FIGURE 3.1: UPGRADING KAMALA-DHALKEBAR-PATHLAIYA MAHENDRA HIGHWAY ALIGNMENT

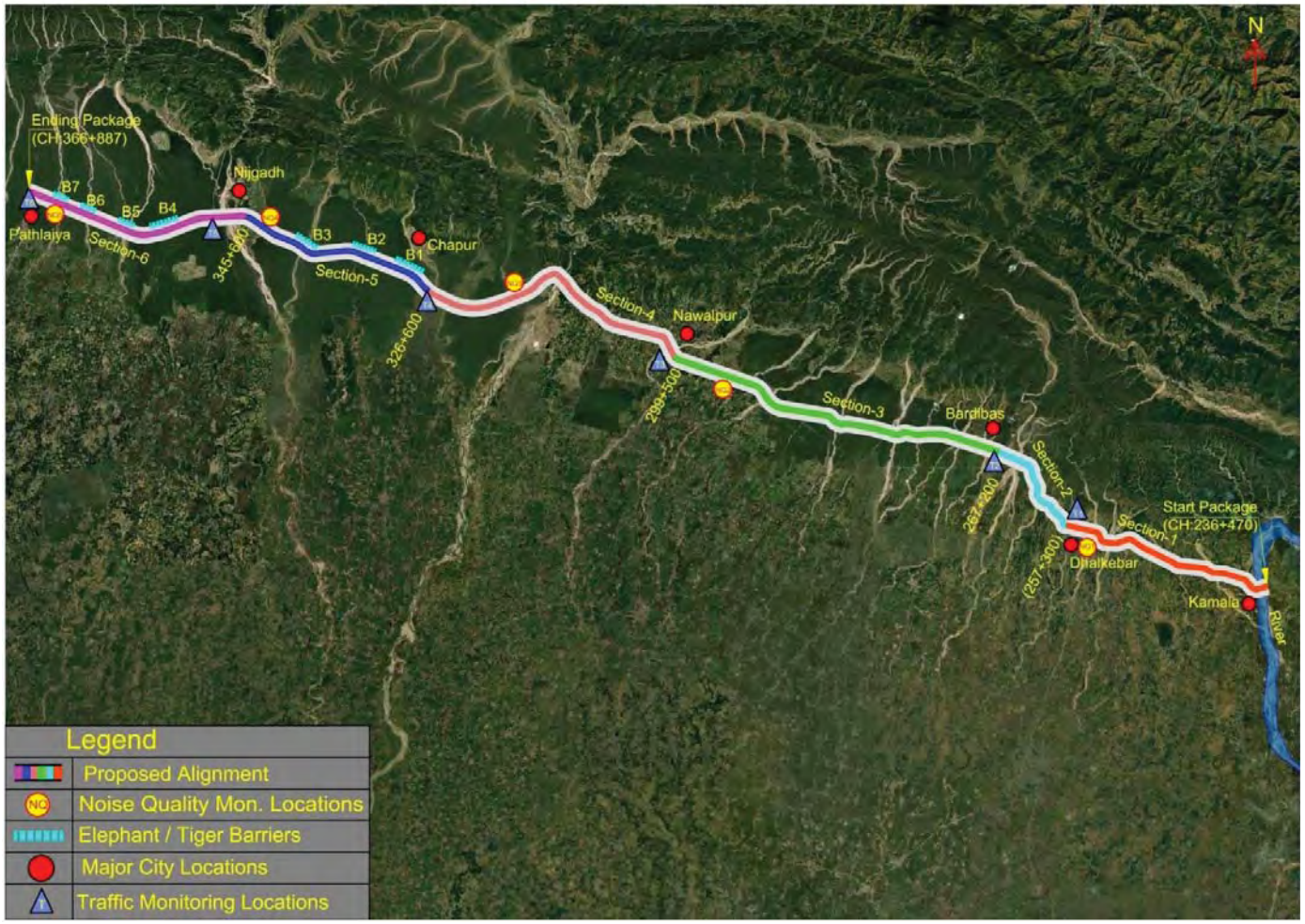


TABLE 3.1: TRAFFIC FORECAST FOR KAMALA-DHALKEBAR SECTION

Vehicle type	AADT Jan, 2026 VPD	AADT Jan, 2031 VPD	AADT Jan, 2036 VPD	AADT Jan, 2041 VPD	AADT Jan, 2046 VPD
MA Truck	1387	1599	1861	2224	2656
Truck	794	916	1066	1273	1521
Mini truck	145	167	194	232	277
Large bus	581	663	773	898	1043
Mini bus	104	118	138	160	186
Micro bus	684	780	911	1058	1228
Car	798	1020	1360	1796	2372
Motorcycle	8221	11929	18136	27232	40892
Utility vehicle	694	781	897	1026	1173
4-wheel drive	1129	1443	1923	2539	3354
Tractor	176	208	253	306	369

TABLE 3.2: TRAFFIC FORECAST FOR DHALKEBAR- BARDIBAS SECTION

Vehicle type	AADT Jan, 2026 VPD	AADT Jan, 2031 VPD	AADT Jan, 2036 VPD	AADT Jan, 2041 VPD	AADT Jan, 2046 VPD
MA Truck	1351	1557	1813	2166	2588
Truck	864	995	1159	1384	1654
Mini truck	159	183	213	254	304
Large bus	705	804	939	1090	1266
Mini bus	108	123	143	166	193
Micro bus	583	665	777	902	1048
Car	812	1037	1382	1825	2411
Motorcycle	9045	13124	19954	29962	44990
Utility vehicle	834	939	1079	1233	1411
4 wheel drive	1292	1651	2200	2905	3837
Tractor	170	201	244	295	357

TABLE 3.3: TRAFFIC FORECAST FOR BARDIBAS –NAWALPUR SECTION

Vehicle type	AADT Jan, 2026 VPD	AADT Jan, 2031 VPD	AADT Jan, 2036 VPD	AADT Jan, 2041 VPD	AADT Jan, 2046 VPD
MA Truck	924	1065	1240	1481	1769
Truck	6263	721	840	1004	1199
Mini truck	232	267	311	371	444
Large bus	742	847	988	1148	1333
Mini bus	139	159	186	215	250
Micro bus	384	439	512	595	691
Car	786	1005	1339	1768	2335
Motorcycle	7361	10681	16239	24384	36614
Utility vehicle	688	774	889	1016	1162
4 wheel drive	918	1173	1563	2064	2726
Tractor	148	175	213	257	310

TABLE 3.4: TRAFFIC FORECAST FOR NAWALPUR-CHAPUR SECTION

Vehicle type	AADT Jan, 2026 VPD	AADT Jan, 2031 VPD	AADT Jan, 2036 VPD	AADT Jan, 2041 VPD	AADT Jan, 2046 VPD
MA Truck	940	1084	1262	1507	1801
Truck	741	854	994	1188	1419
Mini truck	249	287	334	399	477
Large bus	687	784	915	1063	1235
Mini bus	169	192	224	261	303
Micro bus	348	397	463	538	624
Car	815	1042	1388	1833	2421
Motorcycle	10780	15643	23783	35711	53624
Utility vehicle	638	718	825	943	1079
4 wheel drive	896	1145	1526	2015	2661
Tractor	302	357	435	525	634

TABLE 3.5: TRAFFIC FORECAST FOR CHAPUR-NIJGADH SECTION

Vehicle type	AADT Jan,	AADT Jan,	AADT Jan,	AADT Jan,	AADT Jan,

	2026 VPD	2031 VPD	2036 VPD	2041 VPD	2046 VPD
MA Truck	940	1083	1261	1507	1800
Truck	794	916	1066	1273	1521
Mini truck	339	391	455	544	650
Large bus	685	782	912	1060	1231
Mini bus	195	222	259	301	350
Micro bus	294	335	391	455	528
Car	815	1042	1389	1834	2422
Motorcycle	11642	16894	25684	38567	57912
Utility vehicle	545	613	704	805	921
4-wheel drive	794	1015	1353	1786	2359
Tractor	428	506	615	743	897

TABLE 3.6: TRAFFIC FORECAST FOR NIJGADH-PATHLAIYA SECTION

Vehicle type	AADT Jan, 2026 VPD	AADT Jan, 2031 VPD	AADT Jan, 2036 VPD	AADT Jan, 2041 VPD	AADT Jan, 2046 VPD
MA Truck	1397	1610	1875	2240	2660
Truck	1205	1389	1617	1932	2294
Mini truck	637	735	855	1022	1213
Large bus	1044	1191	1390	1614	1874
Mini bus	224	255	298	346	402
Micro bus	253	289	337	392	455
Car	1533	1960	2612	3449	4548
Motorcycle	3914	5680	8636	12967	19445
Utility vehicle	527	593	682	779	891
4-wheel drive	914	1168	1557	2056	2711
Tractor	142	167	204	246	297

Potential noise impact assessment due to the traffic volume in base year 2026 plying on the proposed up-grading Kamala to Pathlaiya corridor without noise barrier was performed using modelling technique with reference to the noise descriptors Ld (Daytime: 6 AM-10 PM), Ln (Nighttime: 10 PM-6 PM) and Ldn (Day-Night: 24-Hour) in dB (A) considering the average vehicular speed 100 kmph for LCV and 90 kmph for Bus and HMV and 60 kmph for motorcycles. Ground condition between source and receptor along the entire alignment was assumed acoustically "hard" (non-absorptive) for conservative assessment. Modelling result with respect to three sound level descriptors Ld, Ln and Ldn due to traffic on each segment of Mahendra highway in the base year (2026) at desired distance 15 m, 30 m, 50 m, 100 m and 150 m from the median of the highway corridor is presented in **Tables 3.7 to 3.12** and spatial variation of noise level along the each corridor alignment at the interested distance are shown graphically in **Figure 3.2 through Figure 3.7.**

TABLE 3.7: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: KAMALA-DHALKEBAR

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	70.3	70.8	73.6
30	66.7	67.3	70.0
50	64.4	65.0	67.7
100	61.4	61.9	64.6
150	59.6	60.1	62.9

TABLE 3.8: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: DHALKEBAR-BARDIBAS

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	70.5	71.1	73.8
30	67.0	67.5	70.3
50	64.7	65.2	67.9
100	61.6	62.1	64.9
150	59.8	60.4	61.1

TABLE 3.9: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: BARDIBAS-NAWALPUR

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	69.6	70.1	72.9
30	66.0	66.6	69.3
50	63.7	64.3	67.0
100	60.7	61.2	63.9
150	58.9	59.4	62.2

TABLE 3.10: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: NAWALPUR-CHAPUR

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	69.7	70.3	73.0
30	66.2	66.7	69.5
50	63.9	64.4	62.1
100	60.8	61.3	64.1
150	59.0	59.6	62.3

TABLE 3.11: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: CHAPUR-NIHGADH

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	69.9	70.4	73.1
30	66.3	66.9	69.6
50	64.0	64.5	67.3
100	60.9	61.5	64.2
150	59.2	59.7	62.5

TABLE 3.12: PREDICTED NOISE LEVEL dB(A) AT DISCRETE DIST DUE TO TRAFFIC: NIHGADH-PATHLAIYA

Distance from Median: Traffic Year 2026	Daytime (Ld) dB(A)	Nighttime (Ln) dB(A)	Day-Nighttime (Ldn) dB(A)
15	71.9	72.5	75.2
30	68.4	68.9	71.7
50	66.1	66.6	69.3
100	63.0	63.5	66.3
150	61.2	61.8	64.5

