DoR-DCID
11. Mr. Rabi Bhattarai DTL, ESIA, KDP CEG-CIAS JV.
12. Mr. Hanumanth Rao, Ecology and Biodiversity Expert, CEG-CIAS JV
13. Mr. Madhav Shankaran, Project Manager, CEG
14. Mr. Durga Baral, Kamala-Dhalkebar-Pathlaiya Road

Following are the Recommendations on draft BMP:

- Speed near the Parsa National Park needs to be limited to 40 km per hour.
- For elephant crossings, it is necessary to install guiding fences and pay attention to openness index while constructing animal crossings.
- Water holes and grass lands at both towards northern and southern side of Kamala-Dhalkebar-Pathlaiya road adjoining to Parsa National Park needs to be developed considering the dietary habits of animals.
- For facilitating animal movement, speed control plan needs to be developed in coordination with road division, traffic police, Parsa National Park and Division Forest Offices.
- As the roadkill, mainly small animals, within Parsa National Park is increasing, subject related to be constructed animal crossing infrastructures should be included in detail design.

- To facilitate the movement of elephants within and around Parsa National Park, underpasses and overpasses should be constructed, particularly between fast-track point to Pathlaiya Junction.
- Elephant underpasses practices within National Park areas of India should also be incorporated into the report.
- Implementation of solar fence and its maintenance should be included in the document.
- For the easy movement of wildlife, different alternatives such as speed control mechanisms, underpasses/overpasses, and resting vehicular movement during nighttime need to be implemented to reduce road casualty and wildlife accidents in road. Provisions as provided in Wildlife Friendly Guidelines should be considered.
- When constructing bridges of Kamala-Dhalkebar-Pathlaiya Road section within Parsa National Park, the height should be a minimum of 6.5 to 7.5 meters sufficient for elephant crossings.
- Suggestions as received in expansion of Pathlaiya-Narayangadh road should also be referred in KDP road section report.

ANNEXURE-VI**Summary of Critical Habitat-Qualifying biodiversity Assessment in the Project area**

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Red-crowned Roofed Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Global Population: A river turtle restricted to mainly to river habitat. Known with certainty only from the Ganga basin of India and Bangladesh. Global Population: is estimated around 500 individuals in Bangladesh (Rashid and Khan 2000) Local Population: Conservation near Karnali River lowlands in western Nepal (more than 50 km distance from the project road). No scientific details were available on local population. As per the IUCN range distribution map, nearest location of Red-crowned Roofed Turtle is more than 50 km from project area. https://www.iucnredlist.org/species/10949/152043133

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the species.
Three-striped Roofed Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. A river turtle restricted to river habitat. Known with certainty only from the Ganga basin of India and Bangladesh. Global Population: Overall the population continues to decline, often through entanglement in fishing nets (S. Singh pers. comm. 2018). Local Population: No scientific details were available on the status of local population. As per the IUCN range distribution map, Three-striped Roofed Turtle is distributed near the project area. https://www.iucnredlist.org/species/10953/152042542 However, as per the site investigation studies

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the species.
Spotted Pond Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. <i>This species inhabits the lowlands of the Indus, Ganga and Brahmaputra River basins of Pakistan, India, Bangladesh and Nepal</i> Global Population: The species common in the Brahmaputra floodplains and rare elsewhere, and rated its population as apparently stable in India (Choudhury <i>et al.</i> 2000). Population decline in the past 20 years in Bangladesh (Rashid and Khan 2000) Local Population: No scientific details were available on local population. As per the IUCN range distribution map, Spotted Pond Turtle is distributed near the project area.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						https://www.iucnredlist.org/species/9029/152050337 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Crowned River Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. A river turtle restricted to mainly to river habitat. Known with certainty Ganga-Brahmaputra basin of northern India and Bangladesh, and the Indus basin of Pakistan, no confirmed records exist from Nepal Global Population: There were good populations across terai 30 years ago, but it is now localized to a few rivers and wetlands and has arguably declined by 80% (Shai pers. comm. 2017). Recent

	Critical Habitat criterion qualified					Justification
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						(unpublished) data indicate estimated population declines of about 50–75% overall. Local Population: No scientific details were available on local population. As per the IUCN range distribution map, Crowned River Turtle is distributed near the project area. https://www.iucnredlist.org/species/9696/3152073 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Indian Eyed Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. A river turtle occurs widely throughout the Bangladesh, and southern Nepal at elevations of between 10 to 100 m above sea level.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						Global Population: In Bangladesh it was considered uncommon, and populations in decline, by 1999 (Rashid and Swingland 1997, Rashid and Khan 2000). There is a very good subpopulation in the Pilibhit Tiger Reserve in Uttar Pradesh, India (S. Singh pers. comm. 2018). Local Population: Only a single record exists from Nepal (Schleich and Kästle, 2002). As per the IUCN range distribution map, Indian Eyed Turtle is distributed near the project area https://www.iucnredlist.org/species/13874/544248 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Indian Soft-shell Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						A turtle occurs widely throughout the drainages of Bangladesh, India, Nepal, Pakistan and Afghanistan (Schneider and Djalal 1970) Global Population: Considered the species common throughout its range in India, but possibly in decline (Choudhury <i>et al.</i> 2000) Local Population: No data available As per the IUCN range distribution map, Indian Soft-shell Turtle is distributed near the project area https://www.iucnredlist.org/species/39618/2930943 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Indian Peacock Softshell Turtle	√	√	X	X	X	IUCN Red List Category: Endangered. A turtle occurs throughout the drainages of Bangladesh, northern India, southern Nepal and

	Critical Habitat criterion qualified					Justification
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						Pakistan (Iverson 1992, Das 1995, Praschag and Gemel 2002, Das <i>et al.</i> 2010). Global Population: Pakistan, found 69 individuals and considered the population of Indian Peacock Softshell Turtle to be in good condition (Safi and Khan 2014). However, it is rare in Sindh, southern Pakistan (Khan <i>et al.</i> 2015). Local Population: The records from Nepal are from the western, central, and Terai regions (Mitchell and Rhodin 1996; Schleich and Kastle 2002). As per the IUCN range distribution map, Indian Peacock Softshell Turtle is distributed near the project area https://www.iucnredlist.org/species/39619/2931203 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Elongated	√	X	X	X	X	National Red List: Not listed

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Tortoise						IUCN Red List Category: Critically Endangered. It is widely distributed across South and Southeast Asia. It has localised occurrences in northern and eastern India, Nepal and Bangladesh, Bhutan and much of Myanmar, Thailand and Cambodia. Global Population: A 50-70% decline in population is believed to have occurred in the India/Bangladesh part of the range in the past 20 years (S. Singh pers. comm. 2018). in Bhutan's Royal Manus National Park but abundance is low (Wangyal <i>et al.</i> 2012). Local Population: Jhapa in eastern Nepal (Tapil <i>et al.</i> 2021) As per the IUCN range distribution map, Elongated Tortoise is distributed near the project area https://www.iucnredlist.org/species/10824/152051190 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a