FIGURE 3.2 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAYTIME (LD): TRAFFIC ON KAMALA-DHALKEBAR

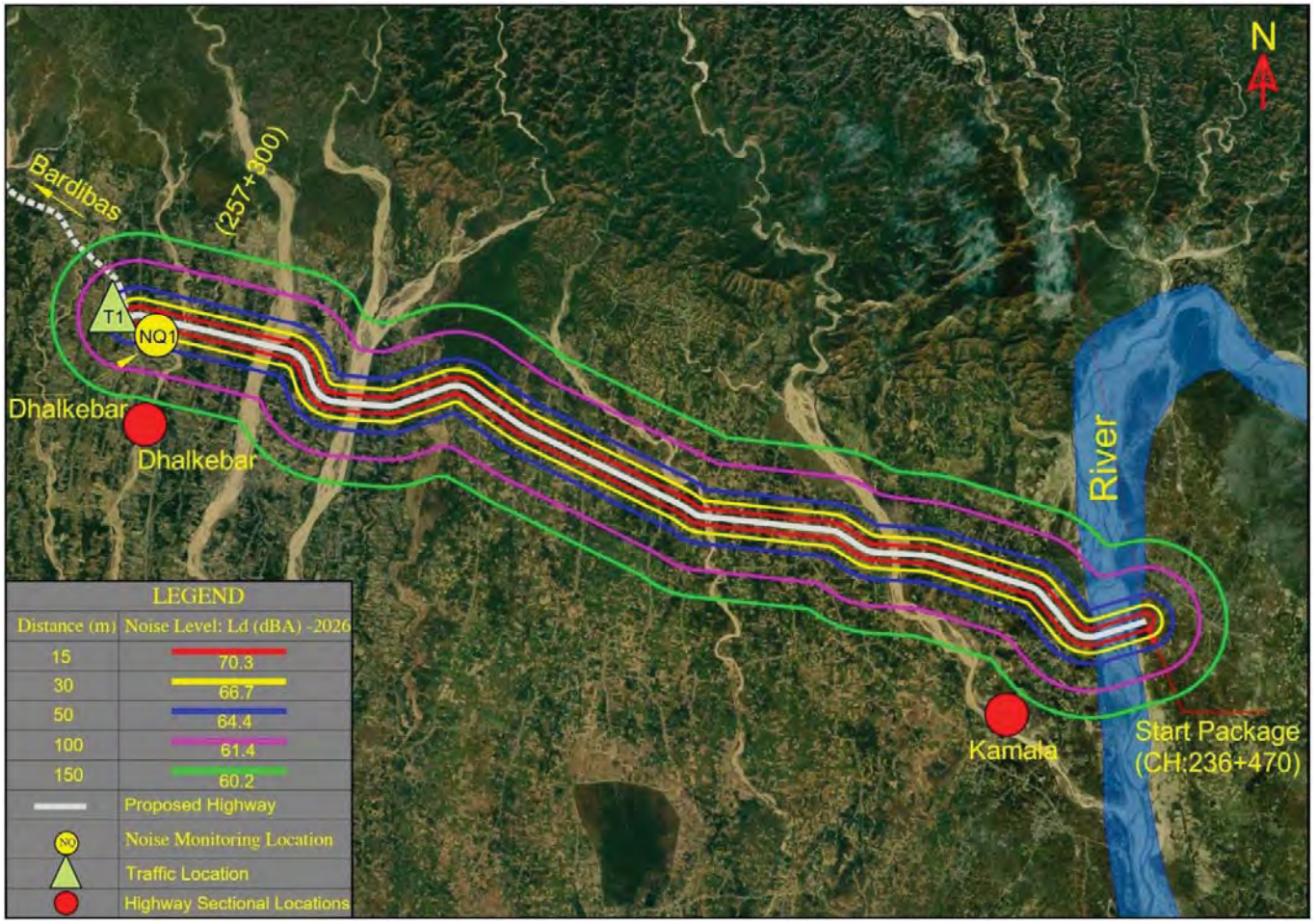


FIGURE 3.2 B: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING NIGHTTIME (LN): TRAFFIC ON KAMALA-DHALKEBAR

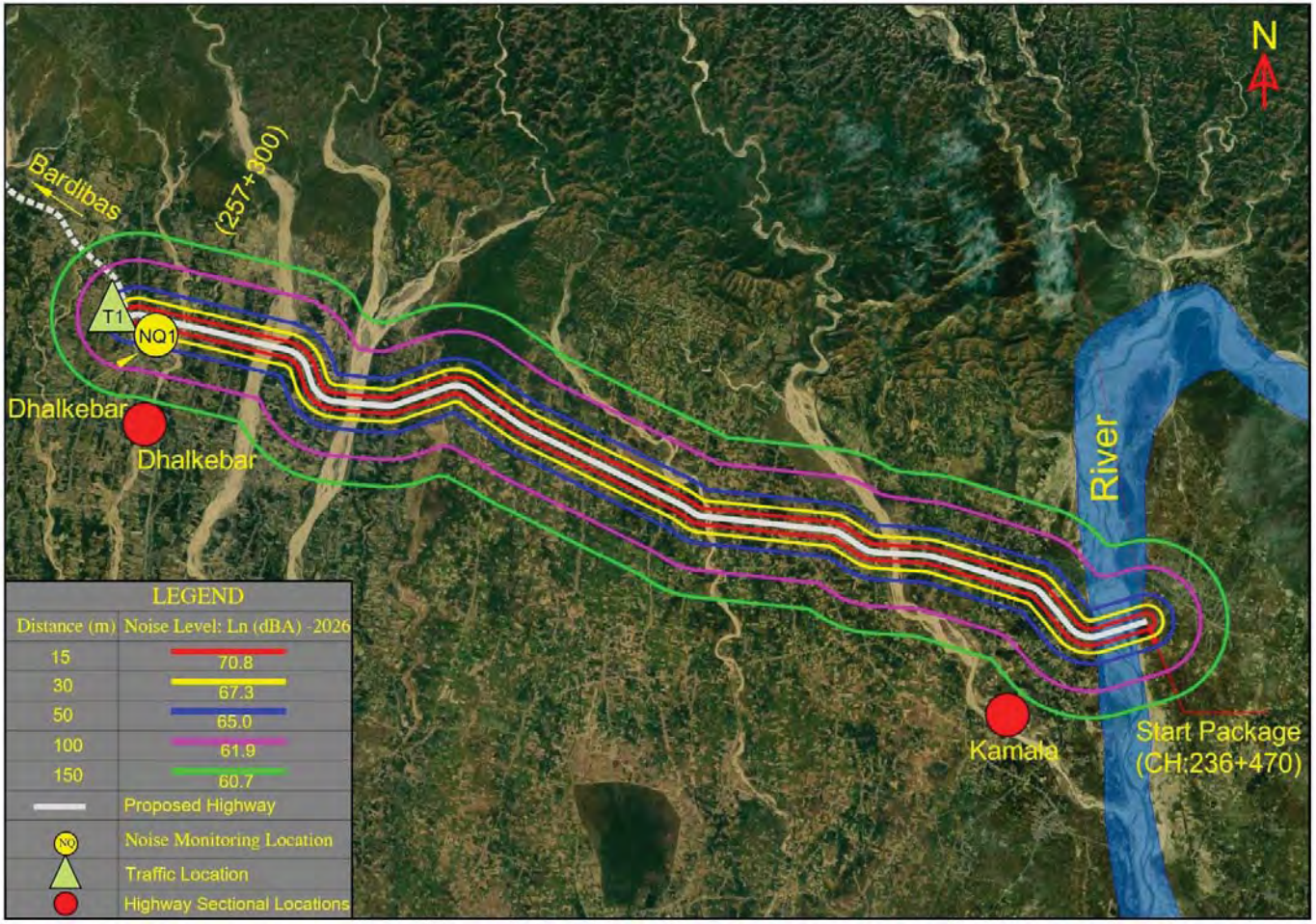


FIGURE 3.2 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHTTIME (LDN): TRAFFIC ON KAMALA-DHALKEBAR

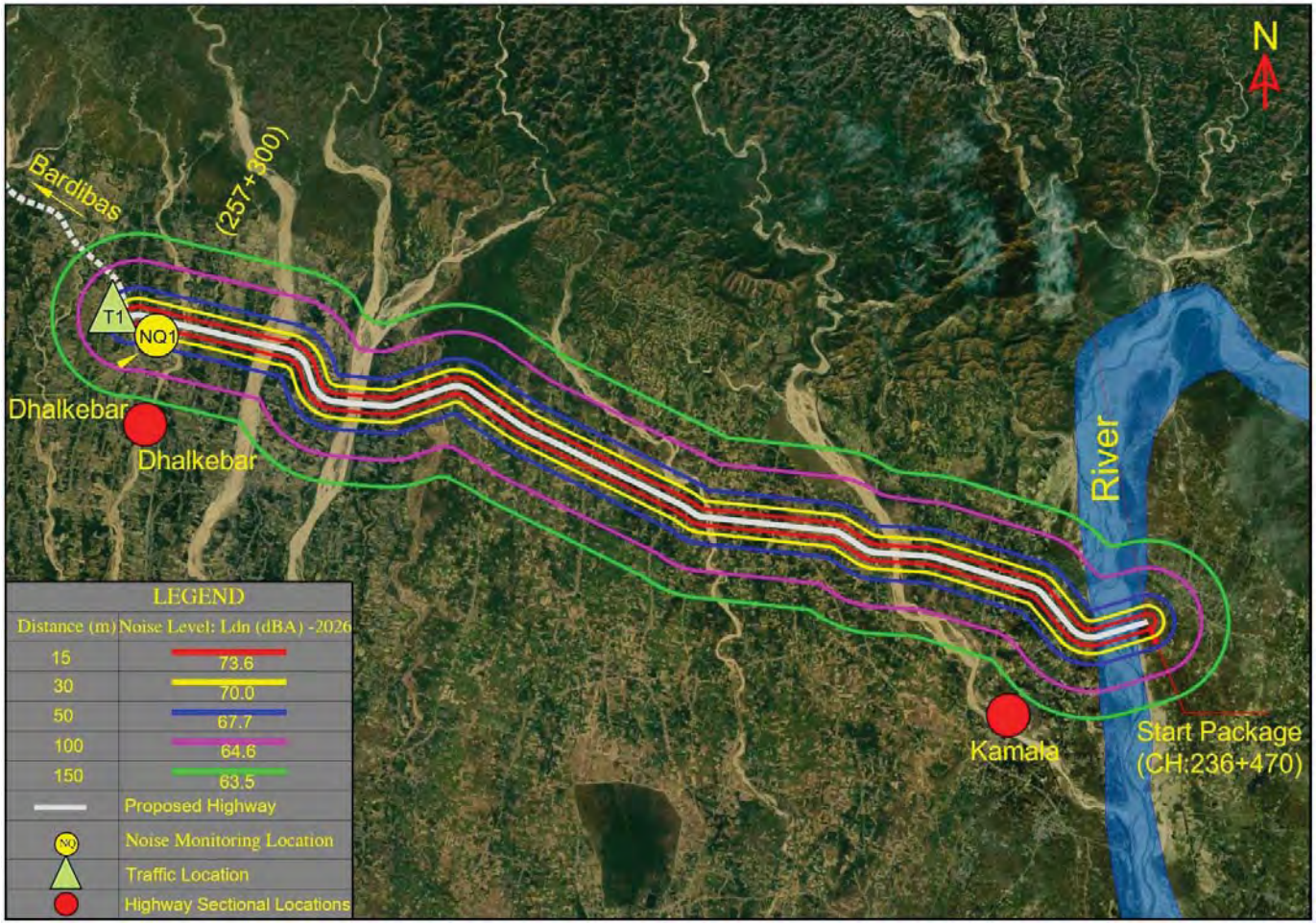


FIGURE 3.3 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAYTIME (LD): TRAFFIC ON DHALKEBAR-BARDIBAS

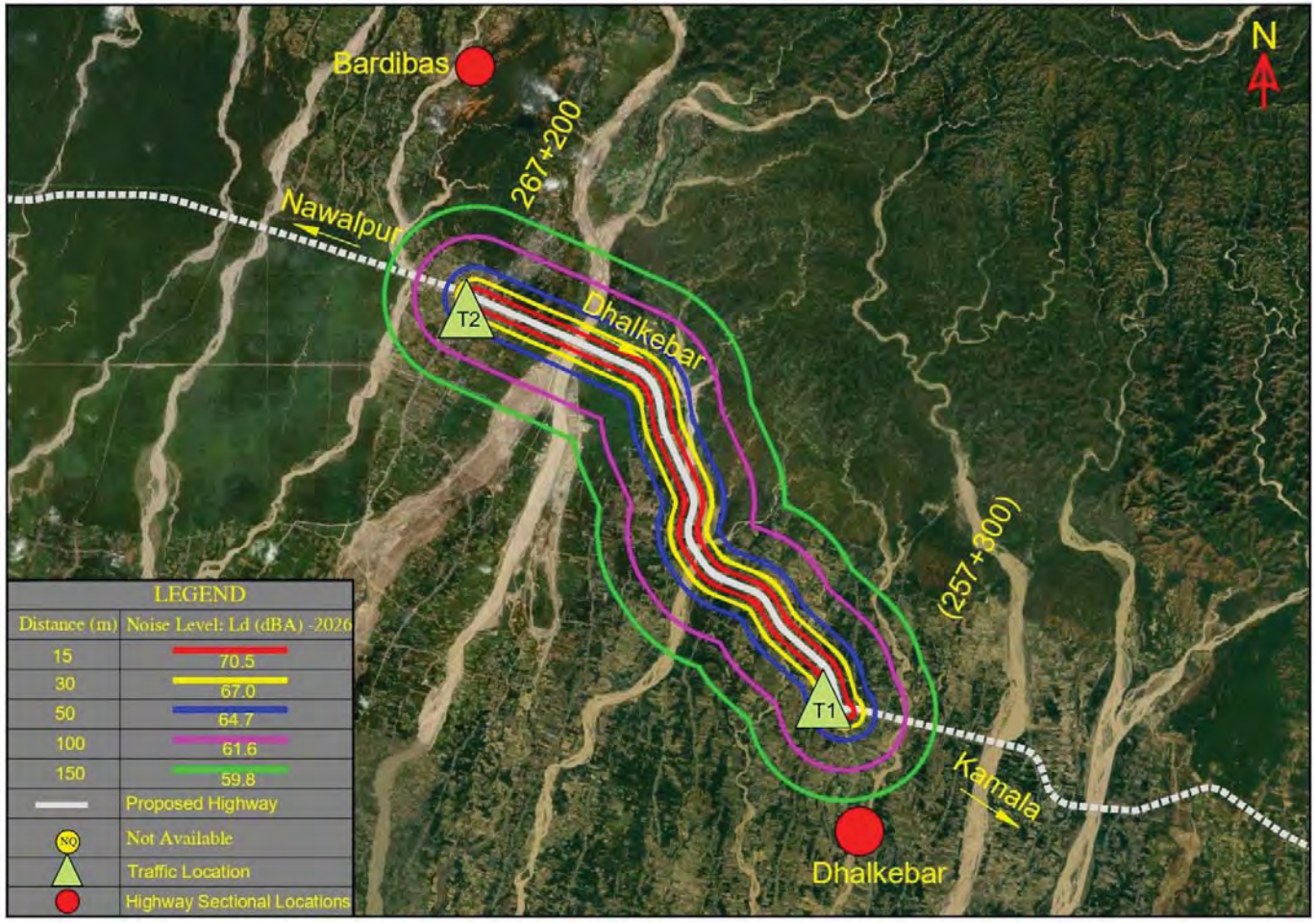


FIGURE 3.3 B: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING NIGHTTIME (LN): TRAFFIC ON DHALKEBAR-BARDIBAS

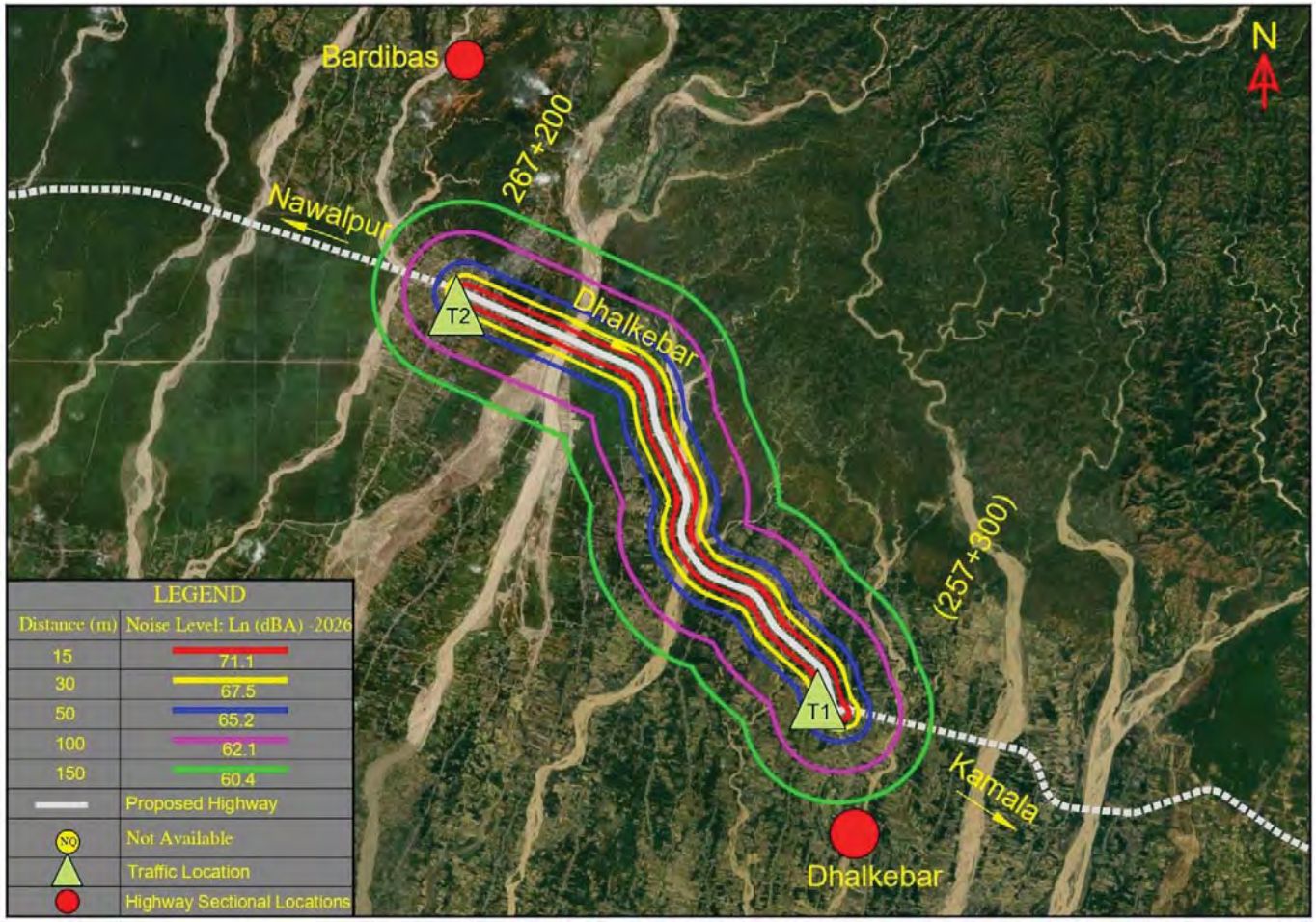


FIGURE 3.3 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHTTIME (LDN): TRAFFIC ON DHALKEBAR-BARDIBAS

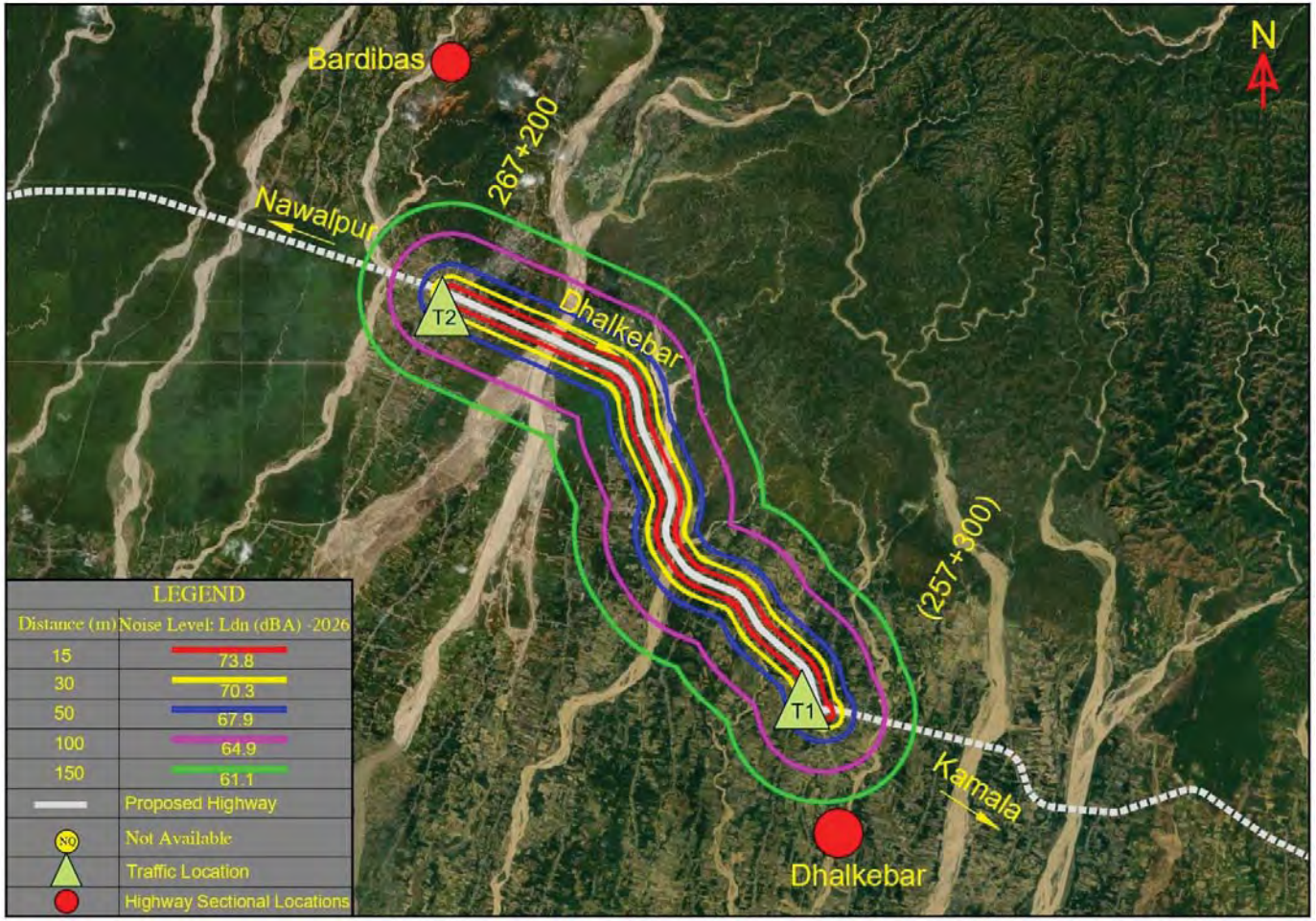


FIGURE 3.4 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAYTIME (LD): TRAFFIC ON BARDIBAS-NAWALPUR

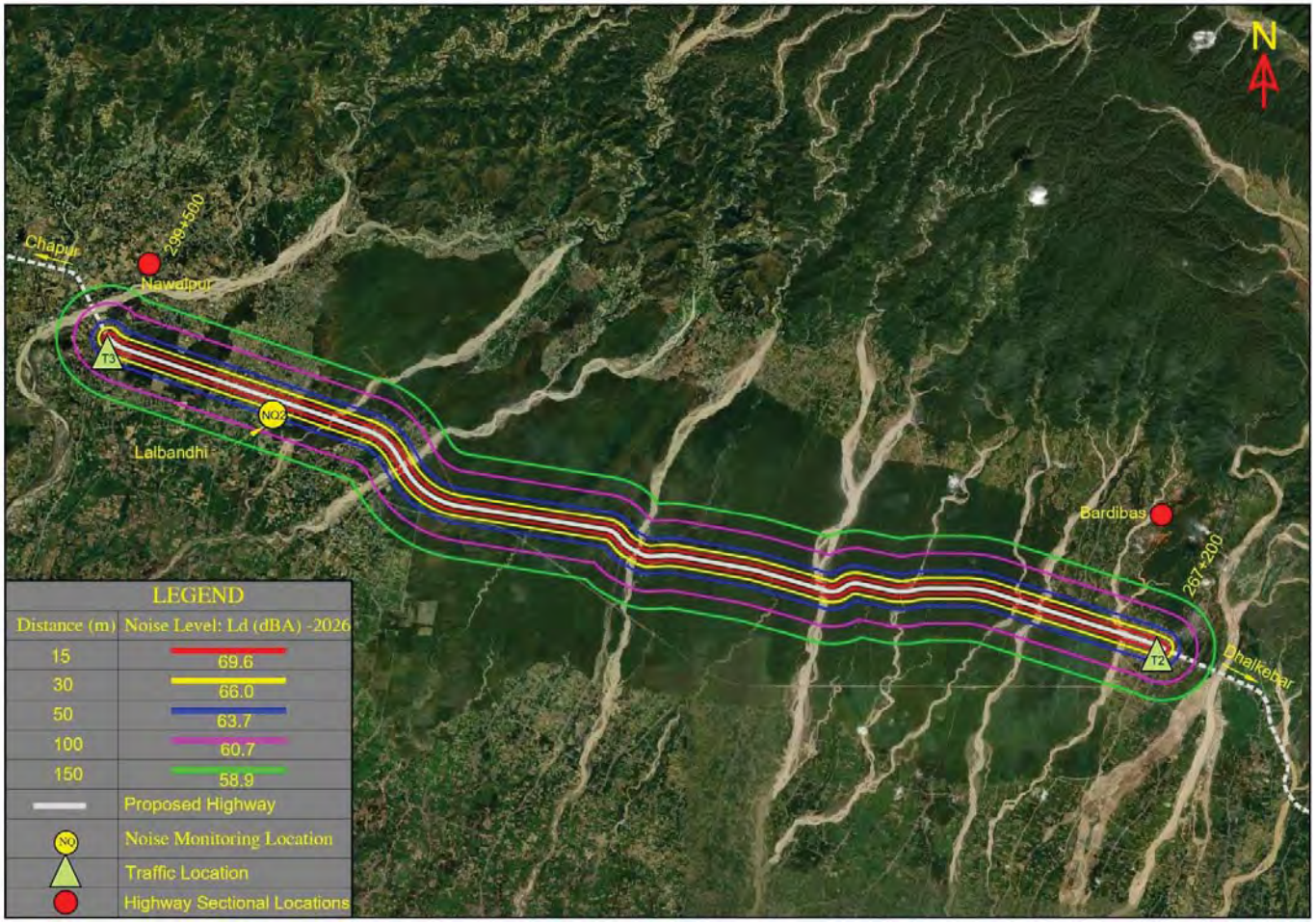


FIGURE 3.4 B: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING NIGHTTTIME (LN): TRAFFIC ON BARDIBAS-NAWALPUR

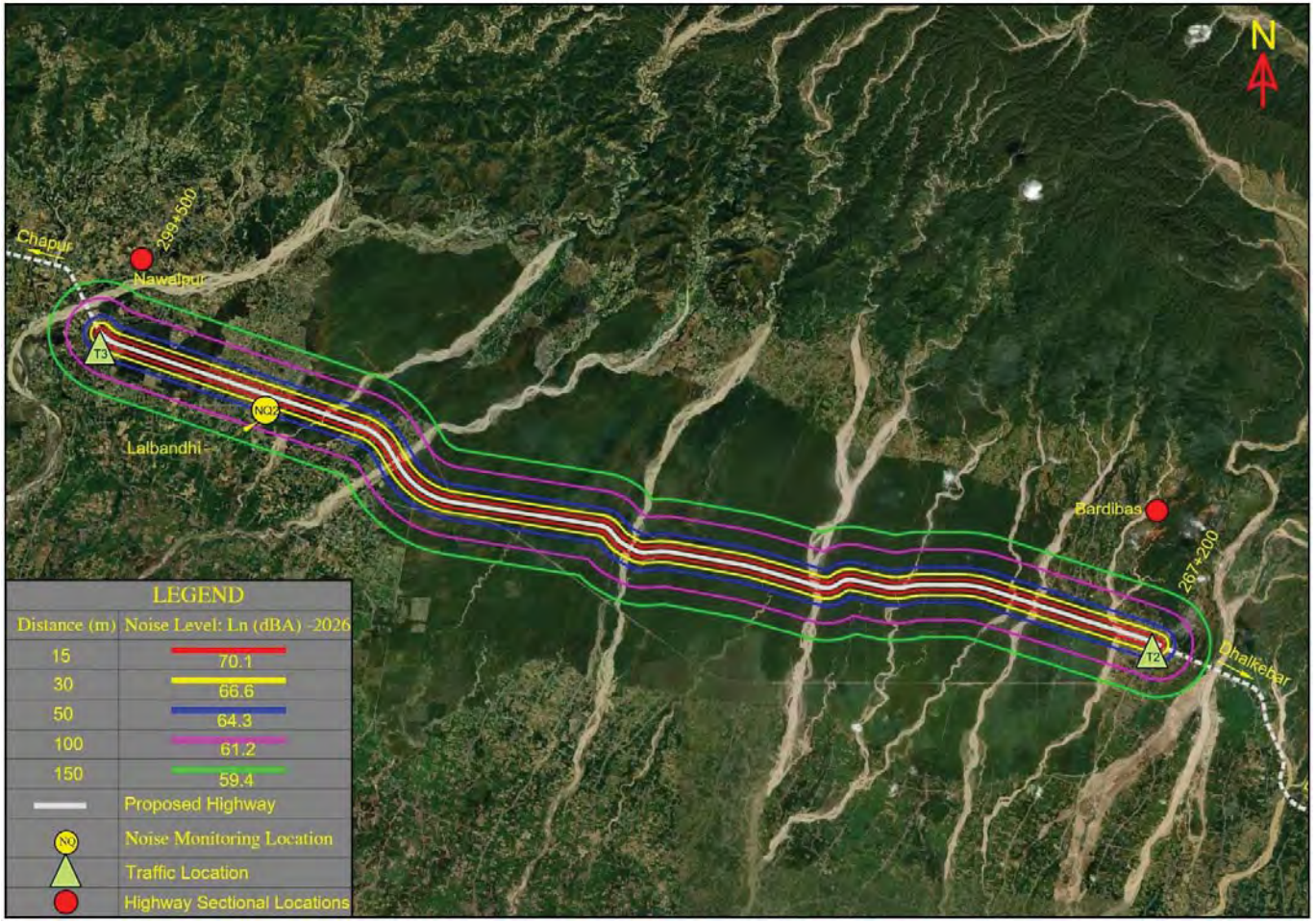


FIGURE 3.4 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHT TIME (LDN): TRAFFIC ON BARDIBAS-NAWALPUR

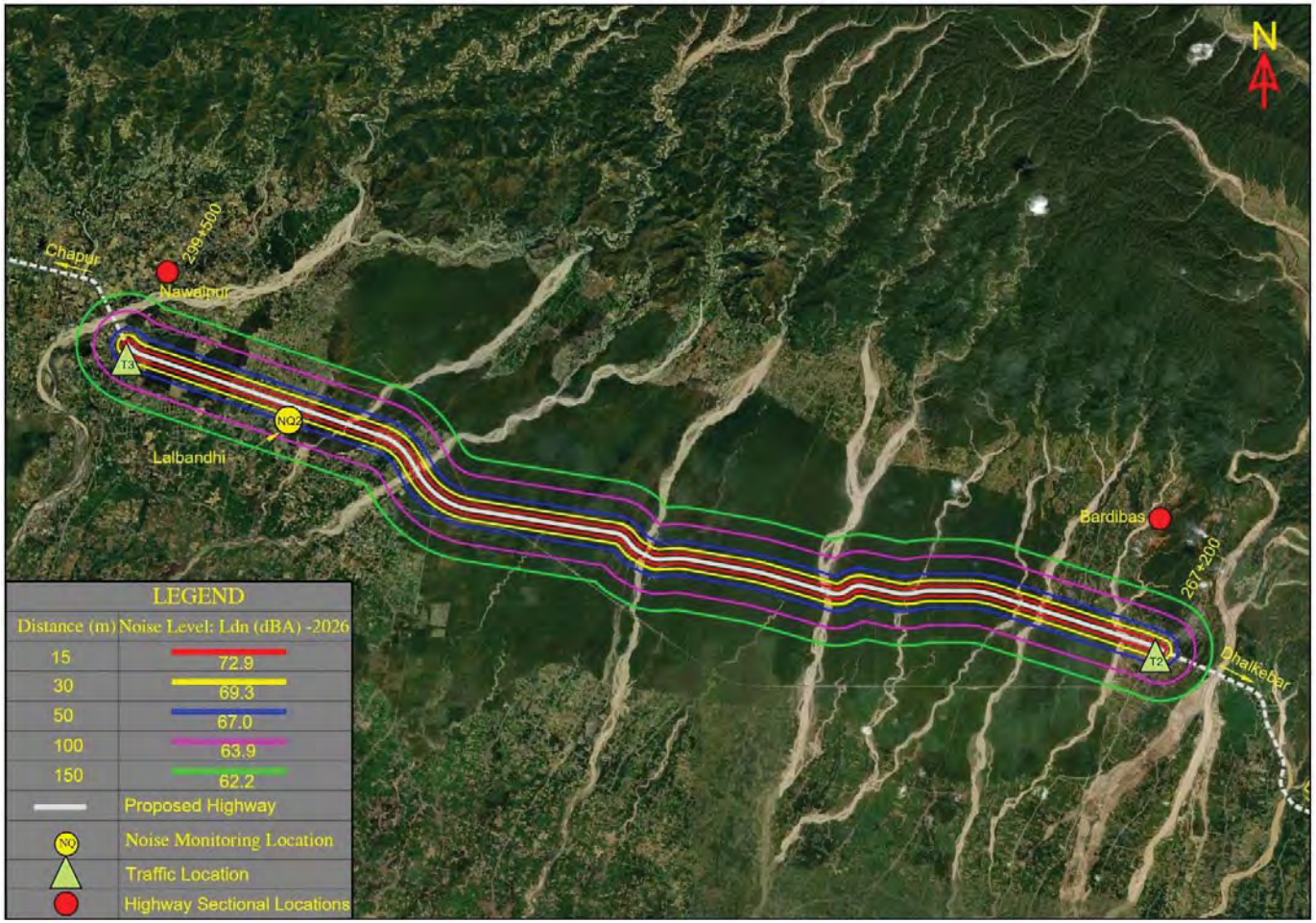


FIGURE 3.5 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY TIME (LD): TRAFFIC ON NAWALPUR-CHAPUR

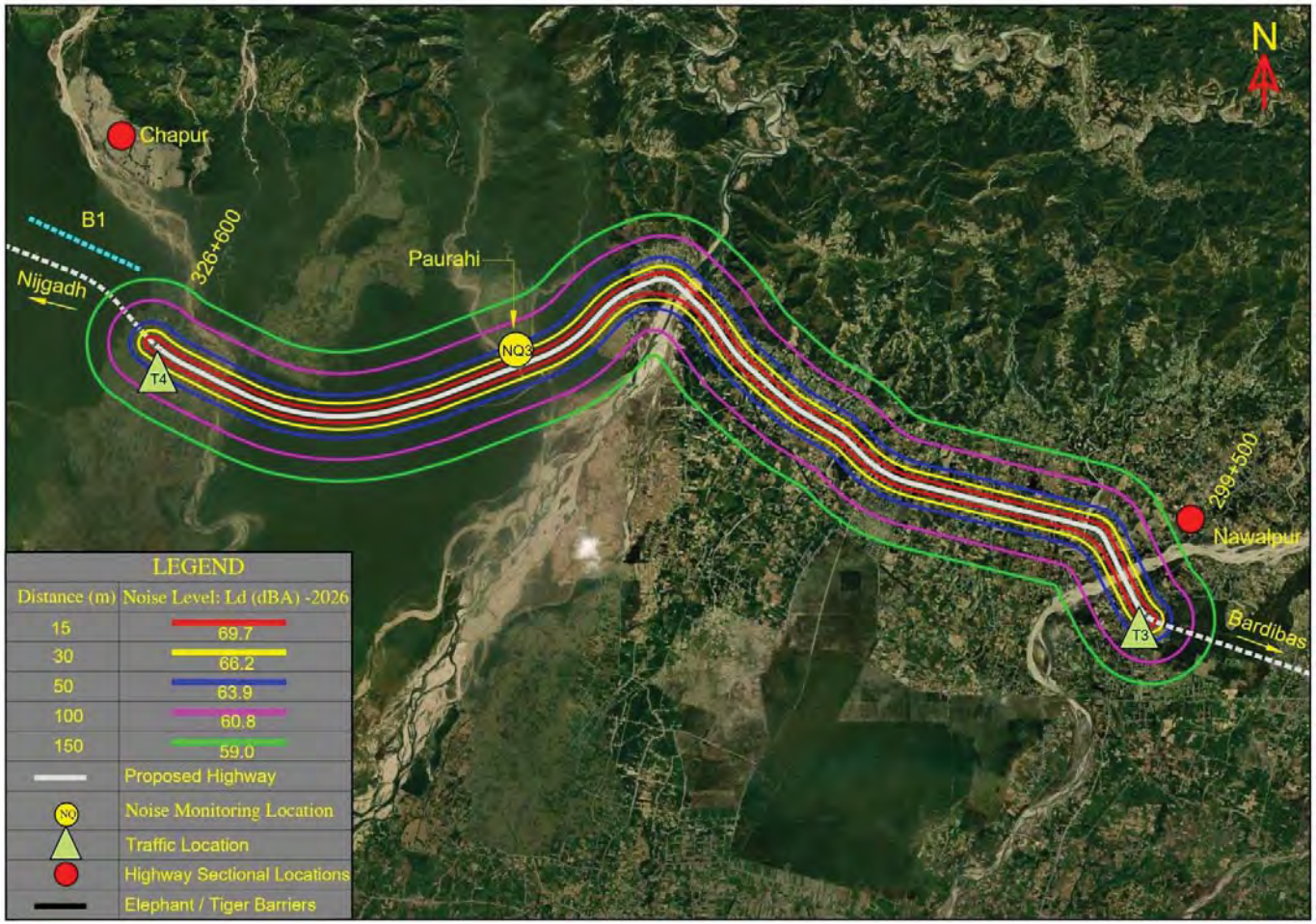


FIGURE 3.5 B: SPATIAL VARATION OF INCREMENTAL NOISE LEVEL DURING NIGHT TIME (LN): TRAFFIC ON NAWALPUR-CHAPUR

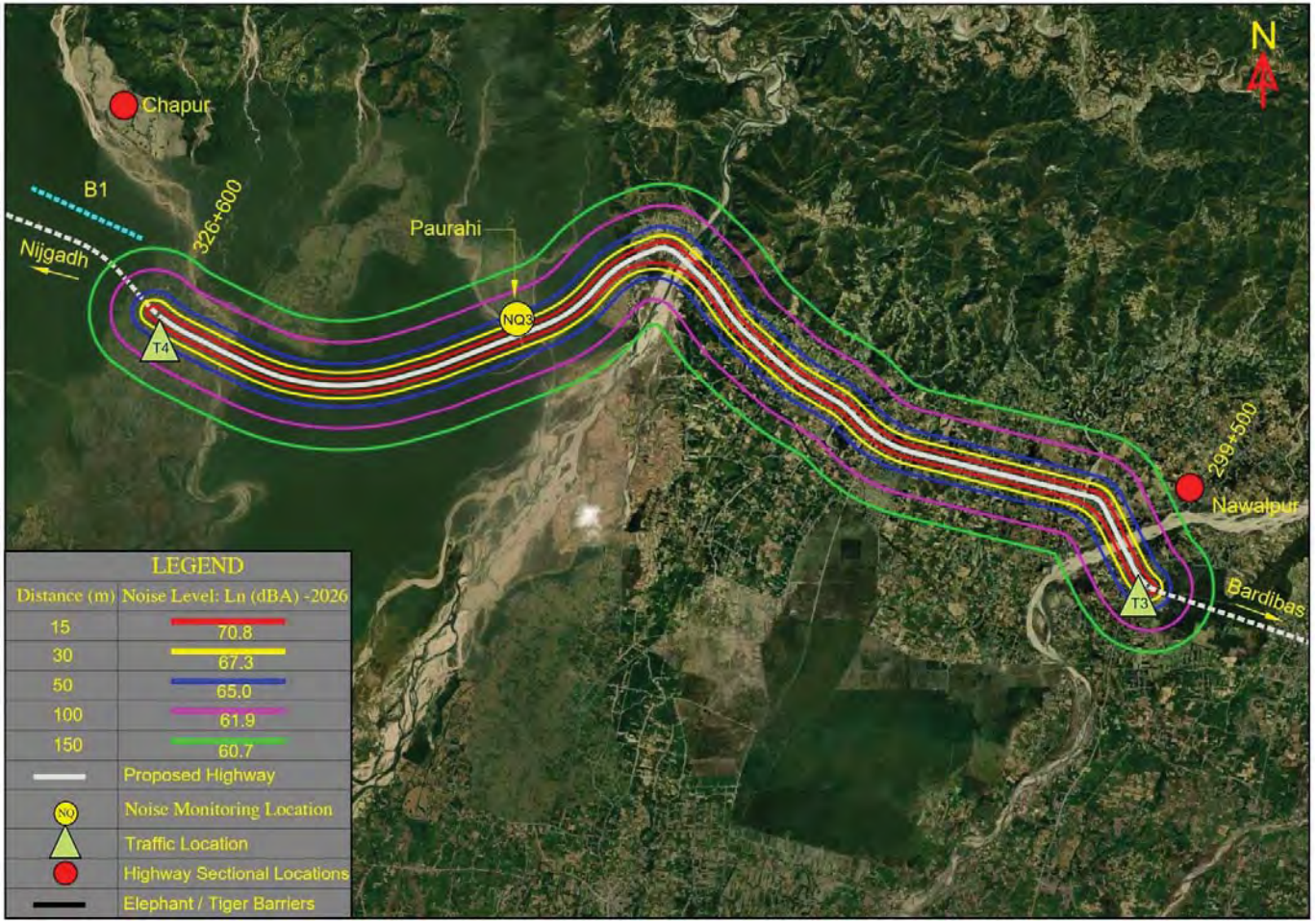


FIGURE 3.5 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHT TIME (LDN): TRAFFIC ON NAWALPUR-CHAPUR

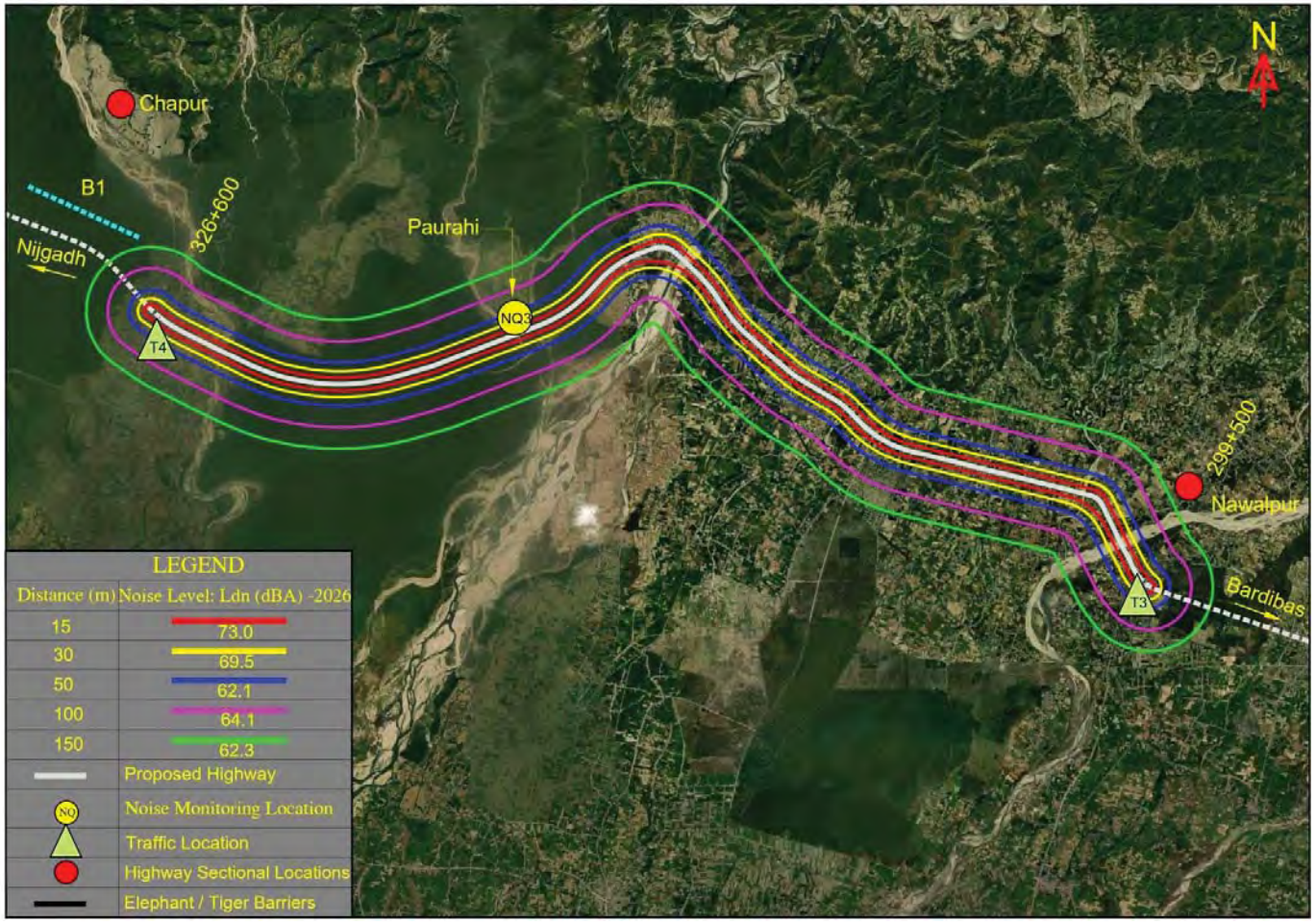


FIGURE 3.6 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY TIME (LD): TRAFFIC ON CHAPUR-NIJGADH