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						population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Dark Sitana	√	√	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. This species is known only from its type locality in central Nepal, GhauriDhara Road Camp 0.8 km north of the road Janakpur-Bardibas (Kastle <i>et al.</i> 2013). Population: There are no data on population size and trends for this species. After the discovery of the species, intensive surveys in the area were not able to find it (Kastle <i>et al.</i> 2013). As per the IUCN range distribution map, Dark Sitana is more than 50 km from project area. https://www.iucnredlist.org/species/127901942/219116426 It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded

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						that the project area is not a critical habitat for the particular species.
Tricarinate Hill Turtle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. Species distributed in the Himalayan foothill of northern and northeastern India and southern Nepal Global Population: study found 48 specimens in two years India (Choudhury <i>et al.</i> 2000; Das 2009) Local Population: surveys at a protected area in the terai resulted in 36 specimens found in a 3-month survey effort (Participants Red List Workshop Singapore 2011). As per the IUCN range distribution map, Tricarinate Hill Turtle is distributed near the project area https://www.iucnredlist.org/species/13038/511526 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the

	Critical Habitat criterion qualified					Justification
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						national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Yellow Monitor	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. This species confined to northern India, Nepal, south central Bhutan, and Bangladesh. Its distribution mainly follows the major river systems of the Indus, Ganges and Brahmaputra (Visser 2004). Population: There are no current data on population size and trends for this species. It is uncommon compared with the other monitor lizards in its range. As per the IUCN range distribution map, Yellow Monitor is distributed near the project area https://www.iucnredlist.org/species/22872/127899602 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a

	Critical Habitat criterion qualified					Justification
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						population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Baer's Pochard	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. The species breeds from the Amur and Ussuri basins in Russia southwards to the central and lower Yangtze floodplain in central-eastern China. Global Population: in Bangladesh recent maximum winter total of only 17 individuals, down from 1,000–2,000 individuals (Chowdhury <i>et al.</i> 2012) Local Population: Only one confirmed location in Nepal (Tordoff, 2007) As per the IUCN range distribution map, Baer's Pochard is distributed near the project area https://www.iucnredlist.org/species/22680384/154436811 However, as per the site investigation studies conducted along the water bodies associated with

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						project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Yellow-breasted Bunting	√	X	X	X	X	IUCN Red List Category: Critically Endangered. This species breed across the northern Palaearctic. Also winter visitor to the South and South East Asia, which includes Nepal and India. Global Population: The European population is estimated to just 120-600 mature individuals (Bird Life International 2015). Local Population: No data available As per the IUCN range distribution map, Yellow-breasted Bunting is distributed near the project area https://www.iucnredlist.org/species/22720966/119335690 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is

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						not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Black-bellied Tern	√	X	X	X	X	IUCN Red List Category: Endangered. This species majority of its range in India where it remains widespread but in decline. Also distributed in Pakistan, Nepal and Bangladesh Global Population: It is widespread in India but population drastically declining. Only not more than 30 individuals recorded from Pakistan and Bangladesh (Zockler <i>et al.</i> 2020) Local Population: with likely no more than 30 individuals in Nepal (Zockler <i>et al.</i> 2020) As per the IUCN range distribution map, Black-bellied Tern is distributed in the project area https://www.iucnredlist.org/species/22694711/207933556 However, as per the site investigation studies conducted along the water bodies associated with

	Critical Habitat criterion qualified					Justification
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						project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Pallas's Fish-eagle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. The species may breed only in northern India (apparent strongholds in Assam and Uttarakhand), Bangladesh and Myanmar, with very small numbers in Bhutan. Global Population: Based on surveys and available data from across the species's extant distribution, the population is estimated to fall well below 2,500 mature individuals (M. Steele and M. Gilbert <i>in litt.</i> 2016). Local Population: No data available As per the IUCN range distribution map, Pallas's Fish-eagle is distributed near the project area

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						https://www.iucnredlist.org/species/22695130/199521572 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Egyptian Vulture	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. Egyptian vultures are widely distributed across the Old World with their breeding range from southern <u>Europe</u> to northern <u>Africa</u> east to <u>western</u> and <u>southern Asia</u> . Global population: 3,000-4,500 pairs are estimated in Europe (BirdLife International <i>in prep</i>), < 2,000 pairs in central Asia, just a few thousand pairs now in the Indian Subcontinent, ~ 1,000 pairs in the Middle East, and ~ 1,000-2,000 pairs in Africa (Thiollay 1989, I. Angelov <i>in litt.</i> 2012).

	Critical Habitat criterion qualified					Justification
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						Local Population: No data available As per the IUCN range distribution map, Egyptian Vulture is distributed near the project area https://www.iucnredlist.org/species/22695180/205187871 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Saker Falcon	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. Saker Falcon occurs in a wide range across the Palearctic region from eastern Europe to western China

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						Global Population: The global population was estimated at c.6, 100-14,900 pairs (median c.10, 500) in 2013. Local Population: No data available As per the IUCN range distribution map, Saker Falcon is distributed near the project area https://www.iucnredlist.org/species/22696495/204182473 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Greater Adjutant	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered. Greater Adjutant prefer forest, grassland, wetlands, also previously widespread and common across

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						much of South and continental South-East Asia (Birdlife International 2001) Global Population: is estimated to number 800-1,200 mature individuals, roughly equivalent to 1,200-1,800 individuals in total. Kamrup District in Assam is known to be a stronghold for the species. Local Population: is not known properly, according to IUCN range distribution map, Greater Adjutant is extinct near the project area https://www.iucnredlist.org/species/22697721/93633471 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Bengal Florican	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						Bengal Florican prefers grasslands (Artificial/Terrestrial). The species has two disjunct populations, one in the Indian Subcontinent, the other in South-East Asia (BirdLife International 2001). Global Population: The population in Cambodia was estimated only 432 individuals (95% CI 312-550) (C. Packman <i>in litt.</i> 2013, Packman <i>et al.</i> 2014). Local Population: Only 75-96 individuals remain in Nepal (Baral <i>et al.</i> 2013). As per the IUCN range distribution map, Bengal Florican is distributed (Possible extinct) near the project area https://www.iucnredlist.org/species/22692015/130184896 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						that the project area is not a critical habitat for the particular species.
Lesser Florican	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Lesser Florican prefers grasslands (Artificial/Terrestrial). Breeds in India and Nepal. Global Population: The total population has been calculated from a recent survey over most of the range which estimated 340 displaying males (95% CI 162–597, Dutta <i>et al.</i> 2018). Local Population: rare summer visitor to the terai of Nepal, less than <10 birds estimated (Inskipp <i>et al.</i> 2016, C. Inskipp and H. S. Baral <i>in litt.</i> 2012). As per the IUCN range distribution map, Lesser Florican is distributed near the project area https://www.iucnredlist.org/species/22692024/199959007 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is