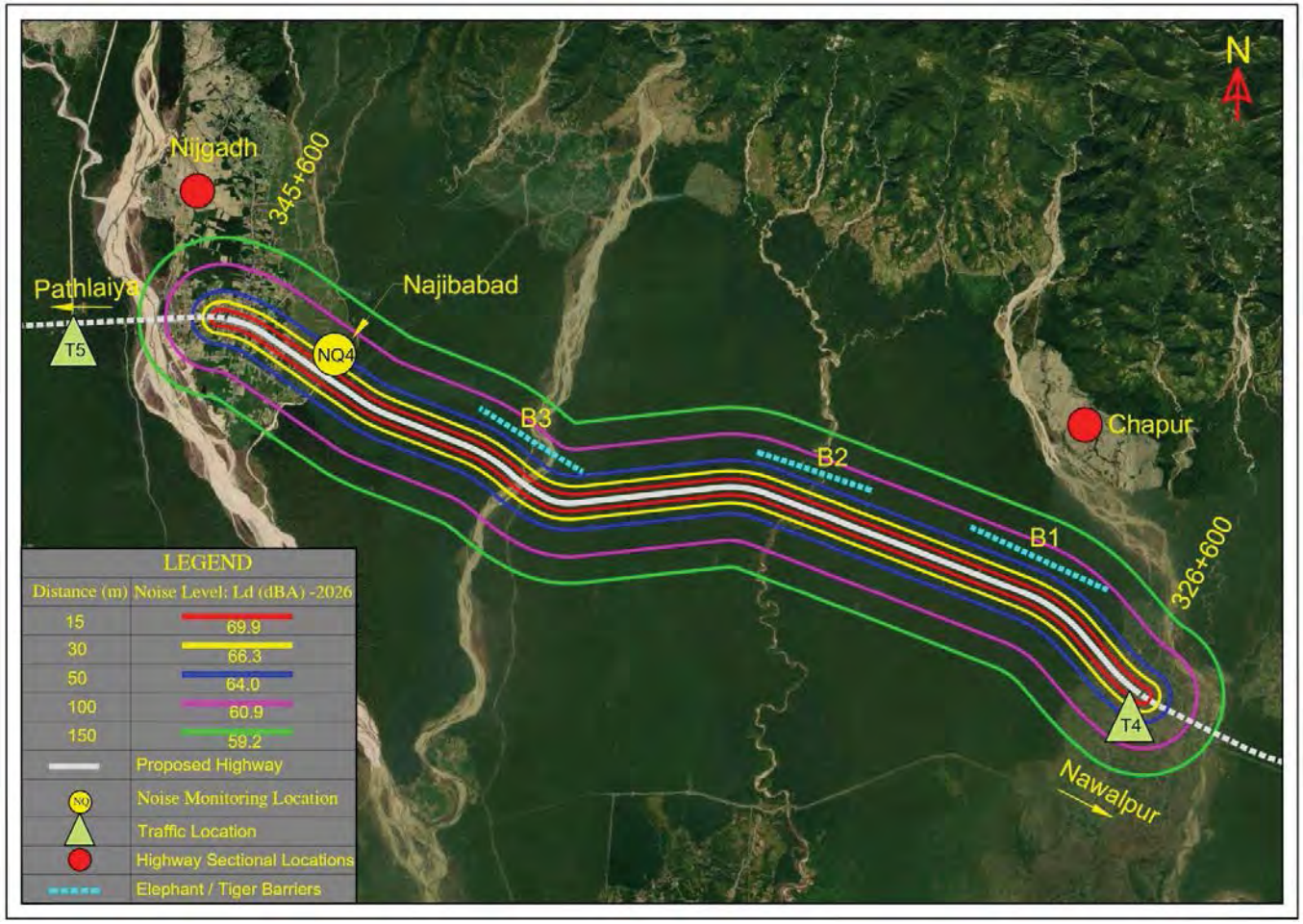


FIGURE 3.6 B: SPATIAL VARATION OF INCREMENTAL NOISE LEVEL DURING NIGHT TIME (LN): TRAFFIC ON CHAPUR-NIHGADH

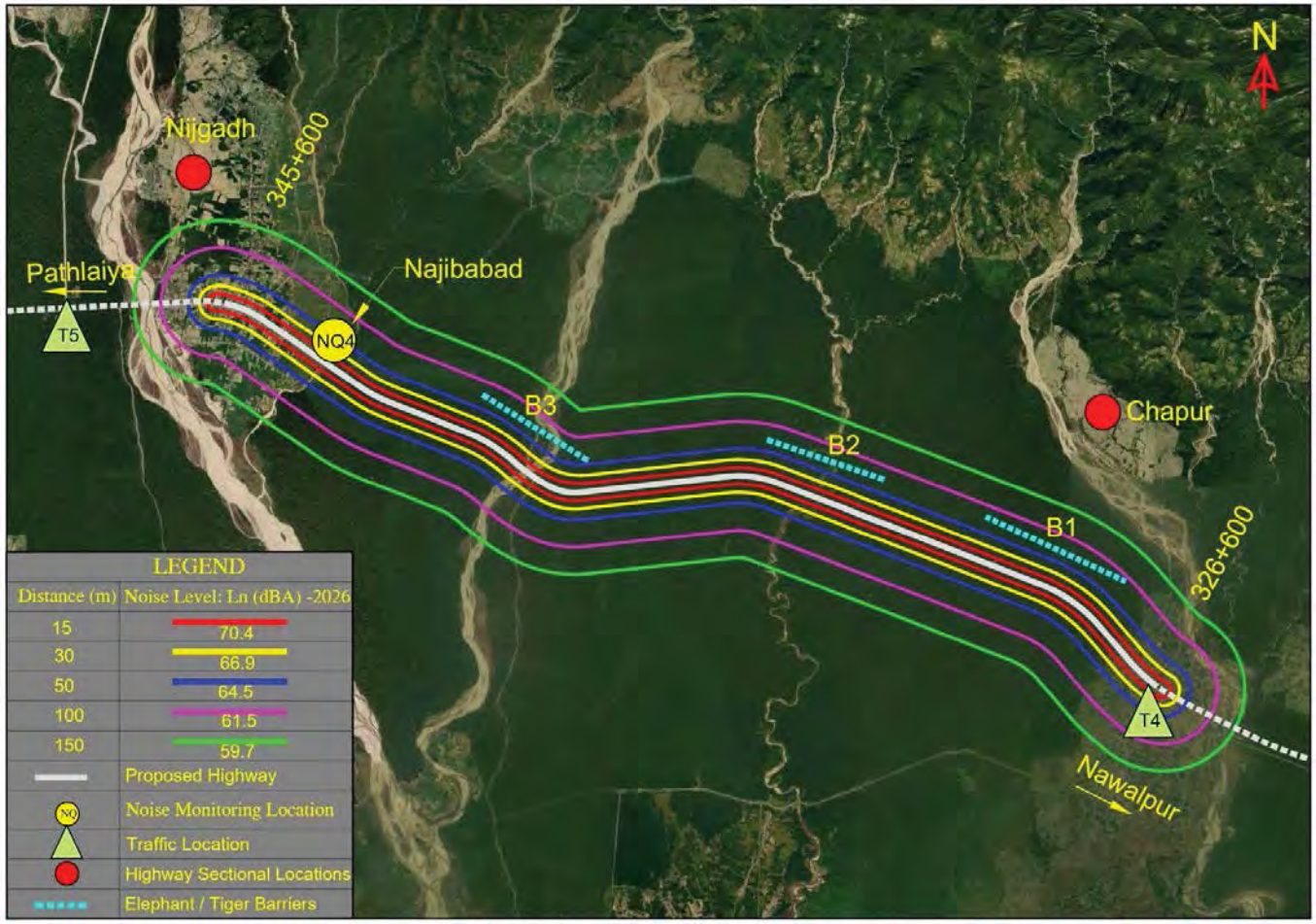


FIGURE 3.6 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHT TIME (LDN): TRAFFIC ON CHAPUR-NIJGADH

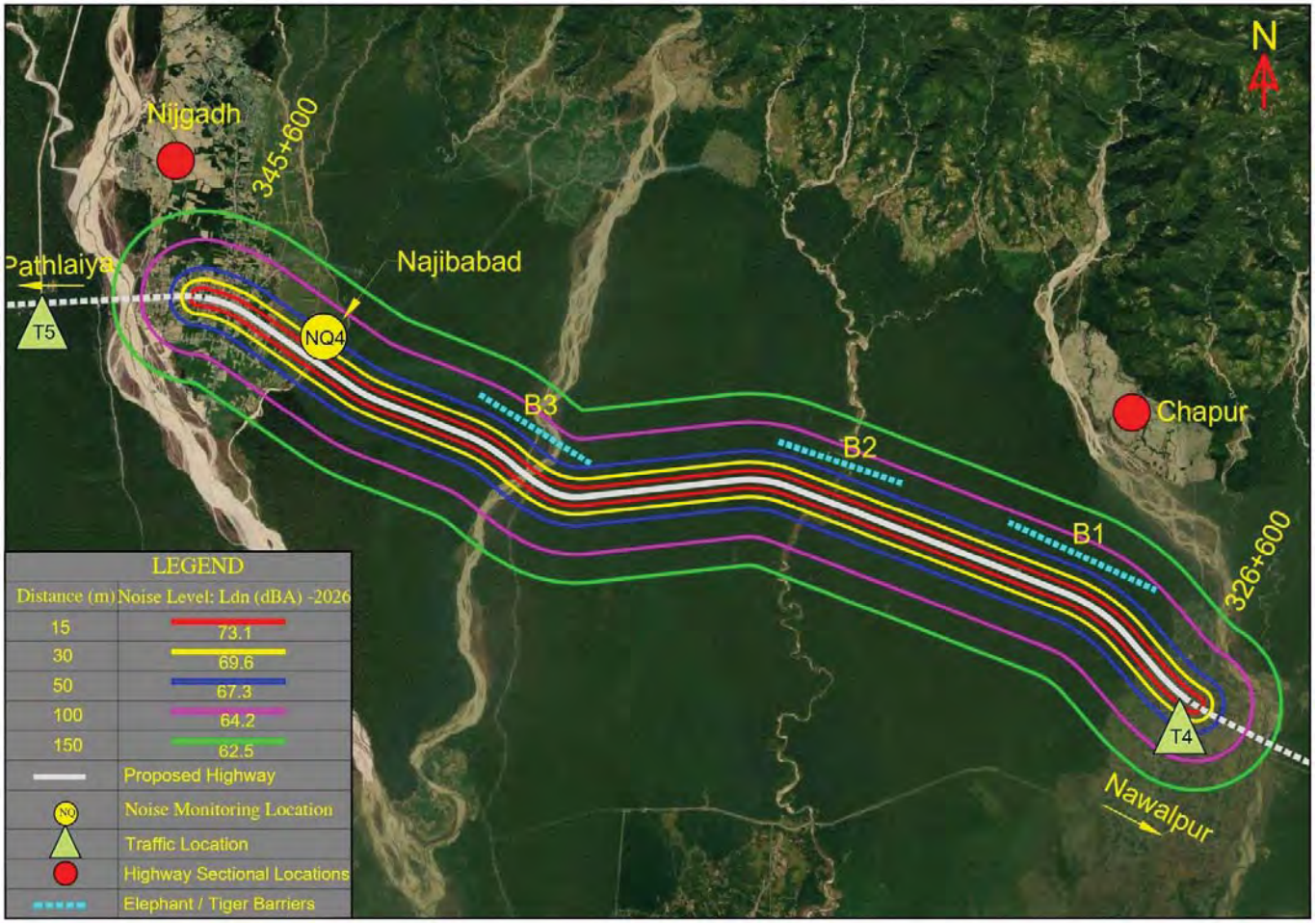


FIGURE 3.7 A: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAYTIME (LD): TRAFFIC ON NIJGADH-PATHLAIYA

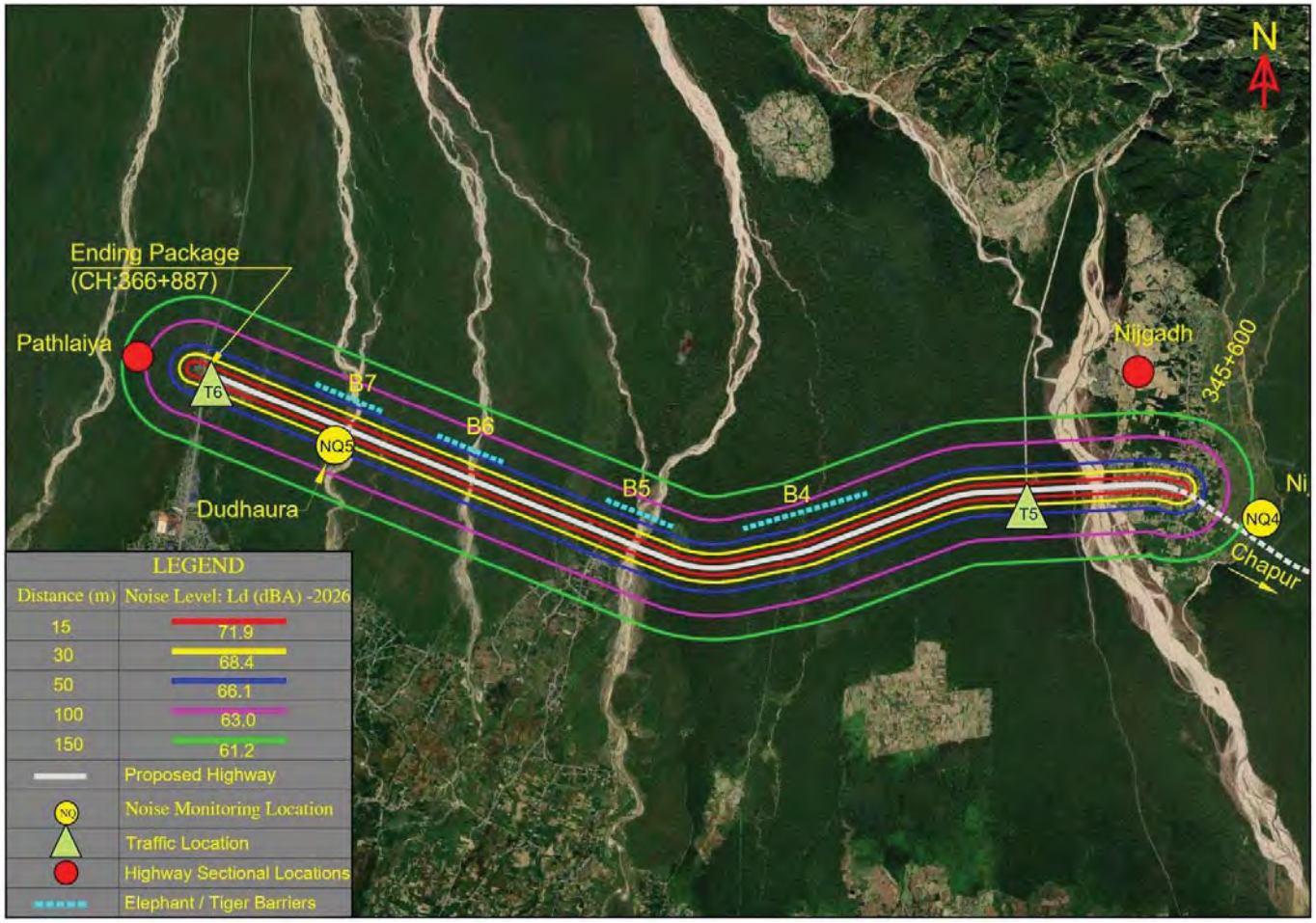


FIGURE 3.7 B: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING NIGHTTIME (LN): TRAFFIC ON NIHGADH-PATHLAIYA

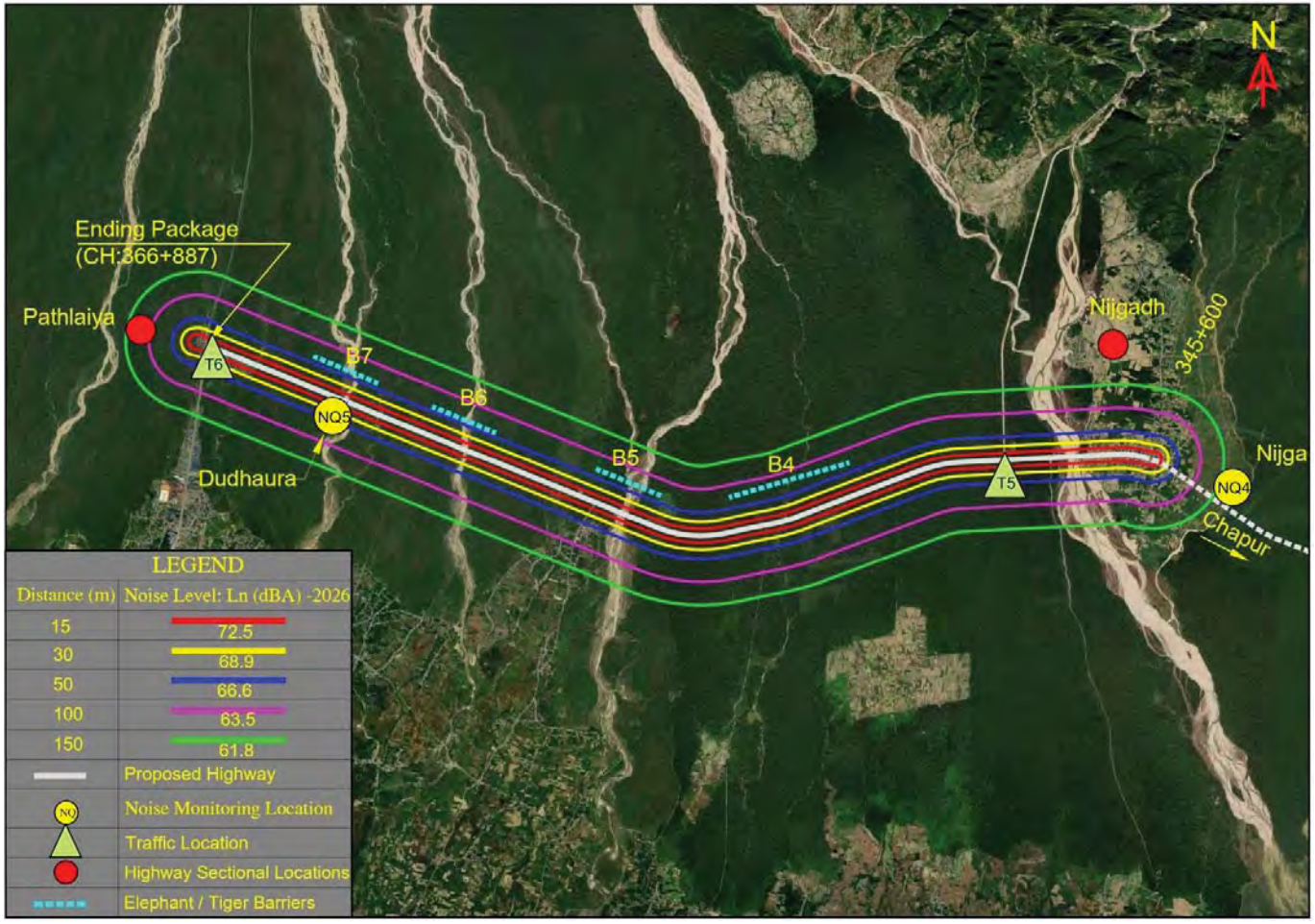
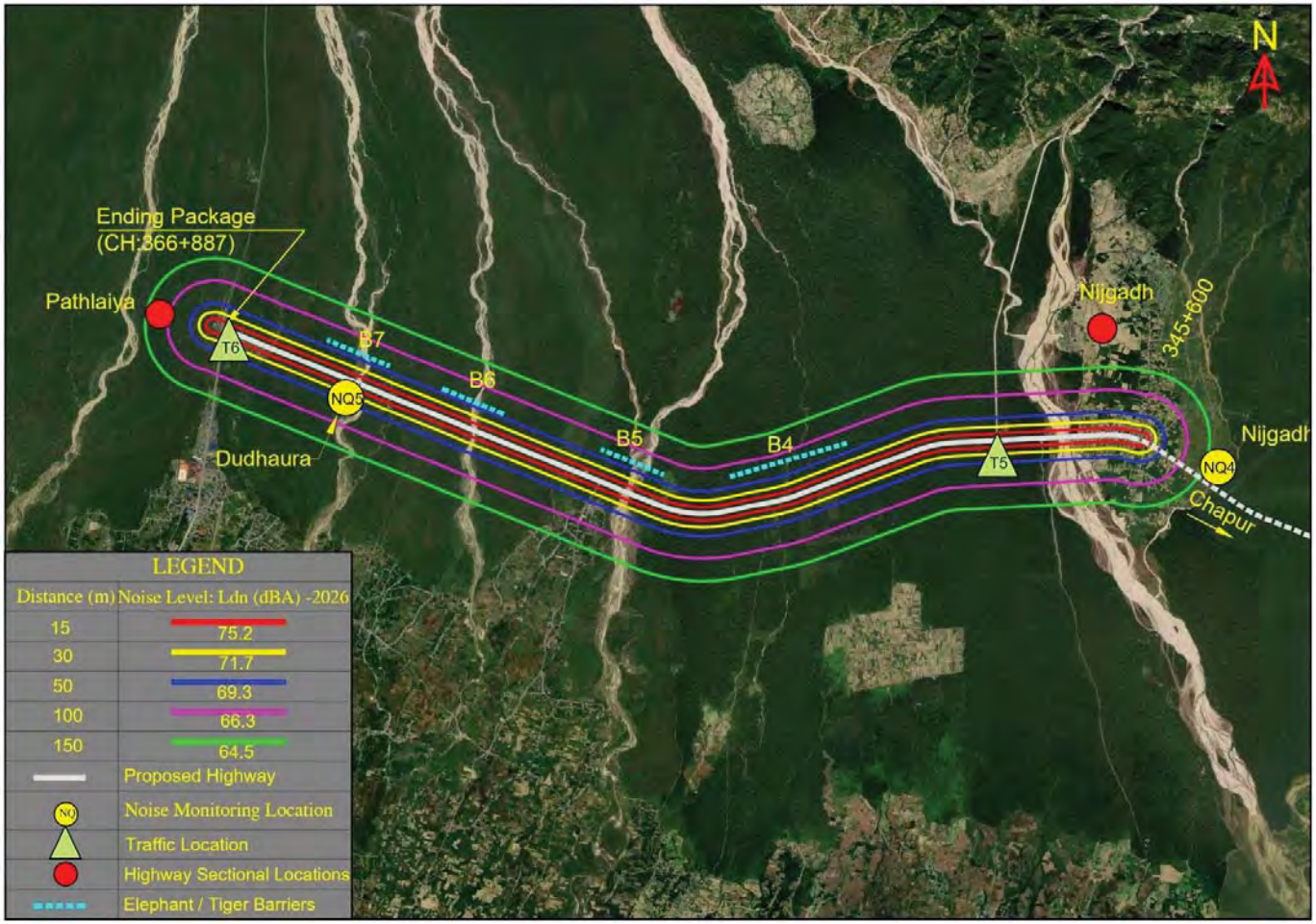


FIGURE 3.7 C: SPATIAL VARIATION OF INCREMENTAL NOISE LEVEL DURING DAY-NIGHTTIME (LDN): TRAFFIC ON NIJGADH-PATHLAIYA



Moreover, in order to assess future potential highway traffic noise at 30 m distance from the median of highway due to the projected traffic count at an regular interval of 5 years i.e. in the years 2031, 2036, 2041 and 2046 using same environmental noise descriptor i.e. Ld, Ln and Ldn along all the six traffic survey segments as discussed distance are presented in **Tables 3.13-3.18** and also shown graphically in **Figures 3.8 t0 3.13.**

TABLE 3.13: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON KAMALA-DHALKEBAR

Distance: 30 m from Median of Highway			
Year	Ld (Daytime)	Ln (Nighttime)	Ldn (Day-Night Time)
2026	66.7	67.3	70.0
2031	67.5	68.0	70.8
2036	68.2	68.7	71.5
2041	69.0	69.5	72.2
2046	69.7	70.3	73.0

FIGURE 3.8: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON KAMALA-DHALKEBAR

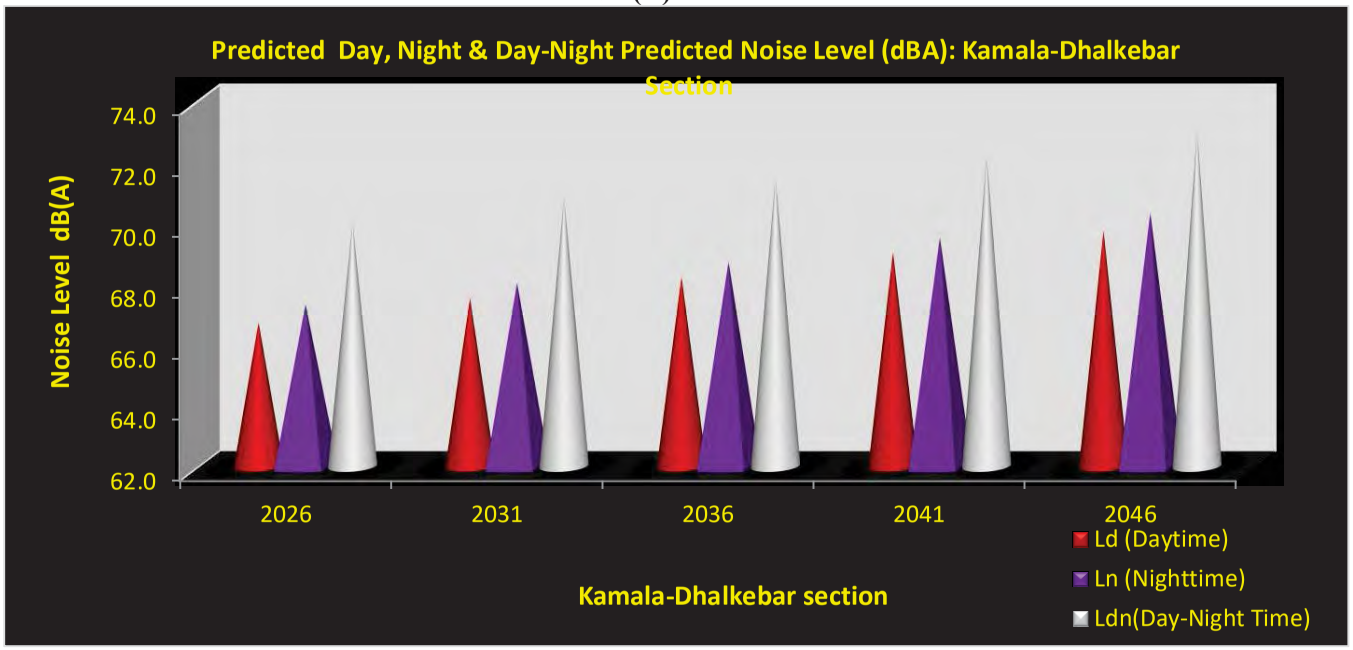


TABLE 3.14: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON DHALKEBAR-BARDIBAS

Distance: 30 m from Median of Highway			
Year	Ld (Daytime)	Ln (Nighttime)	Ldn (Day-Night Time)
2026	67	67.5	70.3
2031	67.6	68.1	70.9
2036	68.3	68.9	71.6
2041	69.1	69.6	72.4
2046	69.8	70.4	73.1

FIGURE 3.9: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON DHALKEBAR-BARDIBAS

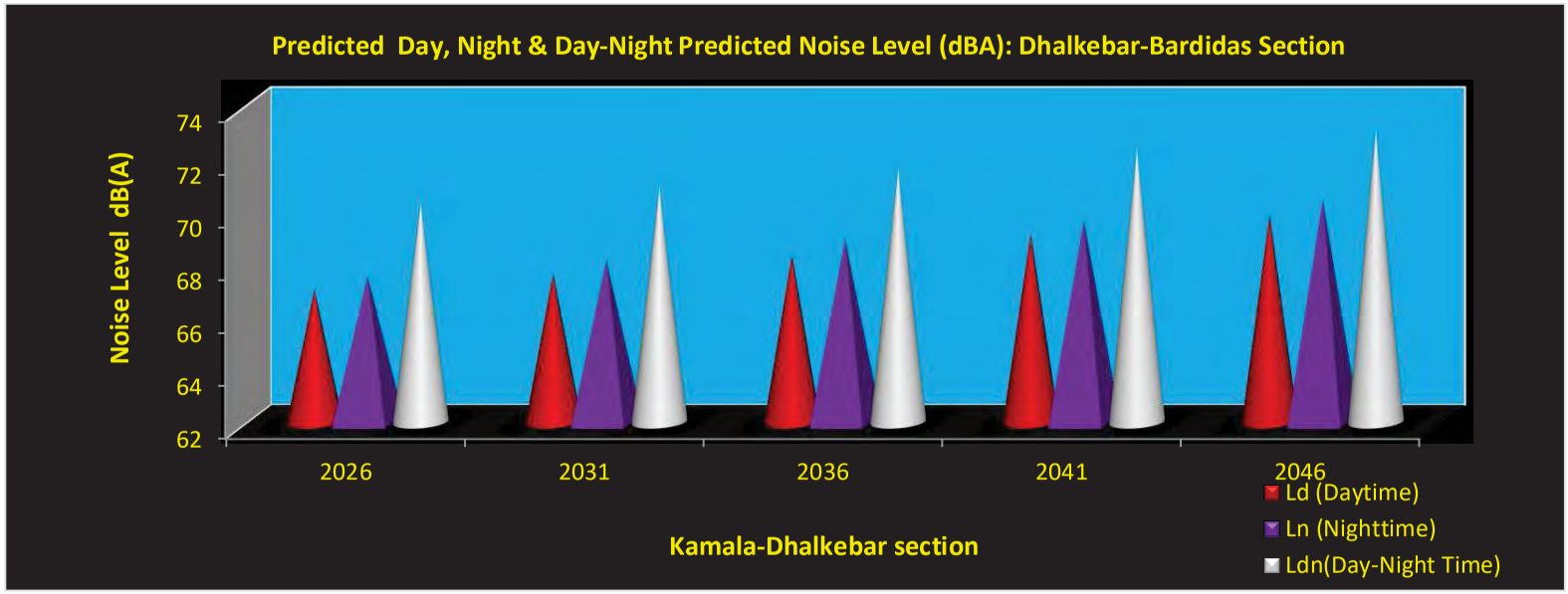


TABLE 3.15: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON DHALKEBAR-BARDIBAS

Distance: 30 m from Median of Highway

Year	Ld (Daytime)	Ln (Nighttime)	Ldn (Day-Night Time)
2026	67	67.5	70.3
2031	67.6	68.1	70.9
2036	68.3	68.9	71.6
2041	69.1	69.6	72.4
2046	69.8	70.4	73.1

FIGURE 3.10: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON DHALKEBAR-BARDIBAS

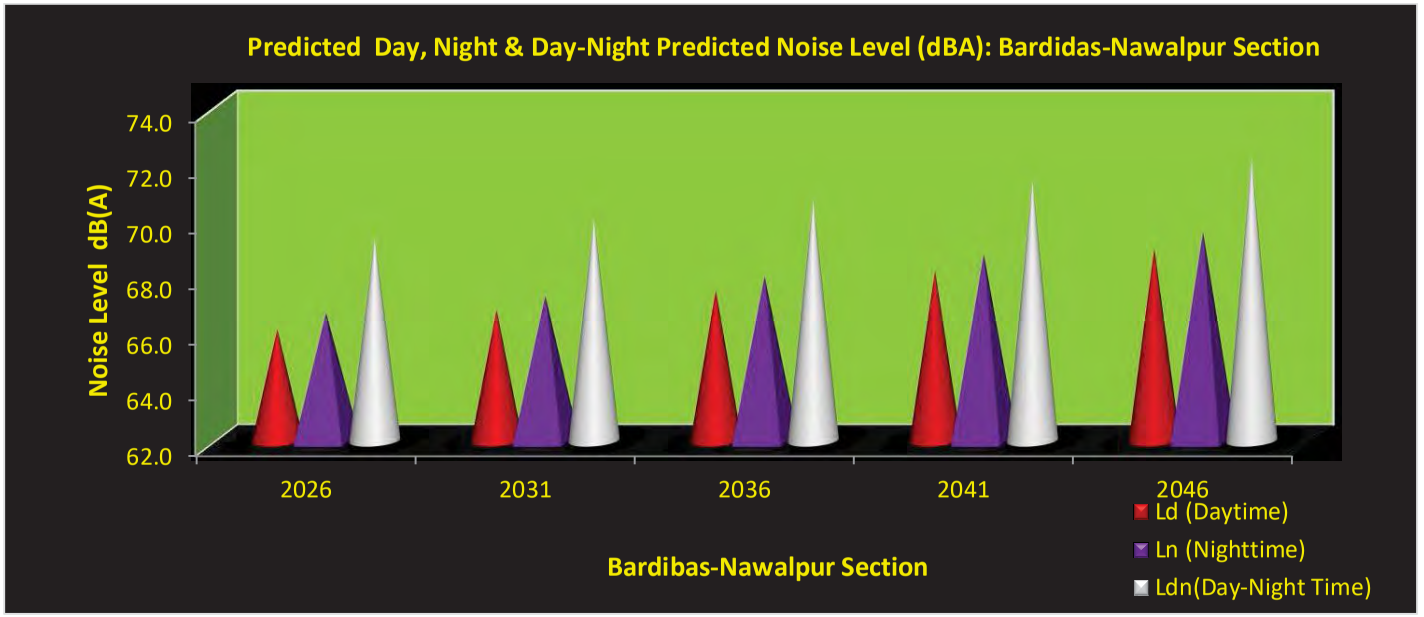


TABLE 3.16: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON BARDIBAS-NAWALPUR

Distance: 30 m from Median of Highway

Year	Ld (Daytime)	Ln (Nighttime)	Ldn (Day-Night Time)
2026	66.0	66.6	69.3
2031	66.7	67.2	70.0
2036	67.4	67.9	70.7
2041	68.1	68.7	71.4
2046	68.9	69.5	72.2

FIGURE3.11: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON BARDIBAS-NAWALPUR

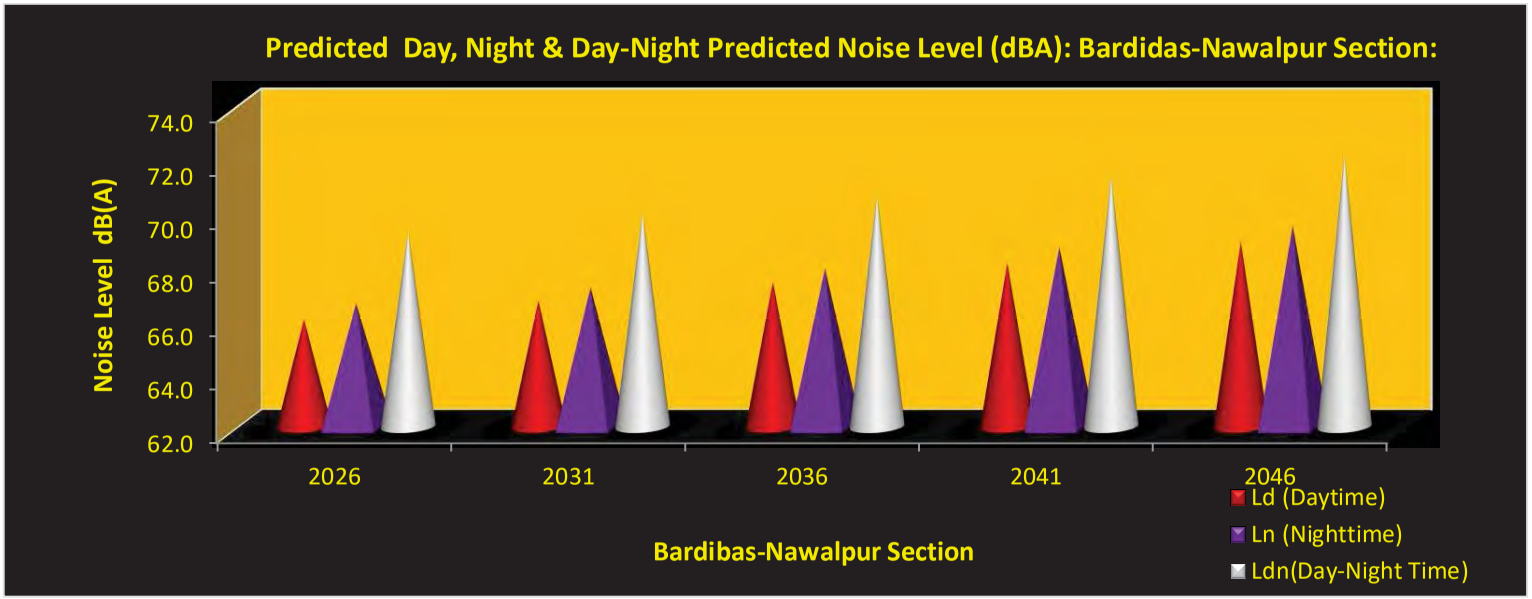


TABLE 3.17: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON NAWALPUR-CHAPUR

Distance: 30 m from Median of Highway			
Year	Ld (Daytime)	Ln (Nighttime)	Ldn (Day-Night Time)

2026	66.2	66.7	69.5
2031	66.8	67.4	70.1
2036	67.5	68.1	70.8
2041	68.3	68.8	71.6
2046	69.1	69.6	72.3

FIGURE 3.12: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON NAWALPUR-CHAPUR

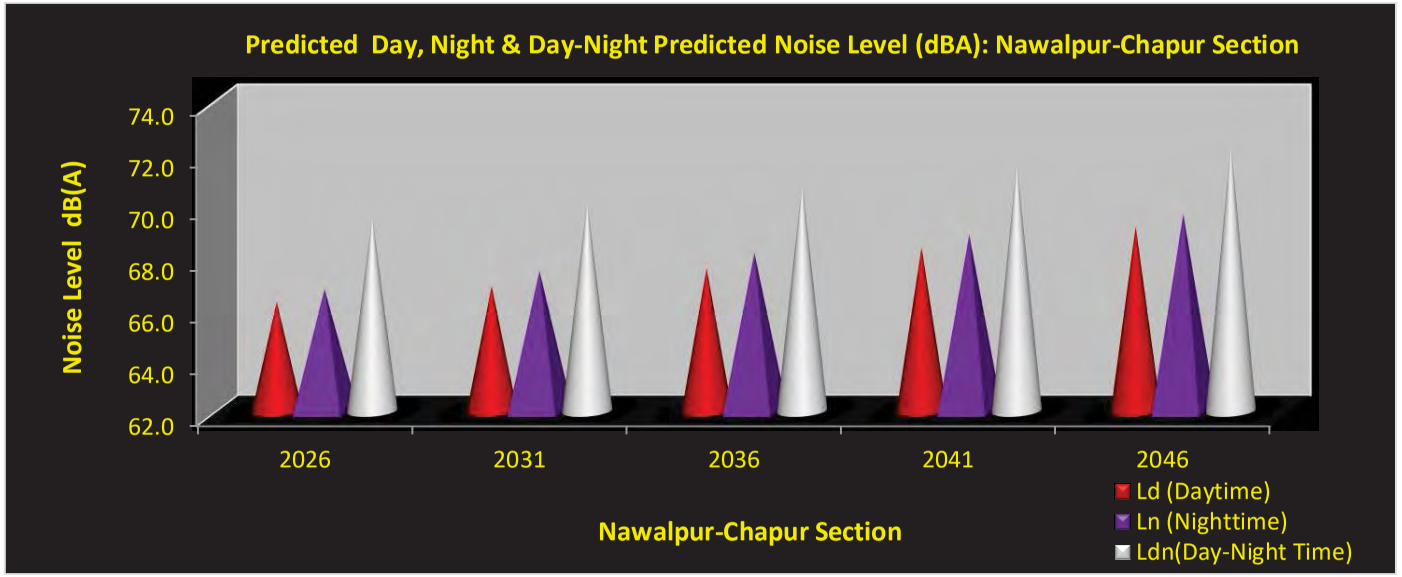


TABLE 3.18: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON CHAPUR-NIJGADH

Distance: 30 m from Median of Highway			
Year	**Ld (Daytime)**	**Ln (Nighttime)**	**Ldn (Day-Night Time)**
2026	66.3	66.9	69.6

2031	66.9	67.5	70.2
2036	67.6	68.2	70.9
2041	68.4	69.0	71.7
2046	69.2	69.7	72.5

FIGURE 3.13: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON CHAPUR-NIJGADH