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						not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Sociable Lapwing	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Sociable Lapwing is mostly occurs in grasslands, wetlands and deserts. Global Population: The European population is estimated at 0-10 pairs, which equates to 0-20 mature individuals (BirdLife International 2015). Local Population: No data available As per the IUCN range distribution map, Sociable Lapwing is distributed near the project area also probably extinct. https://www.iucnredlist.org/species/22694053/155545788 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						that the project area is not a critical habitat for the particular species.
White-rumped Vulture	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						White-rumped Vulture preferring habitat of forest, savanna, shrubland, grassland. Occurs in globally occurs in Pakistan, India, Bangladesh, Nepal, Bhutan. Global Population: There are now an estimated c.6, 000 individuals in India (Prakash <i>et al.</i> 2019). The total population is therefore estimated to be c. 6,000-9,000 individuals, equating to 4,000-6,000 mature individuals. Local Population: total of <2,000 individuals recorded in Nepal (DNPWC 2015). As per the IUCN range distribution map, White-rumped Vulture is distributed (probably extinct.) near the project area. https://www.iucnredlist.org/species/22695194/204618615 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Red-headed Vulture	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Red-headed Vulture preferring habitat of forest, savanna, shrubland, grassland. Global Population: Total of 3,500-15,000 individuals estimated globally. Local Population: still widespread, but has declined significantly such that it is virtually absent from most areas east of Kathmandu (Inskipp <i>et al.</i> 2016) As per the IUCN range distribution map, Red-headed Vulture is distributed near the project area. https://www.iucnredlist.org/species/22695254/205031246 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded

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						that the project area is not a critical habitat for the particular species.
Slender-billed Vulture	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Slender-billed Vulture preferring habitat of forest, savanna, shrubland, grassland. Global Population: The total population is therefore thought to be c.1,100-1,300 individuals, roughly equating to 730-870 mature individuals. Local Population: The total population in Nepal fewer than 50 individuals (DNPWC 2015) As per the IUCN range distribution map, Slender-billed Vulture is distributed near the project area https://www.iucnredlist.org/species/22729460/204781113 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the

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						national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Indian Vulture	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Critically Endangered. Indian Vulture preferring habitat of forest, savanna, shrubland, grassland and Rocky areas (inland cliffs, mountain peaks) Global Population: breeds in India and south-east Pakistan. Roughly 5,000-15,000 mature individuals are estimated. Local Population: The species was first recorded in Nepal in 2011 (Subedi and DeCandido 2013). As per the IUCN range distribution map, Indian Vulture is distributed (possible extinct) near the project area https://www.iucnredlist.org/species/22729731/204672586

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						However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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Steppe Eagle	√	X	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered Steppe Eagle preferring habitat of forest, savanna, shrubland, grassland Global Population: Total 50000-75000 individuals are estimated Local Population: Total of 6,166 individuals recorded in 2014 at Thoolakharka, Nepal (Subedi 2014). As per the IUCN range distribution map, Steppe Eagle is distributed near the project area https://www.iucnredlist.org/species/22696038/205452572 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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Hog Deer	X	√	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Hog Deer preferring habitat of forest, savanna, shrubland, grassland. Distributed in India and Nepal - and perhaps Pakistan and Bhutan No data available related to local and global population As per the IUCN range distribution map, Hog Deer is distributed near the project area. https://www.iucnredlist.org/species/41784/22157664 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered nor secondary evidences were recorded. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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Honey Badger	X	√	X	X	X	National Red List: Data Deficient IUCN Red List Category: Least Concern Honey Badger preferring habitat of forest, savanna, shrubland. Distributed in India and Nepal - and Western Cape, South Africa, to southern Morocco and south-western Algeria. The presence of Honey Badger in Nepal is known from only a few areas in Nepal (Jnawali et al. 2011) No data available related to local and global population As per the IUCN range distribution map, Honey Badger is distributed near the project area as recorded in the camera trap study in May 16 2018, Jan 12 2019 & Jan 16 2019. https://www.iucnredlist.org/species/41629/45210107 https://www.discoveryjournals.org/Species/current-issue/2022/v23/n71/A12.pdf As the species is reported in very few locations of Nepal, Hence the species is qualifying as a criterion b species. Therefore, it is identified that the project area is a critical habitat for the particular species

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						and the habitat has significant importance for survival this species at the national level.

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Sloth Bear	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Sloth Bear preferring habitat of forest, savanna, shrubland, grassland, artificial/terrestrial, historical distribution includes a large portion of India, Bangladesh, and Sri Lanka, as well as the southern lowlands of Nepal and presumably Bhutan. No data available related to local and global population As per the IUCN range distribution map, Sloth bear is distributed near the project area. https://www.iucnredlist.org/species/13143/166519315 Hence the species is qualifying as a criterion a and b species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Striped hyaena	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Near Threatened Striped hyaena preferring habitat of forest, savanna, shrublands, grasslands, wetlands (India). Species widely distributed from Africa, India, Himalayan foot hills and Nepal No data available related to local and global population As per the IUCN range distribution map, Striped hyaena is distributed near the project area. https://www.iucnredlist.org/species/10274/45195080 Hence the species is qualifying as a criterion a and b species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Barking deer	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Barking deer preferring the habitats such as forest, savanna, shrubland, grassland, artificial/terrestrial. This species occurs in Sri Lanka, most of India, northern Pakistan, Nepal, Bhutan, Bangladesh and southern China No data available related to local and global population As per the IUCN range distribution map, Barking deer is distributed near the project area. https://www.iucnredlist.org/species/136551/22165292 Hence the species is qualifying as a criterion e species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Spotted deer	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Spotter deer preferring habitats such as forests, savannas, grasslands. No data available related to local and global population As per the IUCN range distribution map, Spotted deer is distributed near the project area. https://www.iucnredlist.org/species/41783/22158006 Hence the species is qualifying as a criterion e species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Wild boar	X	X	X	X	√	National Red List: Least Concern IUCN Red List Category: Least Concern Wild boar preferring the habitats such as forest, savanna, shrubland, grassland, wetlands (inland), desert. No data available related to local and global population As per the IUCN range distribution map, Wild boar is distributed in the project area. https://www.iucnredlist.org/species/41775/44141833 Hence the species is qualifying as a criterion e species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Nilgai	X	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Least Concern Nilgai preferring the habitats such as forest, savanna, shrubland, grassland. Distributed in India and in the lowland zone of Nepal No data available related to local and global population As per the IUCN range distribution map, Nilgai is distributed in the project area. https://www.iucnredlist.org/species/2893/115064758 Hence the species is qualifying as a criterion e species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Gaur	√	X	X	X	√	National Red List: Vulnerable IUCN Red List Category: Vulnerable Gaur preferring the habitats such as forest, savanna, shrubland, grassland. Distributed throughout mainland south and southeast Asia and Sri Lanka No data available related to local and global population As per the IUCN range distribution map, Gaur is distributed in the project area. https://www.iucnredlist.org/species/2891/46363646 Hence the species is qualifying as a criterion a and e species. Therefore, it is identified that the project area is a critical habitat for the particular species.