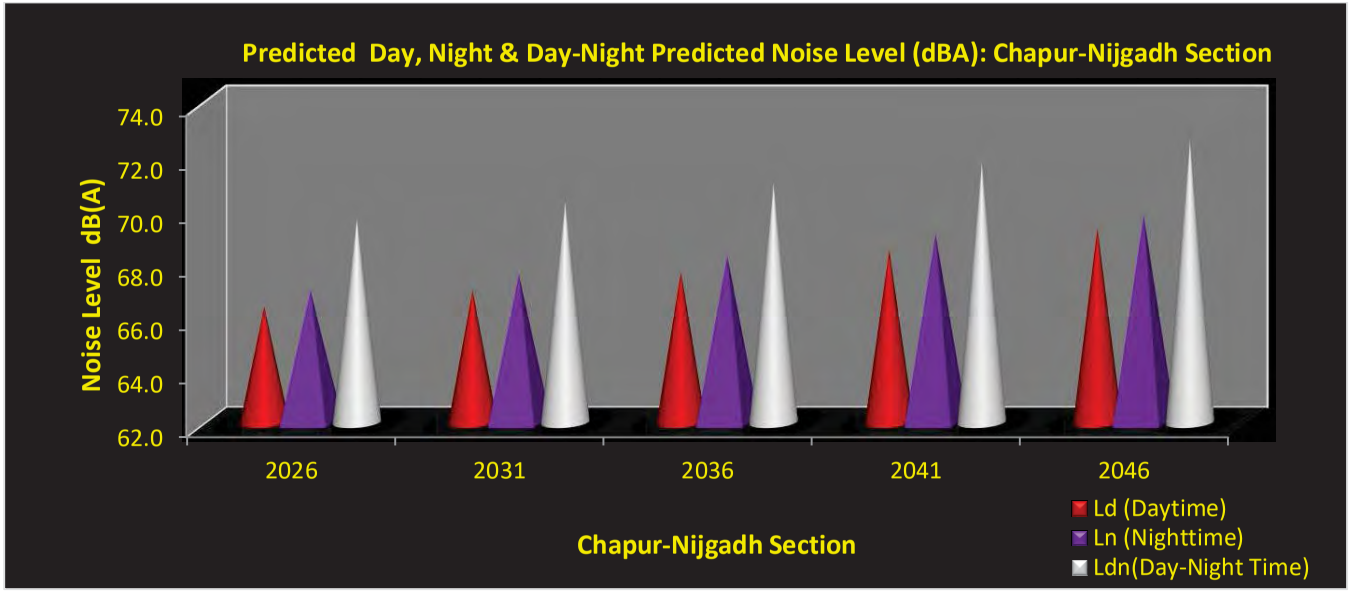
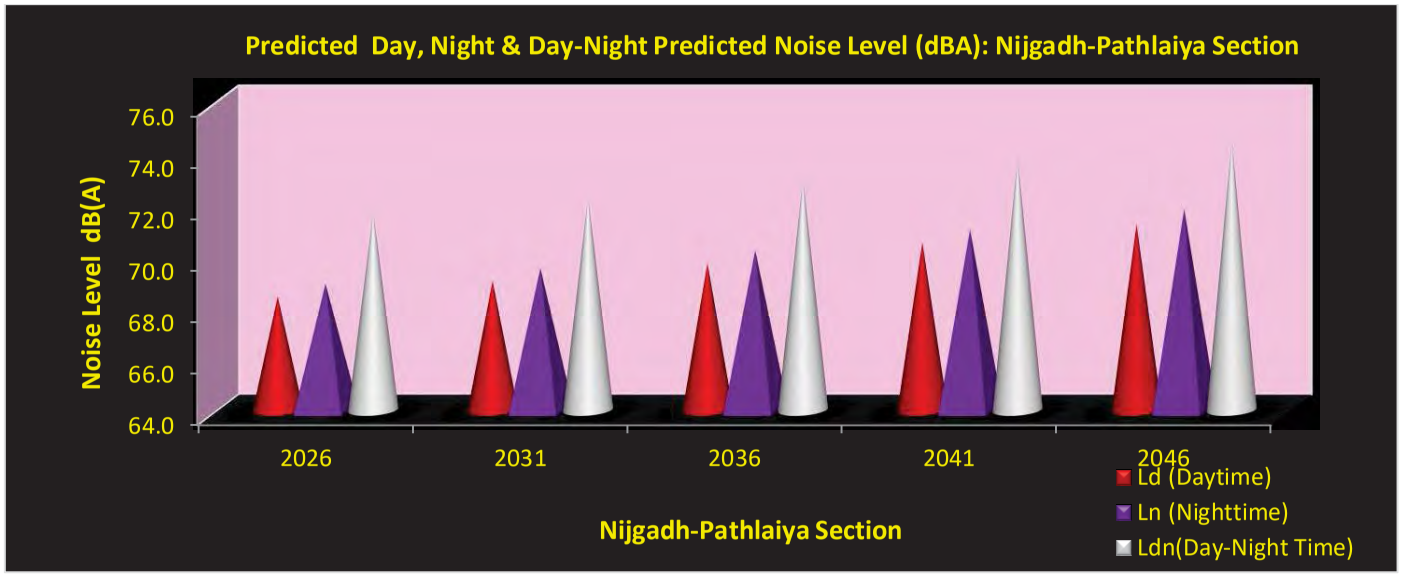


TABLE 3.19: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON NIJGADH-PATHLAIYA

Distance: 30 m from Median of Highway			
Year	**Ld (Daytime)**	**Ln (Nighttime)**	**Ldn (Day-Night Time)**
2026	68.4	68.9	71.7
2031	69.0	69.5	72.3

2036	69.7	70.2	73.0
2041	70.5	71.0	73.8
2046	71.2	71.8	74.5

FIGURE 3.14: PREDICTED FUTURE NOISE LEVEL dB(A) DUE TO PROJECTED TRAFFIC ON NIJGADH-PATHLAIYA



3.1 IMPACT CRITERIA: OPERATION PHASE (TRAFFIC)

Noise impact assessment study for up-grading Kamala-Dhalkebar-Pathlaia (KDP) section of Mahendra highway during operation phase was carried out using the modelling techniques was further compared to the site-specific observed base year 2023 ambient noise level to assess the impact criteria viz; No Impact, Moderate, or Severe Impact and these three impacts are described as follows.

The noise criteria impact analysis for KDP prestigious infrastructure project was carried out for 05 desired monitoring sites (NQ1-NQ5) along the KDP transit corridor where ambient noise level was monitored as shown in the **Figure 3.1**, which include residences and other buildings where people normally sleep. This is because the comparison is based on what people are experiencing now (existing noise), and the change in noise due to the homogeneous 24-hours traffic volume plying on project study road from both sides of carriageway of transit system operation.

Diurnal traffic noise modelling during operation phase was carried out with reference to the surveyed traffic count data of various categories of vehicles supposed to ply on the KDP with maximum traffic volume capacity considering worst-case scenario. For the present study, monitored noise quality data is assumed same as existing ambient noise level data in the year 2026 to analyse the potential noise impact criteria perception. Predicted day-nighttime noise level dB(A) along with existing noise level in day-nighttime is presented in the **Table 3.20.**

TABLE 3.20: PREDICTED NOISE LEVEL dB(A) AT DISCRETE RECEPTORS DUE TO KDP HIGHWAY: YEAR 2026

Noise Monitoring Location No.	Receptor Name	Receptor Distance from Median of Highway (m)	Predicted Noise Level Day-night time (Ldn)	Existing Noise Level Day time (Ld)	Existing Noise Level Night time (Ln)	Existing Noise Level Day-night time (Ldn)	Noise Impact Criteria
KAMAL-DHALKEBAR-PATHLAIYA (KDPMAHENDRA HIGHWAY							
NQ1	Dhalkebar (Kamal –Dhalkeba)	30	70.0	65.32	61.31	68.3	Severe
NQ2	Lalbandhi (Bardibas-Nawalpur)	30	69.3	64.42	60.39	67.4	Severe
NQ3	Paurahi (Nawalpur-Chapur)	30	69.5	55.48	50.14	57.4	Severe
NQ4	Najibabad (Chapur-Nijgadh)	30	69.6	62.05	55.88	63.7	Severe
NQ5	Dudhaura (Nijgadh – Pathlaiya)	30	71.7	50.38	46.11	53.2	Severe

Impact analysis result illustrates that all receptors located at 30 m from the median of the highway i.e at 5 m away from the Right of Way (ROW) are expected to be impacted severely with respect to the observed existing daynighttime (Ldn) ambient noise level. Impact criteria graph relative to existing ambient noise quality at the desired receptor (NQ1-NQ5) locations are shown graphically in **Figure 3.15 through 3.19**. The noise impact criteria here are defined by the two curves in the impact criteria graphs; one for moderate impact and other for severe impact, which allow increasing project noise as existing noise levels increase, up to a point at which impact is determined based on project noise alone. The criteria specify a comparison of future project noise with existing noise. The criteria also consider land use which is an important factor that reflects noise sensitivity based on activity and time period of concern. The impact criteria are defined with the expectation that communities already exposed to high levels of noise can only tolerate a small increase. In contrast, if the existing noise levels are low, it is reasonable to allow a greater change in the community noise. Noise impact analysis attracts special attention where impact fall under moderate and severe criteria. However the present study was carried out with conservative approach, therfore likely impact may be expected less than as predicted.

FIGURE 3.15: NQ1 (DHALKEBAR): YEAR 2026

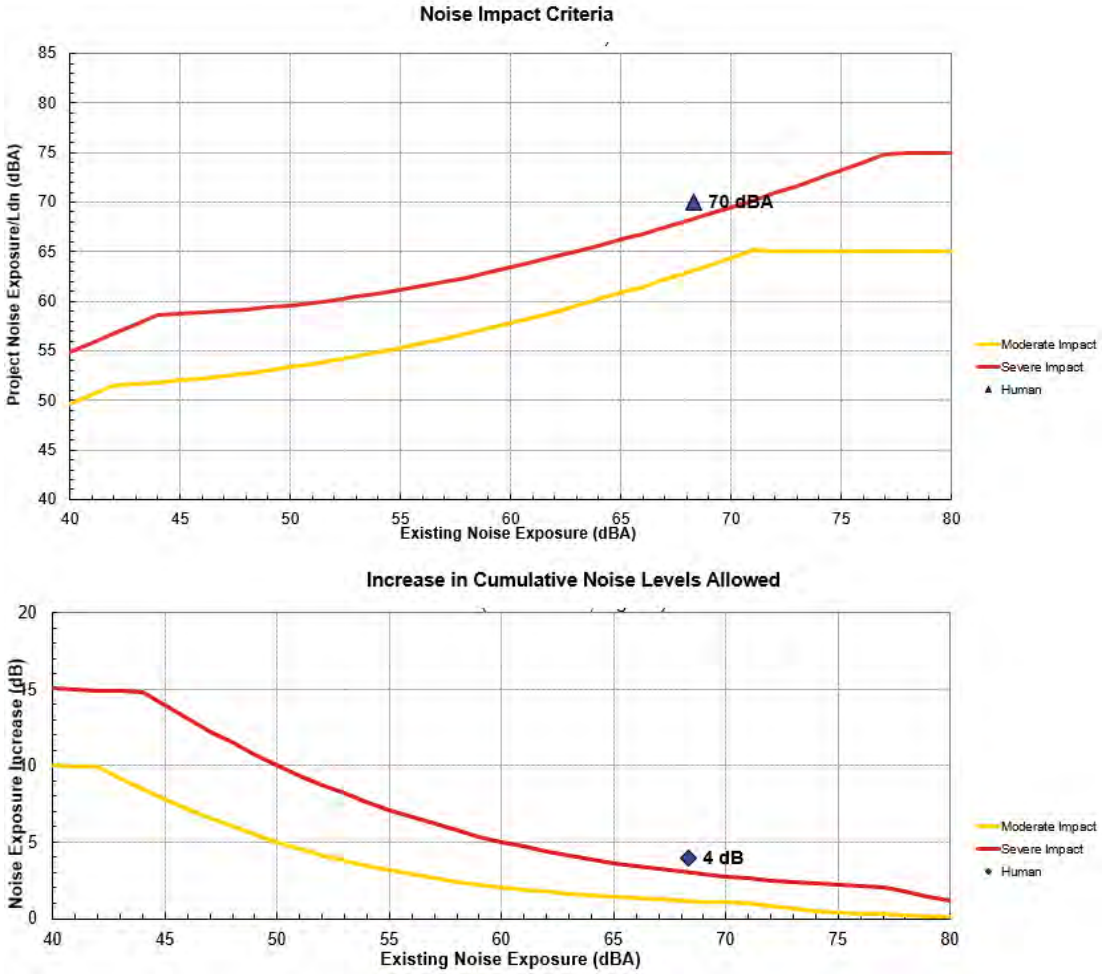


FIGURE 3.16: NQ2 (LALBANDHI): YEAR 2026

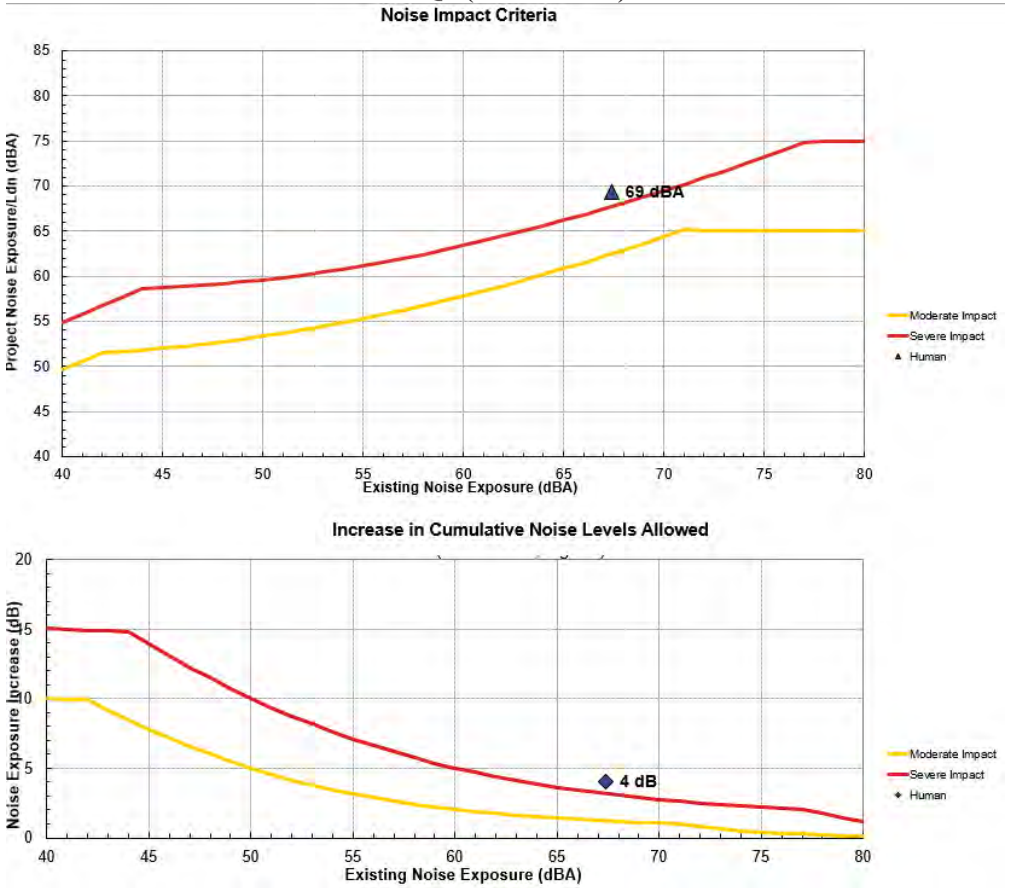


FIGURE 3.17: NQ3 (PAURAHI): YEAR 2026

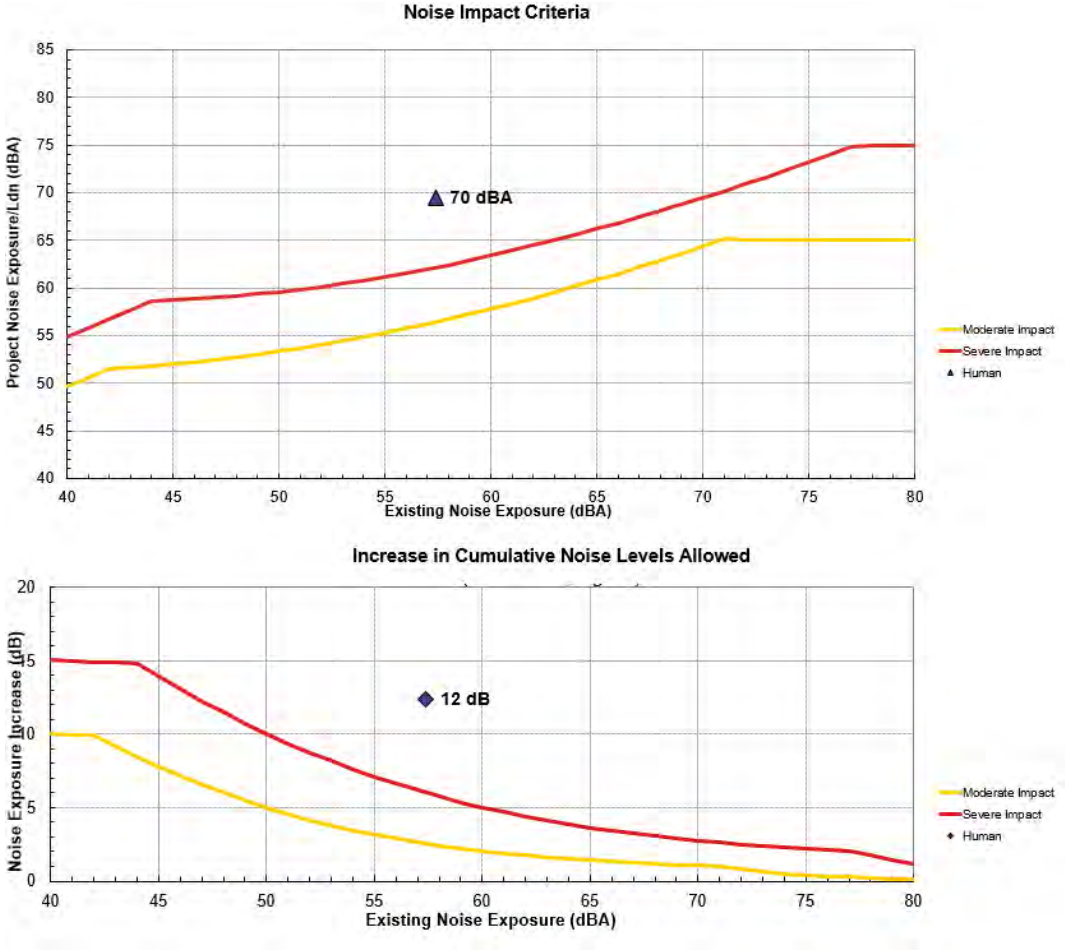


FIGURE 3.18: NQ4 (NAJIBABAD): YEAR 2026

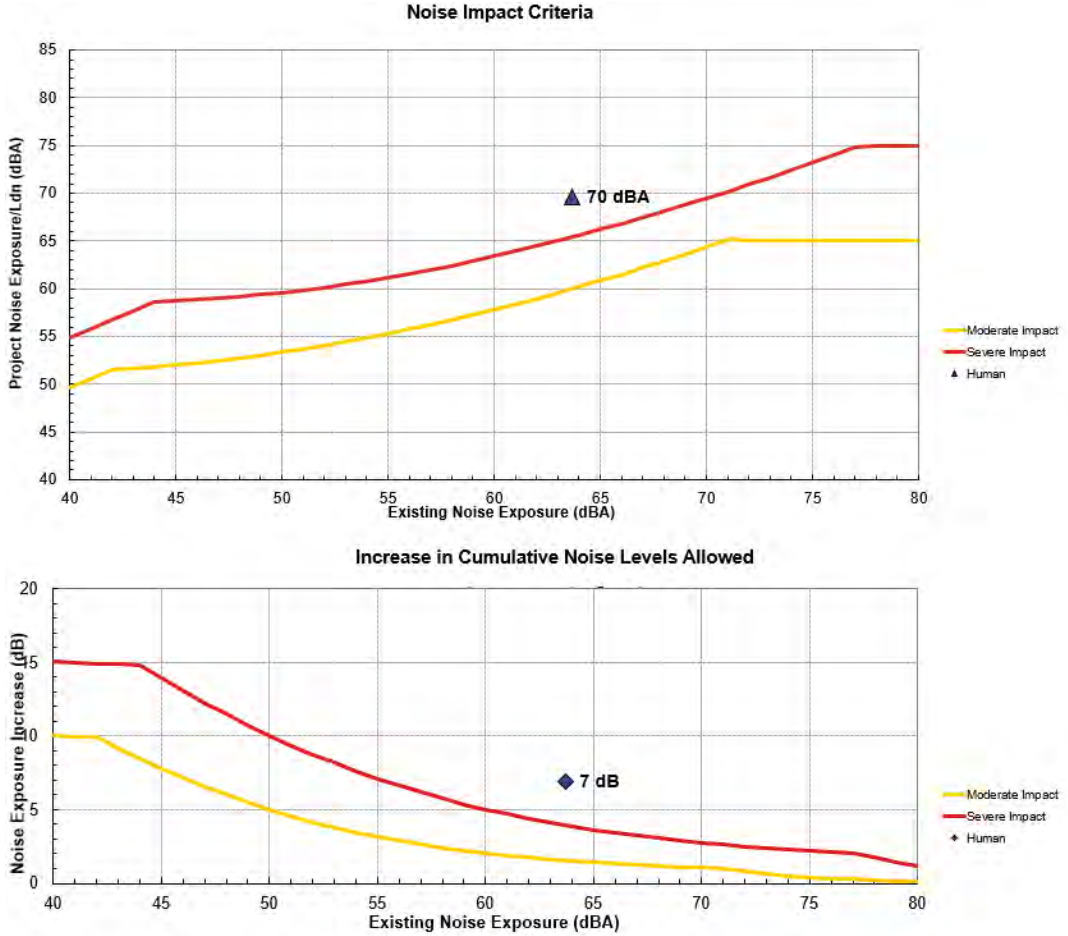
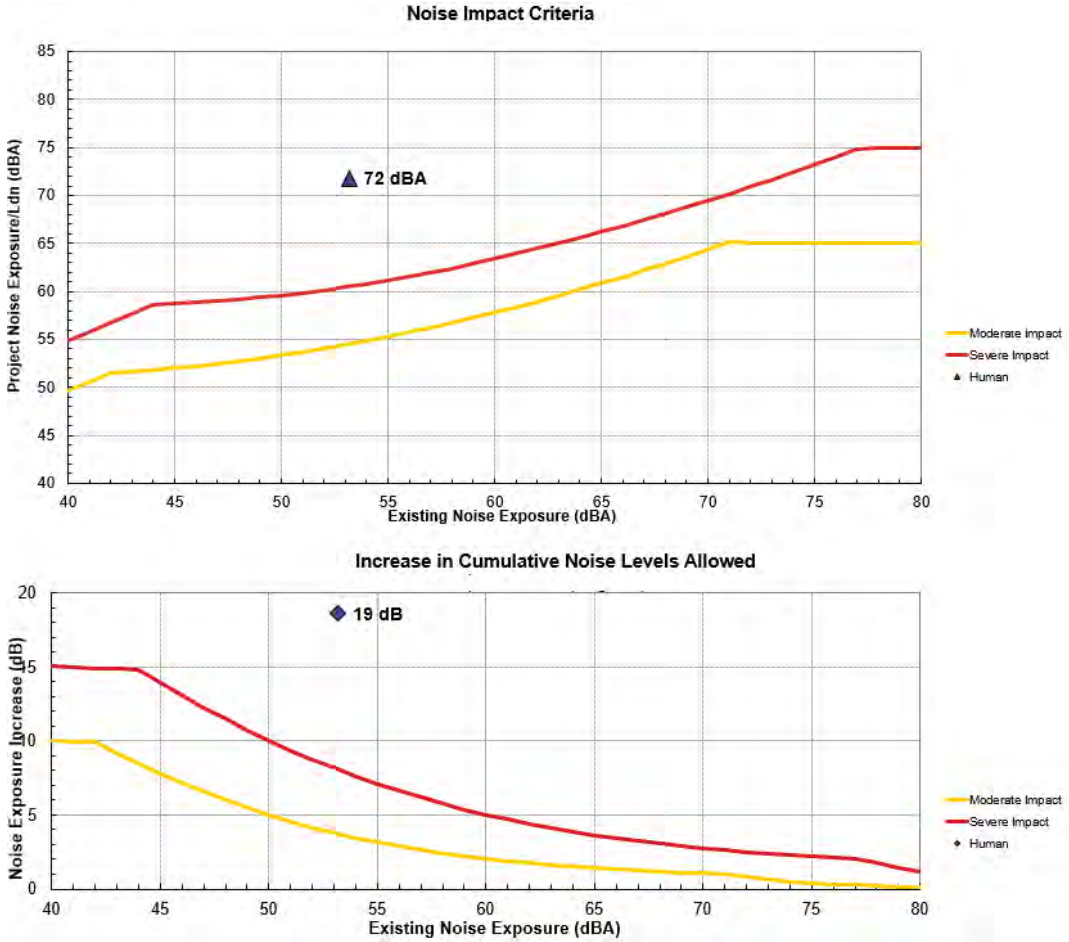


FIGURE 3.19: NQ5 (DUDHAURA): YEAR 2026


Noise Impact Criteria
Project Noise Exposure/Ldn (dBA)
Existing Noise Exposure (dBA)
72 dBA
Moderate Impact
Severe Impact
Human
Increase in Cumulative Noise Levels Allowed
Noise Exposure Increase (dB)
Existing Noise Exposure (dBA)
19 dB
Moderate Impact
Severe Impact
Human

Further for comparative analysis predicted noise level has been compare with respective existing noise level at all the five desired receptor locations during Daytime, Nighttime and Day-Nighttime and presented in **Tables 3.21-3.23** and graphically shown in **Figure 3.21 through Figure 3.23.**

TABLE 3.21: PREDICTED V/S EXISTING NOISE LEVEL DURING DAYTIME (LD): KDP-2026

Receptor (30 m from Median of Highway)	Ld_Predicted dB(A)	Ld_Existing dB(A)	Resultant Ld dB(A)
NQ1 (Dhalkebar on Kamal–Dhalkeba)	66.7	65.3	69.1
NQ2 Lalbandhi on Bardibas-Nawalpur)	66.0	64.4	68.3
NQ3 (Paurahi on Nawalpur-Chapur)	66.2	55.5	66.6
` NQ4 (Najibabad on Chapur-Nijgadh)	66.3	62.1	67.7
NQ5 (Dudhaura on Nijgadh – Pathlaiya)	68.4	50.4	68.5

FIGURE 3.20: PREDICTED V/S EXISTING NOISE LEVEL DURING DAY TIME (LD): KDP-2026

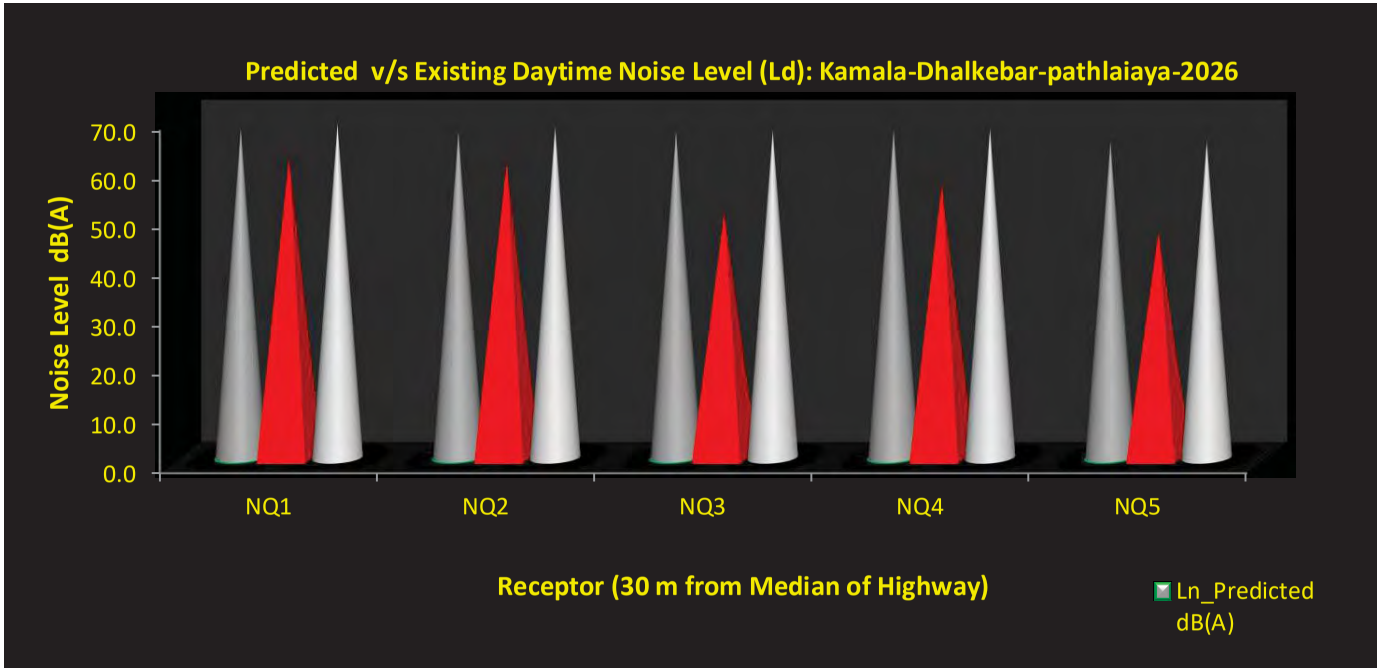


TABLE 3.22: PREDICTED V/S EXISTING NOISE LEVEL DURING NIGHTTIME (LN): KDP-2026

Receptor (30 m from Median of Highway)	Ln_Predicted dB(A)	Ln_Existing dB(A)	Resultant Ln dB(A)
NQ1 (Dhalkebar on Kamal–Dhalkeba)	67.3	61.3	68.3
NQ2 Lalbandhi on Bardibas-Nawalpur)	66.6	60.4	67.5
NQ3 (Paurahi on Nawalpur-Chapur)	66.7	50.1	66.8
NQ4 (Najibabad on Chapur-Nijgadh)	66.9	55.9	67.2
NQ5 (Dudhaura on Nijgadh – Pathlaiya)	64.5	46.1	64.6

FIGURE 3.21: PREDICTED V/S EXISTING NOISE LEVEL DURING NIGHT TIME (LN): KDP-2026

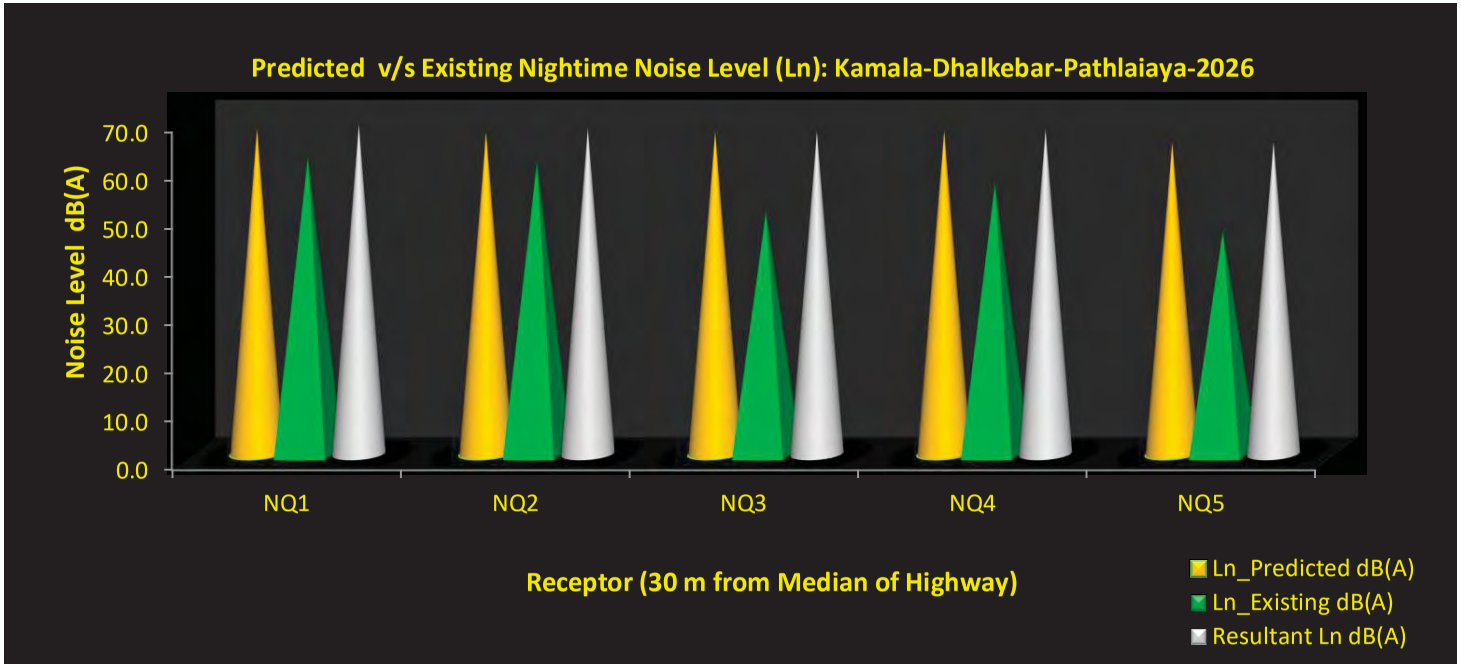
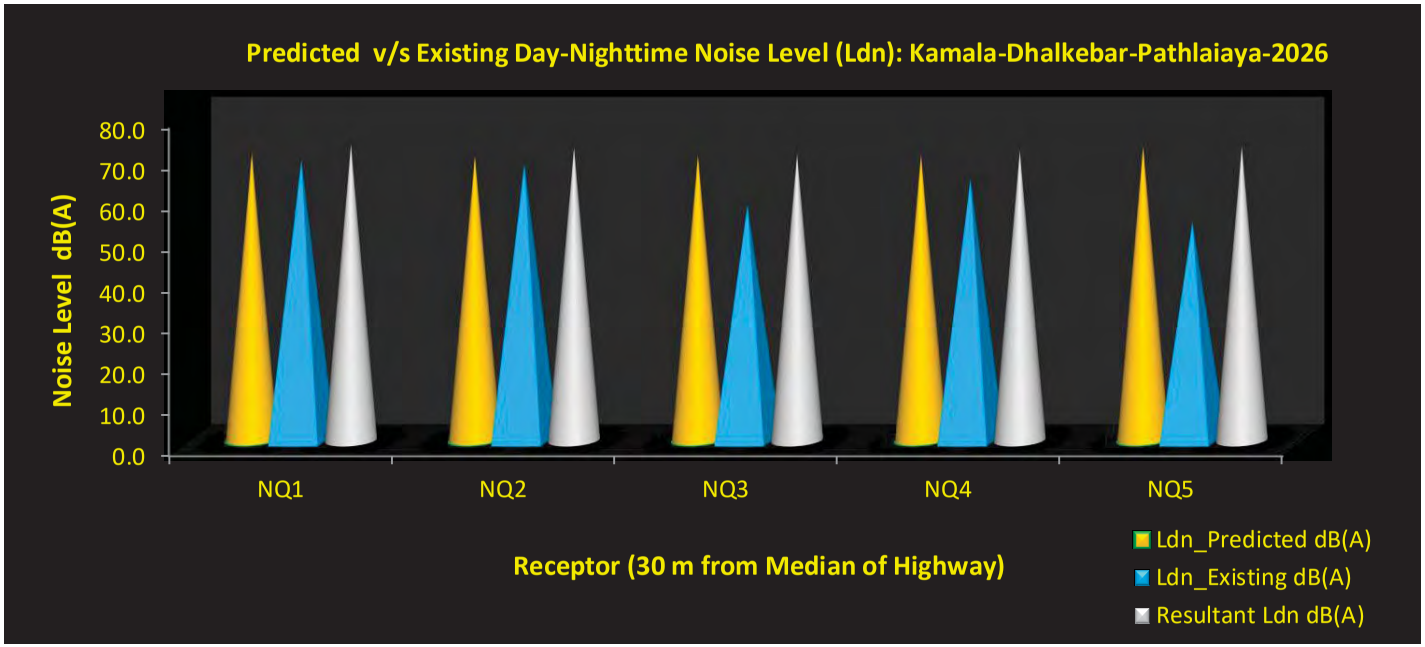


TABLE 3.23: PREDICTED V/S EXISTING NOISE LEVEL DURING DAY-NIGHTTIME: KDP- 2026

Receptor	Ldn_Preicted dB(A)	Ldn_Existing dB(A)	Resultant dB(A)

NQ1 (Dhalkebar on Kamal–Dhalkeba)	70.0	68.3	72.2
NQ2 Lalbandhi on Bardibas-Nawalpur)	69.3	67.4	71.5
NQ3 (Paurahi on Nawalpur-Chapur)	69.5	57.4	69.8
NQ4 (Najibabad on Chapur-Nijgadh)	69.6	63.7	70.6
NQ5 (Dudhaura on Nijgadh – Pathlaiya)	71.7	53.2	71.8

FIGURE 3.22: PREDICTED V/S EXISTING NOISE LEVEL DURING DAY-NIGHT TIME (LN): KDP-2026



Keeping overall view of noise impact assessment study for up-grading Kamala-Dhalkebar-Pathlaiya (KDP) section of Mahendra Highway of length 130 km and width 45 m having uniform ROW 25 m on either side of the highway median along entire study corridor, incremental noise level in dB(A) with respect to three sound level descriptors Daytime (Ld), Nighttime (Ln) and Day-nighttime (Ldn) are shown in **Figures 3.23, 3.24 and 3.25** respectively in the base year 2026 to get an idea how far from the proposed corridor the incremental noise level comply country specific day 55 dB(A) and night 50 dB(A) Ambient Noise Quality Standard (ANQS) for urban residential area without noise barrier and it is expected to meet at approximately 369 m and 1298 m respectively from the median of the highway. With respect to sailent zone landuse, day-standard 50 dB(A) and night-standard 40 dB(A) is expected to meet at 1298 m and 12975 m. It is worthy to mention that compliance distance is estimated under conservative approach considering maximum traffic volume on Bardibas-Nawalpur section and without any noise absorption in the direction of propagation of sound wave. Based on the noise modelling, the noise level at all desired receptors location exceeds the prescribed noise standards **(Table 3.24)** presented with respect to respective land use. To protect from any adverse impact due to noise where noise level exceeds the noise standard it is recommended. However, before installing noise barrier along highway prior site specific noise monitoring should also be performed.