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Chinese Pangolin	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Critically Endangered Chinese Pangolin occurs in forests, shrub lands and grasslands. Distributed Himalayan foothills of Nepal, southern Bhutan, north and north-eastern India. No data available related to local and global population As per the IUCN range distribution map, Chinese Pangolin is distributed near the project area. https://www.iucnredlist.org/species/12764/45222544 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered nor secondary evidences were recorded. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Red Panda	√	√	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Red Panda preferring habitats such as forest and shrub lands. Distributed in Nepal, China, Myanmar, India and Bhutan Global Population declined by 50% over the last three generations (estimated at 18 years). No data available related to local and global population number As per the IUCN range distribution map, Red Panda is distributed far the project area more than 30 km from the project road. https://www.iucnredlist.org/species/714/110023718 It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

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Hispid Hare	√	√	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Hispid Hare preferring habitats such as Grasslands and Wetlands (Inlands). Distributed in Bangladesh, India, Nepal, and Bhutan No data available related to local and global population number As per the IUCN range distribution map, Hispid Hare is distributed in the project area https://www.iucnredlist.org/species/3833/45176688 It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Dhole	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						Dhole preferring habitats such as Grasslands and Shrublands. Historically, Dholes occurred throughout South and East Asia, to as far north as the southern parts of the Russian Federation. Global Population: likely 949-2215 matured individuals are there globally Local Population: Dhole sightings in Nepal are not common hence species occurred in Rara and Khaptad National Parks, Dhorpatan Hunting Reserve of Nepal. As per the IUCN range distribution map, Dhole is distributed in near the project area https://www.iucnredlist.org/species/5953/72477893 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered nor secondary evidences were recorded. It is not possible to demonstrate the presence of a population that has significant importance at the national or global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Asian Elephant	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Asian Elephant prefers habitat such as Forest, Grasslands and Shrublands. Distributed in West Asia along the Iranian coast to Indian subcontinent . The Asian elephant is distributed across 13 range countries with a population of about 41,000 to 52,000 (Sukumar 2006; Williams et al. 2020). The number of Nepal's resident elephants is estimated in 227 individuals. Number of elephants known to be present near the project road ranges from 4-8 individuals, however during monsoon season it will be increase from 12-18 individuals. Therefore, the area can be considered as a refuge habitat of the Asian elephant. Nevertheless, prior precautionary measures will be taken to avoid any disturbance to the Asian elephant in the project area. https://www.iucnredlist.org/species/7140/45818198 Number of elephants known to be present near the project road ranges from 4-8 individuals, however during monsoon season it will be increase from 12-

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						18 individuals. Therefore, the area can be considered as a refuge habitat of the Asian elephant. From Km 130-100, it was noticed that the elephant movement is mostly seasonal during the larger trans-border migratory herds 12-18 individuals from the Chitwan National Park. From Km 100-50, it was noticed that the elephant movement is mostly due to the Small and isolated populations of wild elephants number ranging from 4-7 individuals. As per the site investigation studies conducted along reserve forest areas, the water bodies associated with project road, the species encountered at several location. Hence the species is qualifying as a criterion a and b species. Therefore, it is identified that the project area is a critical habitat for the particular species.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Indian Pangolin	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered Indian Pangolin occurs in Forest, Savanna, Shrubland, Grassland. Distributed in South Asia from northern and southeastern Pakistan through much of India south of the Himalayas. There is very limited information or data on population of this species at any level, and generally there is a lack of research on abundance. There are no quantitative population data available for Nepal. As per the IUCN range distribution map, Indian Pangolin is distributed near the project area https://www.iucnredlist.org/species/12761/123583998 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered nor secondary evidences were recorded. It is not possible to demonstrate the presence of a population that has significant importance at the national or

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: 1. Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. 2. Habitat of significant importance to endemic or restricted-range species. 3. Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. 4. Highly threatened or unique ecosystems. 5. Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
Himalayan Muskdeer	√	√	X	X	X	National Red List: Not listed IUCN Red List Category: Endangered Himalayan Muskdeer is prefers the Forest, Shrubland and Grassland. Distributed in Himalayas of Bhutan, northern India (including Sikkim), Nepal, and China (southwest Xizang) (Groves <i>et al.</i> 1995, Grubb 2005). Little is known of the species' current status. There are very few in China, reflecting the small range there (Yang <i>et al.</i> 2003). As per the IUCN range distribution map, Himalayan Muskdeer is distributed in more than 50 km distance away from the project area https://www.iucnredlist.org/species/13901/61977764 However, as per the site investigation studies conducted along the water bodies associated with project road, the species was not encountered nor secondary evidences were recorded. It is not possible to demonstrate the presence of a population that has significant importance at the national or

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						global level. Therefore, it is concluded that the project area is not a critical habitat for the particular species.
Royal Bengal Tiger	√	X	X	X	X	National Red List: Endangered IUCN Red List Category: Endangered The Tiger is a keystone species, crucial in maintaining the integrity of the ecosystems in which it thrives. Based on the most recent national estimates, the global Tiger population numbers between 3,726 and 5,578 individuals and is restricted to ten countries. Current surveys estimate a population of 235 tigers in Nepal (July 2022). https://www.iucnredlist.org/species/15955/214862019 With reference to the project road, as per the recent tiger census, it was noticed that range distribution of two Tigers namely FT-79 & FT-78 were reported part of the project road. These locations were identified between the km 333+100 to 327+700, this section is outside the Parsa National Park.

	Critical Habitat criterion qualified					Justification
	(a)	(b)	(c)	(d)	(e)	☐ attracting Criterion/ Criteria ☐ not attracting Criterion/ Criteria Criterion as per ESS6: - Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches. - Habitat of significant importance to endemic or restricted-range species. - Habitat supporting globally or nationally significant concentrations of migratory or congregatory species. - Highly threatened or unique ecosystems. - Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).
						As per the site investigation studies conducted along reserve forest areas, the water bodies associated with project road, the species encountered at several location. Hence the species is qualifying as a criterion a and b species. Therefore, it is identified that the project area is a critical habitat for the particular species.

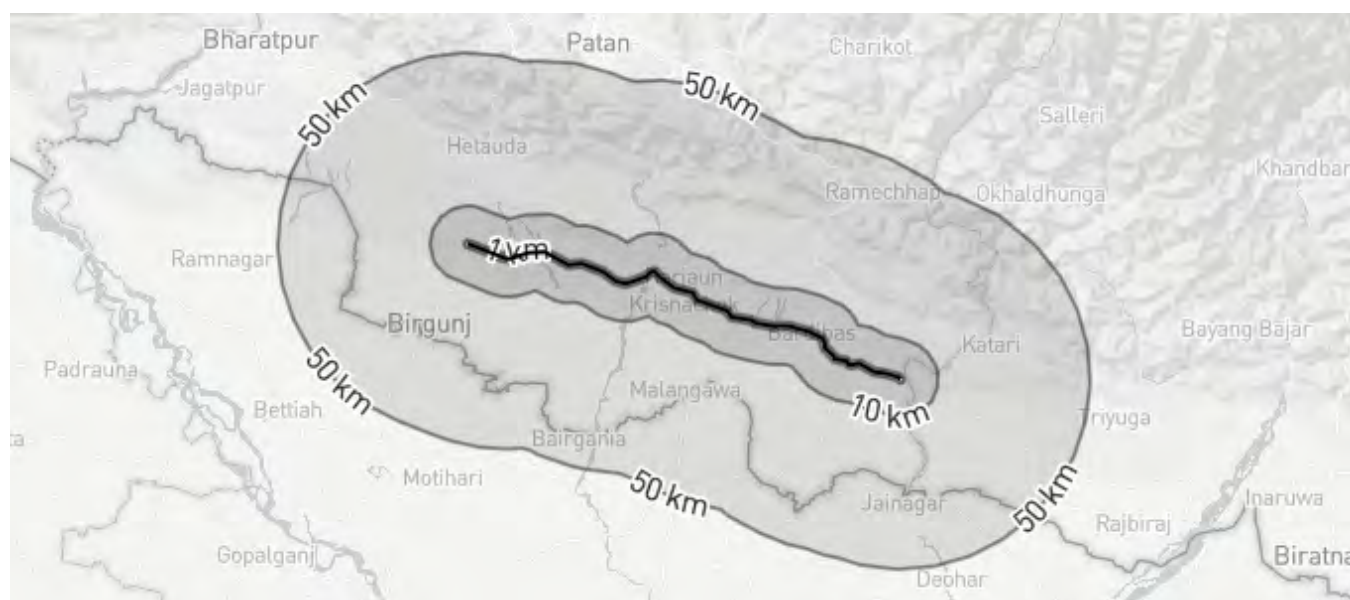
Integrated Biodiversity Assessment Tool World Bank Group Biodiversity Risk Screen

KDP ROAD

- **Country:** Nepal
- **Location:** [27, 85.7]
- **IUCN Red List Biomes:** Freshwater, Terrestrial
- **Created by:** Andrew Edward Cauldwell

Overlaps with:

Protected Areas	1 km: 1	10 km: 1	50 km: 5	7
World Heritage (WH)	1 km: 0	10 km: 0	50 km: 1	1
Key Biodiversity Areas	1 km: 1	10 km: 0	50 km: 3	4
Alliance for Zero Extinction (AZE)	1 km: 0	10 km: 0	50 km: 0	0
IUCN Red List	39			
Critical Habitat	Likely			



Displaying project location and buffers: 1 km, 10 km, 50 km



This report is based on IFC Performance Standard 6 (PS6) but applies to World Bank Environmental and Social Standard 6 (ESS6)

About this report

The recommendations stated alongside any Protected Areas and Key Biodiversity Areas identified in this report are determined by the following:

Protected Areas:

- 'Highest risk. Seek expert help' is stated if the report identifies a designation that includes either 'natural' or 'mixed world heritage site'.
- 'Assess for Critical Habitat' is stated if the report identifies a Strict Nature Reserve, Wilderness Area or National Park as coded by IUCN protected area categories Ia, Ib and II.
- 'Assess for biodiversity risk' is stated if the report identifies any other type of protected area.

Key Biodiversity Areas:

- 'Highest risk. Seek expert help' is stated if the report identifies an Alliance for Zero Extinction site.
- 'Assess for Critical Habitat' is stated if the report identifies Critically Endangered or Endangered species OR species with restricted ranges OR congregatory species as coded in the IUCN Red List of Threatened Species.
- 'Assess for biodiversity risk' is stated if the report identifies any other type of Key Biodiversity Area.

IBAT provides initial screening for Critical Habitat values. Performance Standard 6 (PS6) defines these values for Critical Habitat (PS6: para. 16) and legally protected and internationally recognized areas (PS6: para. 20). PS6 will be triggered when IFC client activities are located in modified habitats containing "significant biodiversity value," natural habitats, Critical Habitats, legally protected areas, or areas that are internationally recognized for biodiversity. References to PS6 and Guidance Note 6 (GN6) are provided to guide further assessment and detailed definitions where necessary. Please see <https://www.ifc.org/ps6> for full details on PS6 and GN6.

The report screens for known risks within a standard 50km buffer of the coordinates used for analysis. This buffer is not intended to indicate the area of impact. The report can be used to:

- Scope risks to include within an assessment of risks and impacts
- Identify gaps within an existing assessment of risks and impacts
- Prioritize between sites in a portfolio for further assessment of risks and impacts
- Inform a preliminary determination of Critical Habitat
- Assess the need for engaging a biodiversity specialist
- Identify additional conservation experts or organizations to inform further assessment or planning

WARNING: IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment as described in PS6 and GN6. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the [Sensitive Data Access Restrictions Policy for the IUCN Red List](#). This relates to sensitive Threatened species and KBAs triggered by sensitive species.

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Priority Species

Habitat of significant importance to priority species will trigger Critical Habitat status (See PS6: para 16). IBAT provides a preliminary list of priority species that could occur within the 50km buffer. This list is drawn from the IUCN Red List of Threatened Species (IUCN RL). This list should be used to guide any further assessment, with the aim of confirming known or likely occurrence of these species within the project area. It is also possible that further assessment may confirm occurrence of additional priority species not listed here. It is strongly encouraged that any new species information collected by the project be shared with species experts and/or IUCN wherever possible in order to improve IUCN datasets.

IUCN Red List of Threatened Species - CR & EN

The following species are potentially found within 50km of the area of interest.
For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Batagur kachuga	Red-crowned Roofed Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Batagur dhongoka	Three-striped Roofed Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Aythya baeri	Baer's Pochard	AVES	CR	Decreasing	Freshwater
Emberiza aureola	Yellow-breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater
Geoclemys hamiltonii	Spotted Pond Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Hardella thurjii	Crowned River Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Morenia petersi	Indian Eyed Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Nilssonia gangetica	Indian Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Nilssonia hurum	Indian Peacock Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Axis porcinus	Hog Deer	MAMMALIA	EN	Decreasing	Terrestrial, Freshwater
Amblyceps arunchalensis		ACTINOPTERYGII	EN	Unknown	Freshwater
Sterna acuticauda	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
Haliaeetus leucoryphus	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
Neophron percnopterus	Egyptian Vulture	AVES	EN	Decreasing	Terrestrial, Freshwater
Falco cherrug	Saker Falcon	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
Leptoptilos dubius	Greater Adjutant	AVES	EN	Decreasing	Terrestrial, Freshwater
Tor putitora		ACTINOPTERYGII	EN	Decreasing	Freshwater
Indotestudo elongata	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
Manis pentadactyla	Chinese Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
Houbaropsis bengalensis	Bengal Florican	AVES	CR	Decreasing	Terrestrial
Sypheotides indicus	Lesser Florican	AVES	CR	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Vanellus gregarius</i>	Sociable Lapwing	AVES	CR	Decreasing	Terrestrial
<i>Gyps bengalensis</i>	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
<i>Sarcogyps calvus</i>	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
<i>Gyps tenuirostris</i>	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
<i>Gyps indicus</i>	Indian Vulture	AVES	CR	Decreasing	Terrestrial
<i>Nardostachys jatamansi</i>	Indian Nard	MAGNOLIOPSIDA	CR	Decreasing	Terrestrial
<i>Sitana fusca</i>	Dark Sitana	REPTILIA	CR	Unknown	Terrestrial
<i>Ailurus fulgens</i>	Red Panda	MAMMALIA	EN	Decreasing	Terrestrial
<i>Caprolagus hispidus</i>	Hispid Hare	MAMMALIA	EN	Decreasing	Terrestrial
<i>Cuon alpinus</i>	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
<i>Elephas maximus</i>	Asian Elephant	MAMMALIA	EN	Decreasing	Terrestrial
<i>Manis crassicaudata</i>	Indian Pangolin	MAMMALIA	EN	Decreasing	Terrestrial
<i>Melanochelys tricarinata</i>	Tricarinate Hill Turtle	REPTILIA	EN	Decreasing	Terrestrial
<i>Moschus leucogaster</i>	Himalayan Muskdeer	MAMMALIA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Panthera tigris</i>	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
<i>Varanus flavescens</i>	Yellow Monitor	REPTILIA	EN	Decreasing	Terrestrial
<i>Aquila nipalensis</i>	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
<i>Trillium govanianum</i>	Himalayan Trillium	LILIOPSIDA	EN	Decreasing	Terrestrial

Restricted Range Species

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Chrysomma altirostre</i>	Jerdon's Babbler	AVES	VU	Decreasing	Terrestrial, Freshwater
<i>Salvinia natans</i>	Floating Fern	POLYPODIOPSIDA	LC OR LR/LC	Decreasing	Freshwater
<i>Amblyceps mangois</i>		ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater
<i>Xenentodon cancila</i>		ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater
<i>Schistura multifasciata</i>		ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater
<i>Schizothorax progastus</i>	Dinnawah snowtrout	ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater
<i>Oreichthys cosuatis</i>		ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Psilorhynchus nepalensis		ACTINOPTERYGII	LC OR LR/LC	Unknown	Freshwater
Macrobrachium rosenbergii	Giant River Prawn	MALACOSTRACA	LC OR LR/LC	Unknown	Freshwater
Geokichla wardii	Pied Thrush	AVES	LC OR LR/LC	Decreasing	Terrestrial, Freshwater
Macromia sombui		INSECTA	DD	Unknown	Freshwater
Prinia cinereocapilla	Grey-crowned Prinia	AVES	VU	Decreasing	Terrestrial
Argya longirostris	Slender-billed Babbler	AVES	VU	Decreasing	Terrestrial
Liopeltis rappi	Himalayan Stripe-necked Snake	REPTILIA	LC OR LR/LC	Unknown	Terrestrial
Trimeresurus tibetanus	Tibetan Pit Viper	REPTILIA	LC OR LR/LC	Unknown	Terrestrial
Acanthoptila nipalensis	Spiny Babbler	AVES	LC OR LR/LC	Stable	Terrestrial
Diomys crumpi	Crump's Mouse	MAMMALIA	DD	Unknown	Terrestrial
Eptesicus dimissus	Surat Serotine	MAMMALIA	DD	Unknown	Terrestrial

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 1 km and 10 km and 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Parsa - Buffer Zone	1 km	VI	Designated	Wildlife Reserve - Buffer Zone	 Assess for biodiversity risk
Parsa	10 km	IV	Designated	Wildlife Reserve	 Assess for biodiversity risk
Bara	50 km	Not Reported	Proposed	Conservation Area	 Assess for biodiversity risk
Chitwan	50 km	II	Designated	National Park	 Assess for critical habitat
Chitwan - Buffer Zone	50 km	VI	Designated	National Park - Buffer Zone	 Assess for biodiversity risk
Chitwan National Park	50 km	Not Applicable	Inscribed	World Heritage Site (natural or mixed)	 Highest risk. Seek expert help
Phulchoki	50 km	Not Reported	Proposed	Conservation Area	 Assess for biodiversity risk

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km and 10 km and 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	IBA	AZE	Recommendation
Parsa Wildlife Reserve	1 km	Yes	No	 Assess for critical habitat
Chitwan National Park	50 km	Yes	No	 Assess for critical habitat
Phulchoki Mountain forests	50 km	Yes	No	 Assess for critical habitat
Valmiki Tiger Reserve and Saraiyaman Lake	50 km	Yes	No	 Assess for critical habitat

Species with potential to occur

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
REPTILIA	98	17	4	7	6	7	72	2
AVES	672	31	9	6	16	28	613	0
MAMMALIA	133	22	1	8	13	11	95	5
ACTINOPTERYGII	75	4	0	2	2	6	58	7
INSECTA	107	1	0	0	1	0	102	4
GASTROPODA	52	1	0	0	1	0	44	7
AMPHIBIA	33	0	0	0	0	1	31	1

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
MALACOSTRACA	16	0	0	0	0	0	14	2
BIVALVIA	40	0	0	0	0	0	35	5
POLYPODIOPSIDA	4	0	0	0	0	0	4	0
MAGNOLIOPSIDA	72	2	1	0	1	1	68	1
LILIOPSIDA	62	3	0	1	2	0	57	2
AGARICOMYCETES	1	0	0	0	0	0	1	0
ARACHNIDA	3	0	0	0	0	0	3	0
LECANOROMYCETES	1	0	0	0	0	0	1	0

Recommended citation

IBAT PS6 & ESS6 Report. Generated under licence 6354-27097 from the Integrated Biodiversity Assessment Tool on 14 February 2022 (GMT). www.ibat-alliance.org

Recommended Experts and Organizations

For projects located in Critical Habitat, clients must ensure that external experts with regional expertise are involved in further assessment (GN6: GN22). Clients are encouraged to develop partnerships with recognized and credible conservation organizations and/or academic institutes, especially with respect to potential developments in natural or Critical Habitat (GN6: GN23). Where Critical Habitats are triggered by priority species, species specialists must be involved. IBAT provides data originally collected by a large network of national partners, while species information is sourced via the IUCN Red List and affiliated Species Specialist Groups. These experts and organizations are listed below. **Please note that this is not intended as a comprehensive list of organizations and experts. These organizations and experts are under no obligation to support any further assessment and do so entirely at their discretion and under their terms. Any views expressed or recommendations made by these stakeholders should not be attributed to the IFC or IBAT for IFC partners.**

Birdlife Partners

URL: <https://www.birdlife.org/worldwide/partnership/birdlife-partners>

Directory for Species Survival Commission (SSC) Specialist Groups and Red List Authorities

URL: <https://www.iucn.org/commissions/ssc-groups>

Annexure VIII: Guidance/Case Studies Referred for Arriving Mitigation Measures

Case Study 1: Asian Elephant Transport Working Group 2021¹

The Asian Elephant Transport Working Group (AsETWG) is a cross-commission collaboration of the IUCN World Commission on Protected Areas' Connectivity Conservation Specialist Group (CCSG) and the IUCN Species Survival Commission's Asian Elephant Specialist Group (AsESG). Case studies were captured from Malaysia, India, Bangladesh, Sri Lanka, Nepal, China, Bhutan, Myanmar and Cambodia.

- In Bhutan to accommodate elephant passage, underpasses constructed range in height from 5.6 to 7.6 meters with 76% passing through the structures between 2015-2017.



Figure 0-1: Elephant utilizing underpass in Bhutan <5 meters have height been documented².

- Group recommended Expanded bridges span rivers, streams and wetland areas and exceed 40 meters in width under which elephants can pass (minimum 5 meters height clearance, preferably higher)

¹ Ament, R., Tiwari, S.K., Butynski, M., Chen, B.S., Dodd, N., Gangadharan, A., Jayasinghe, N., Laur, A., Oppler, G., Wong, E.P., van der Ree, R., Wang, Y. (2021). Protecting Asian Elephants from Linear Transport Infrastructure: The Asian Elephant Transport Working Group's Introduction to the Challenges and Solutions. AsETWG (Asian Elephant Transport Working Group; IUCN WCPA Connectivity Conservation Specialist Group/IUCN SSC Asian Elephant Specialist Group). <https://doi.org/10.53847/VYWN4174>, https://conservationcorridor.org/wp-content/uploads/2021_12-5_AsETWG_Primer_final_en.pdf

² https://conservationcorridor.org/wp-content/uploads/16-2_Norris-Dodd-ADB_Bhutan-2-scaled.jpg

ADB-2019: Green Infrastructure Design for Transport Projects A Road Map to Protecting Asia's Wildlife Biodiversity³.

ADB has developed guidelines for balancing economic development with conserving Asia's biodiversity in transport infrastructure projects by adopting proactive integration of ecological protection measures.

- Recommendations were “For Asian Elephant Minimum Underpass Dimensions were 6.5 m height for width more than 15 m”.

Table 0-1: Wildlife Underpass Types, Size Categories and Recommended Dimensions

Size Class	Underpass Structure Type				Focal Wildlife Taxa	Minimum Underpass Dimensions			
	CMP	CBC	Arch	Bridge		≤20 m Length		35 m Length	
						Width (m)	Height (m)	Width (m)	Height (m)
Small	X	X	X		Reptiles Amphibians Mustelids	2.0	2.0	3.0	2.5
Medium		X	X		Small ungulates Small felids Bears	6.0	3.0	8.0	3.0
Large			X	X	Large ungulates Bovids Large felids Large canids	10.0	4.0	15.0	4.5
Very Large			X	X	Asian elephant	12.0	5.5	15.0	6.5

CBC = concrete box culverts, CMP = corrugated metal pipe culverts, m = meter.
Source: Asian Development Bank consultant's estimates.

Wildlife Institute of India (WII), 2016.⁴

WII in association with WORLDBANK Group has developed “Eco-Friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife” in India.

- Recommendations were “The Minimum height of the underpass should be 6-8 m to provide an optimum passage for Asian Elephants & Rhinos”.

³ The Asian Development Bank's *Green Infrastructure Design for Transport Projects: A Road Map to Protecting Asia's Wildlife Biodiversity* published in 2019 to highlight the impacts of transport projects on wildlife and biodiversity in Asia, and the diversity of measures available for balancing construction with conservation (ADB, 2019). <https://www.adb.org/publications/green-transport-projects-asia-wildlife>

⁴ Wildlife Institute of India (2016) *Eco-Friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife* to provide detailed guidance for planning, locating, designing, implementing and operating infrastructure roads, railways and powerlines in wildlife habitats https://wii.gov.in/cia_bpg_guidance_document_2017

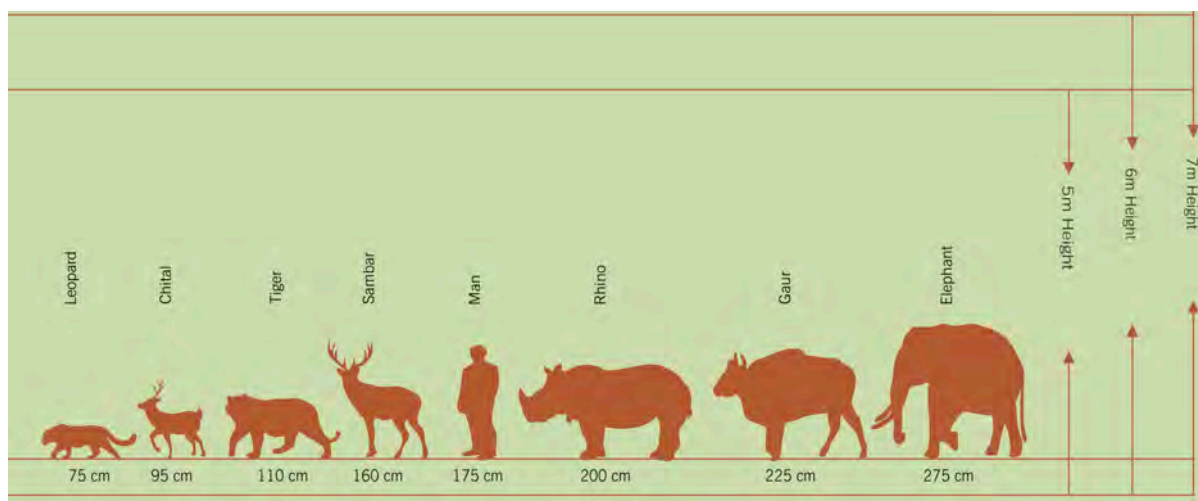


Figure 0-2: Underpass Height as they should Relate to Animals

Nepal Guidelines

- A. As per the Ministry of Forest & Environment, Nepal Wildlife friendly infrastructure construction Guideline dated 2078 BS
 - o “Minimum height for Asian Elephant Minimum Underpass Dimensions were 6.5 m”.
- B. Department of Roads in association with Ministry of Forest & Environment, Nepal framed Draft Guidelines for Construction of Eco-friendly Linear Infrastructures.
 - o Minimum Recommended Dimensions for Asian Elephant with Clear Height of 8-10 m and Openness index must be a minimum of 1.4 m.

Case Study 2: Nepal- Kakarbhitta-Laukahi Road (South-Eastern Nepal)

- A. Nepal: South Asia Sub-regional Economic Cooperation Highway Enhancement Project (ADB Funding project), Kakarbhitta-Laukahi Road:
 - o Minimum underpass dimensions for the target KL Road wildlife species such as Elephants and small mammals from the Nepal endorsed wildlife-friendly infrastructure guidelines (MoFE 2022) by underpass size classes for Asian elephant is 6.5 m and two underpasses were suggested.

Case Study 3: India, Uttarakhand

A. Rajaji National Park, Uttarakhand:

Three flyovers are being constructed during upgradation of NH 58 and NH 72 which pass through three elephant corridors of Rajaji Tiger Reserve, Uttarakhand. The recommendations included flyovers of at least 6 m height⁵ each and width of 736 m on NH 58 which passes through Chilla Motichur corridor.

To facilitate the movement of elephants and other wildlife, three “flyovers for vehicles” are being constructed. Two of the underpasses below the flyover have been completed – Chilla-Motichur corridor (0.9 km) and Motichur-Barkote & Rishikesh (0.5 km) and a third is being constructed in Kansra-Barkote corridor (0.5 km).

⁵ <https://www.researchgate.net/publication/329916021> CURRENT SCIENCE, VOL. 115, NO. 12, 25 DECEMBER 2018



Figure 0-3: A view of the National Highway 72 underpass (6 m height) for the Elephant Chilla-Motichur corridor in Northern India.

© Wildlife Trust of India, <https://conservationcorridor.org/ccsg/working-groups/asewtg/case-studies/indianh72/>

B. SASEC Road Connectivity Investment Program – Tranche 1, ADB Funding Project 2017. Asian Highway 2 (India /Nepal Border to India/Bangladesh Border)

- The raising of level would only be required when Elephant Under Pass EUP is constructed to provide 6 m vertical clearance⁶.

Vertical Clearance Proposed for Elephant Crossings by Different Agencies/Countries

Table 0-2: Summary of Height for Vertical Clearance proposed for Elephant Crossings by Different Agencies/Countries

S.No.	Agency/Organization	Country	Minimum Height of the Bridge (meters)
1.	Asian Elephant Transport Working Group Guidelines (AsETWG) 2021	Bhutan	5.6 to 7.6
2.	ADB Guidelines 2019	Philippines	6.5
3.	Wildlife Institute of India 2016	India	6-8
4.	SASEC Assam Northeast India /Nepal Border. ADB Project	India	6.0
5.	NH-54E, Assam	India	6.0
6.	NH 58, Uttarakhand	India	6.0
7.	MoFE Nepal	Nepal	6.5
8.	EIA of Upgrading Kakarbhitta-Laukahi Road- ADB Funding Project	Nepal	6.5

⁶ <https://www.adb.org/sites/default/files/project-document/79885/47341-001-eia.pdf>.

Annexure IX: List of Culverts and its locations proposed for wildlife crossings

S.N.	Chainage	BOX SIZE			Total Width of box
		CELL	W	H	
	km	no	mm	mm	m
1	270+020	2	3000	3000	26.90
2	270+216	2	3000	3000	26.90
3	272+469	1	3000	3000	26.90
4	273+223	3	6000	3500	26.90
5	273+890	2	6000	3500	26.90
6	274+011	2	6000	3500	26.90
7	275+477	1	6000	3000	26.90
8	276+527	2	6000	3000	26.90
9	279+041	1	3000	3000	31.42
10	279+730	3	6000	3500	26.90
11	280+231	2	3000	2500	26.90
12	281+416	2	3000	3000	26.90
13	283+845	2	3000	3000	36.47
14	284+289	1	3000	2000	26.90
15	284+769	1	3000	3000	26.90
16	285+188	1	3000	2000	26.90
17	286+113	3	6000	4000	26.90
18	286+600	1	6000	3000	26.90
19	287+167	2	3000	2000	26.90
20	287+830	3	6000	4000	29.30
21	288+884	3	6000	4500	28.42
22	315+896	2	3000	3000	26.90
23	316+558	2	3000	2500	26.90
24	316+888	1	6000	3000	26.90
25	317+305	1	6000	3500	26.90
26	318+520	2	3000	2000	26.90
27	320+498	3	6000	4000	28.46
28	321+770	2	6000	3000	26.90
29	322+528	2	6000	3500	26.90
30	328+483	1	3000	2500	26.90
31	329+360	1	6000	4500	26.90
32	330+347	1	6000	3000	26.90
33	331+896	1	6000	3000	26.90

S.N.	Chainage	BOX SIZE			Total Width of box
		CELL	W	H	
	km	no	mm	mm	m
34	334+595	1	3000	3000	26.90
35	334+937	1	3000	3000	29.78
36	335+166	1	6000	4500	26.90
37	336+205	3	6000	4000	29.94
38	337+073	1	6000	3000	26.90
39	338+015	2	3000	3000	31.98
40	340+907	1	6000	3000	26.90
41	341+808	1	6000	3000	26.90
42	347+665	1	6000	3000	26.90
43	348+056	2	3000	2500	26.90
44	350+172	2	3000	3000	32.26
45	350+273	1	6000	3500	26.90
46	350+800	2	3000	2500	26.90
47	351+249	1	3000	2000	26.90
48	352+107	1	3000	3000	31.06
49	352+206	1	3000	3000	31.18
50	352+706	2	3000	2500	26.90
51	355+300	2	3000	2500	26.90
52	356+080	2	6000	3500	28.12
53	359+478	2	3000	2500	26.90
54	360+100	2	3000	2500	26.90
55	361+106	1	6000	3500	26.90
56	361+703	2	3000	3000	26.90
57	362+054	1	6000	3000	26.90
58	362+304	2	3000	2500	26.90
59	363+184	1	3000	2500	26.90
60	363+969	2	3000	2500	26.90

Annexure X : Location of Rumble Strips suggested

S.NO	CHAINAGE (Km)	CHAINAGE (Km)	
		LHS	RHS
1	270+020	269+920	270+120
2	270+216	270+116	270+316
3	272+469	272+369	272+569
4	273+223	273+123	273+323
5	273+890	273+790	273+990
6	274+011	273+911	274+111
7	275+477	275+377	275+577
8	276+527	276+427	276+627
9	279+041	278+941	279+141
10	279+730	279+630	279+830
11	280+231	280+131	280+331
12	281+416	281+316	281+516
13	283+845	283+745	283+945
14	284+289	284+189	284+389
15	284+769	284+669	284+869
16	285+188	285+088	285+288
17	286+113	286+013	286+213
18	286+600	286+500	286+700
19	287+167	287+067	287+267
20	287+830	287+730	287+930
21	288+884	288+784	288+984
22	315+896	315+796	315+996
23	316+558	316+458	316+658
24	316+888	316+788	316+988
25	317+305	317+205	317+405
26	318+520	318+420	318+620
27	320+498	320+398	320+598
28	321+770	321+670	321+870
29	322+528	322+428	322+628
30	328+483	328+383	328+583
31	329+360	329+260	329+460
32	330+347	330+247	330+447
33	331+896	331+796	331+996
34	334+595	334+495	334+695
35	334+937	334+837	335+037
36	335+166	335+066	335+266
37	336+205	336+105	336+305
38	337+073	336+973	337+173
39	338+015	337+915	338+115

40	340+907	340+807	341+007
41	341+808	341+708	341+908
42	347+665	347+565	347+765
43	348+056	347+956	348+156
44	350+172	350+072	350+272
45	350+273	350+173	350+373
46	350+800	350+700	350+900
47	351+249	351+149	351+349
48	352+107	352+007	352+207
49	352+206	352+106	352+306
50	352+706	352+606	352+806
51	355+300	355+200	355+400
52	356+080	355+980	356+180
53	359+478	359+378	359+578
54	360+100	360+000	360+200
55	361+106	361+006	361+206
56	361+703	361+603	361+803
57	362+054	361+954	362+154
58	362+304	362+204	362+404
59	363+184	363+084	363+284
60	363+969	363+869	364+069
61	365+002	364+902	365+102