TABLE 3.24: RECEPTORS LAND USE AND RESPECTIVE DAY & NIGHT NOISE STANDARDS

Receptors	Land use	Day-Noise Standard in dB(A)	Night-Noise Standard in dB(A)
NQ1 (Dhalkebar on Kamal–Dhalkeba)	Mix Residential Area	63.0	55.0
NQ2 Lalbandhi on Bardibas-Nawalpur)	Mix Residential Area	63.0	55.0
NQ3 (Paurahi on Nawalpur-Chapur)	Sailent Zone	50.0	40.0
NQ4 (Najibabad on Chapur-Nijgadh)	Urban Residential	55.0	50.0
NQ5 (Dudhaura on Nijgadh – Pathlaiya)	Sailent Zone	50.0	40.0

FIGURE 3.23: DAYTIME (LD) INCREMENTAL NOISE LEVEL ALONG ENTIRE KDP STUDY CORRIDOR AT 15 M, 30M, 50 M, 100 M &150M: 2026

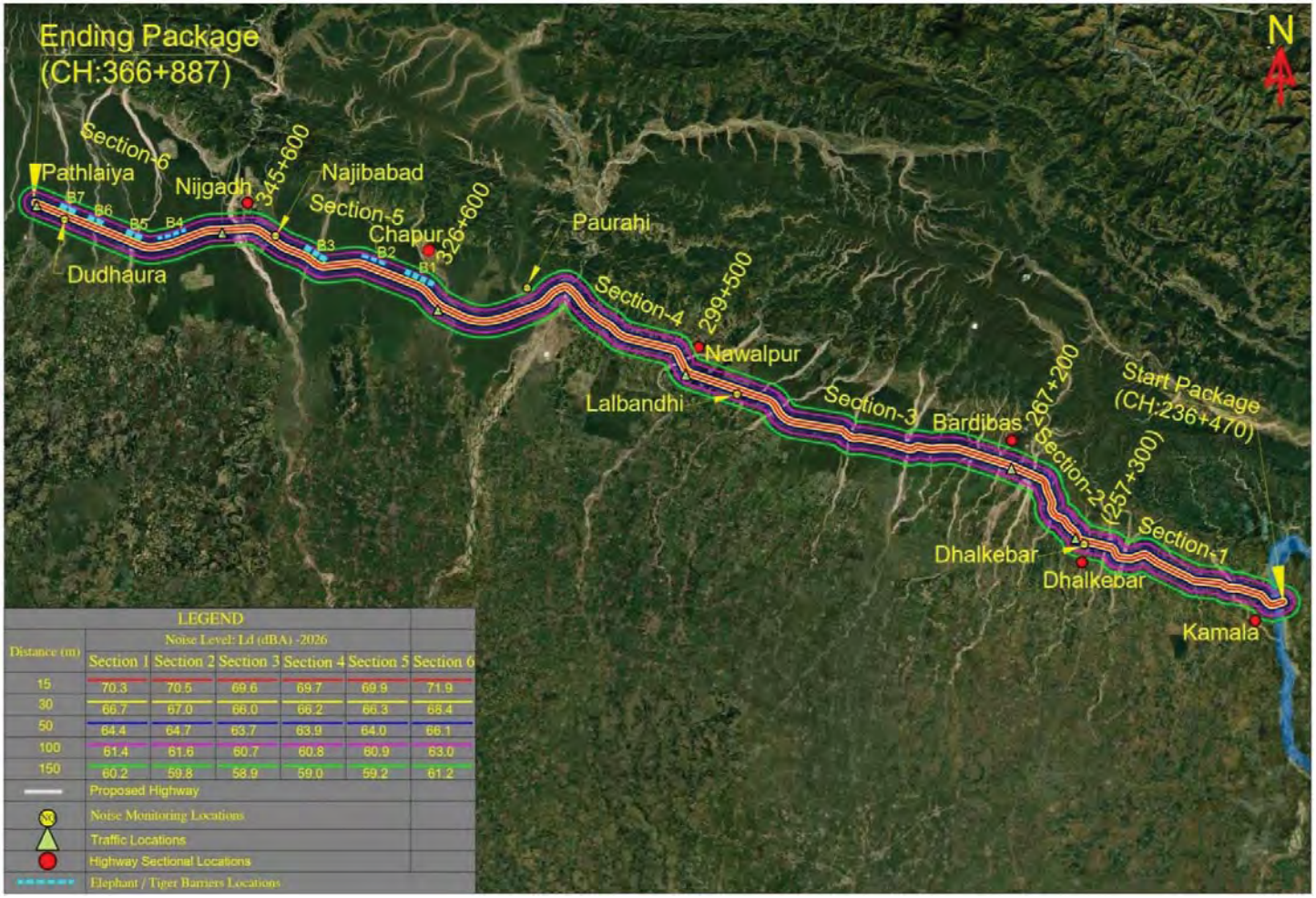


FIGURE 3.24: NIGHTTIME (LN) INCREMENTAL NOISE LEVELD ALONG ENTIRE KDP STUDYCORRIDOR AT 15 M, 30M, 50 M, 100 M &150M: 2026

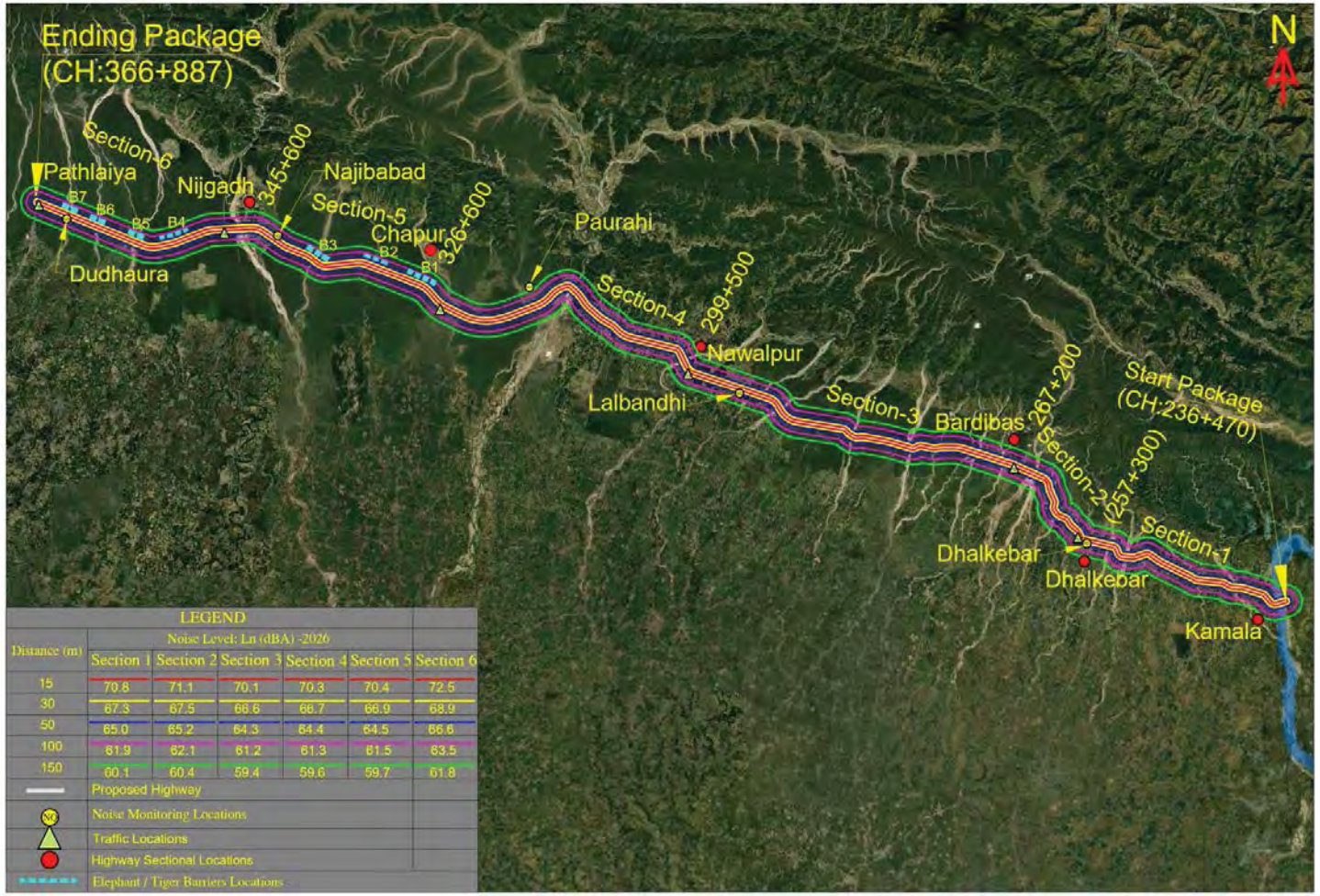
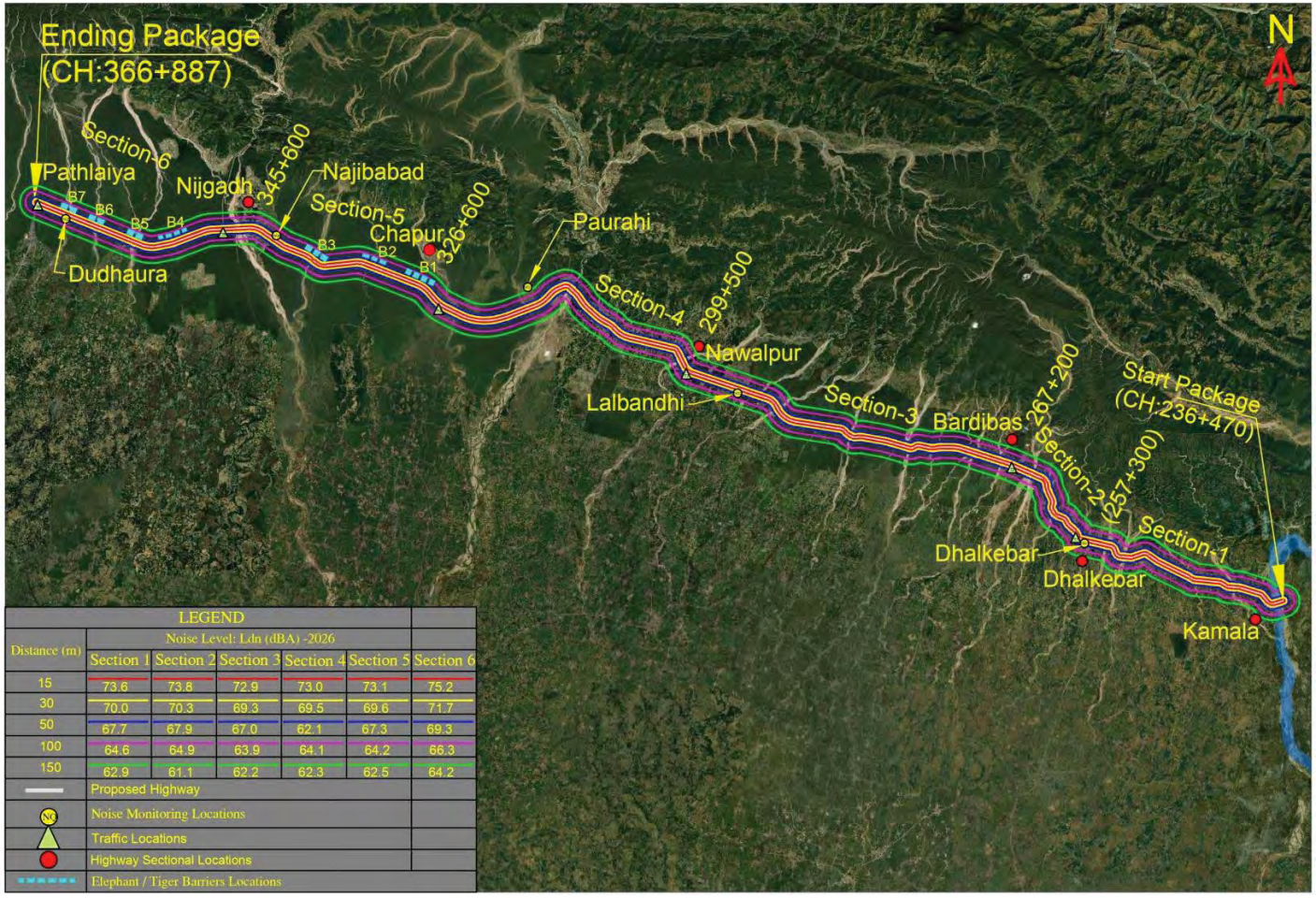


FIGURE 3.25: DAY-NIGHTTIME (LDN) INCREMENTAL NOISE LEVEL ALONG KDP ENTIRE CORRIDOR AT 15 M, 30M, 50 M, 100 M &150M: 2026



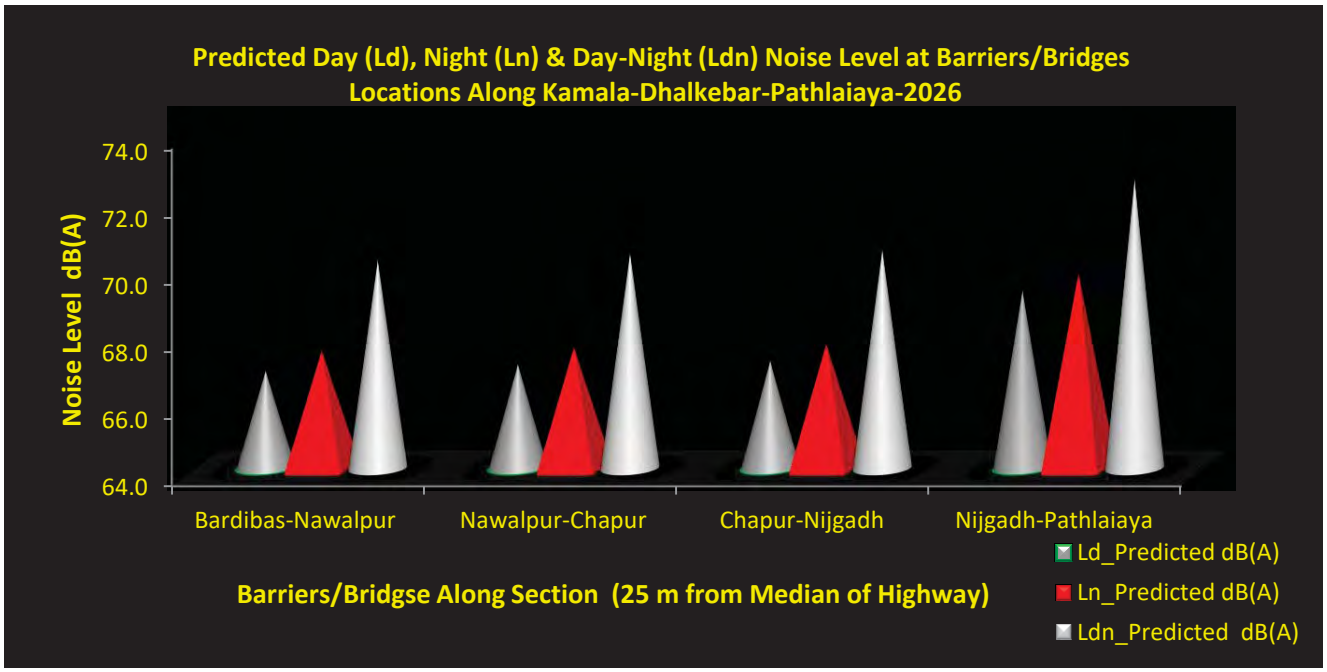
LEGEND						
Distance (m)	Noise Level: Ldn (dBA) -2026					
	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
15	73.6	73.8	72.9	73.0	73.1	75.2
30	70.0	70.3	69.3	69.5	69.6	71.7
50	67.7	67.9	67.0	62.1	67.3	69.3
100	64.6	64.9	63.9	64.1	64.2	66.3
150	62.9	61.1	62.2	62.3	62.5	64.2
Proposed Highway						
Noise Monitoring Locations						
Traffic Locations						
Highway Sectional Locations						
Elephant / Tiger Barriers Locations						

Further, predicted noise level at wildlife crossing points along the carriageway due to traffic on respective section of KDP corridor is presented in **Table 3.25** and shown graphically in **Figure 3.26**. Predicted noise level exceeds noise level standard at all sections and in order to protect wildlife from any adverse noise impact due to traffic flow noise barrier is recommended and prior site specific due diligence study is also suggested.

TABLE 3.25: PREDICTED DAY (LD), NIGHT)(LN) & DAY-NIGHT (LDN) AT WILDLIFE CROSSING SECTIONS

Section	Ld_Predicted dB(A)	Ln_Predicted dB(A)	Ldn_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 3.26: PREDICTED DAY (LD), NIGHT)(LN) & DAY-NIGHT (LDN) AT WILDLIFE CROSSING SECTIONS



4.0 MITIGATION MEASUURES

.4.1 CONSTRUCTION PHASE

Noise control measures during construction phase will be required to minimize noise levels on existing noise-sensitive land uses. All construction activities will have to comply with local noise regulations. Nighttime work could require a variance for local noise regulations.

The noise control measures discussed in the following sections are examples of those that will be incorporated into the project's construction phase. The contractor will be required to comply with applicable noise regulations permits acquired for the project. Construction hours could be set, and construction activity noise level emission criteria should be determined and complied during construction.

(I) DESIGN CONSIDERATIONS

During the early stages of construction plan development, natural and artificial barriers could be considered for use as shielding against construction noise. Strategic placement of stationary equipment, such as compressors and generators, could reduce effects at sensitive receivers.

(II) ALTERNATE CONSTRUCTION METHODS

Certain phases of construction work, such as pile (Impact) driving, if any, may produce noise levels in excess of acceptable limits, even when feasible noise reduction methods are used. Using alternate methods of construction may reduce these effects. For pile driving (if required), vibratory or hydraulic insertion could be used, depending on a variety of factors (i.e., vibratory pile driving is not always quieter). Drilling holes for cast-in-place piles is an alternative construction method that would produce significantly lower levels of noise.

(III) SOURCE CONTROL

The contractor will comply with standard specifications and all local sound control and noise level rules, regulations, and ordinances that apply to any work performed pursuant to the contract. Each internal combustion engine used for any purpose on the project or related to the project will be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine will be operated without a muffler.

(IV) TIME AND ACTIVITY CONSTRAINTS

Noisier activities involving large machinery will be limited to daytime hours. Nighttime construction will require a variance. Compliance with local noise ordinances would mitigate effects associated with construction noise. To comply with these ordinances, all construction activities adjacent to residential uses will be limited to daytime hours (7:00 AM to 6:00 PM) Monday through Saturday.

(V) COMMUNITY RELATIONS

Community meetings will be held to explain the construction work, time involved, and control measures to be taken to reduce the effect of construction noise.

.4.1.2 OPERATION PHASE

During operation phase of transit system. Noise barriers are effective in mitigating noise when they break the line-of-sight between source and receiver. Barriers on the ROW line, the height must be increased to provide equivalent effectiveness to barriers located close to the vehicles. Otherwise, the effectiveness can drop to 3 dB or less, even if the barrier breaks the line-of-sight. The length of the barrier wall is also important to its effectiveness. The barrier must be long enough to block noise from a moving traffic along most of its visible path. This is necessary so that traffic noise from beyond the ends of the barrier will not severely compromise noise-barrier performance at noise-sensitive locations. The barrier length can be refined in the engineering phase, closely examining the predicted sound level exceedances at specific receivers, site geometries, and the contribution of barrier flanking noise, then adjusting the length as appropriate. Vegetation which hides the source from view but does not reduce sound levels substantially over short distances. Vegetation and Trees can provide some mitigation if at least 33 m of trees intervene between the source and receiver, if no clear line-of-sight exists between the source and receiver, and if the trees extend 5 m or more above the line-of-sight

In cases where noise barriers are not feasible—such as multi-story buildings, buildings very close to the ROW—the only practical noise mitigation measure may be to provide sound insulation for the buildings. In these cases, the need for mitigation at locations where impact has been identified will depend on the use (outdoor vs. indoor), any existing outdoor to indoor reduction in noise levels, and the feasibility of constructing effective noise barriers for second stories and above.

Depending on the quality of the original building façade, especially windows and doors, sound insulation treatments can improve the noise reductions from transit noise by 5 to 20 dB. To be considered cost-effective, a treatment should provide a minimum reduction of 5 dB in the interior of the building and meet the nighttime (Ln) 45 dB(A) interior criterion.

Annexure 6.3: Educational and Health Institutes along KDP Road

Educational and Health Institutes along KDP Road

District	Settlement	Educational Institutions	Health Institutions
Siraha	Bandipur	Oxford English Boarding School	Sarpadansa Upachar Kendra
		Aryan Adarsha Pathsala	
Dhanusha	Godar	Shree Janata Jaiswal H.S. School	
		Shubha Oxford Boading School	
	Birendra Bazar	Navasanti Bidhya Ashram H.S. School	Hari Om Health Care Pvt. Ltd.
	Dharapani	Creative Secondary English School	Panchmukhi Nagarik Hospital Pvt. Ltd.
		Dhrapani High School	
		Supersense Secondary English School	Health Post
	Pushpalpur		Pushpalpur Health Care Pvt. Ltd.
	Dhalkebar	Binayak English Boarding H. S. School	
		Janak International Academy	
		Children's Garden Secondary E. B. School	
		Mahendra Secondary School, Dhalkebar	
		Shatkona Montessory Pre-School, Dhalkebar	
	Januniya	Osis Academy School, Jamuniya	Om Laxmi Health Care Center
		Jamunibas Basic School	Lalgadh Model Hospital Pvt. Ltd.
	Badahari	New Horizon English Boarding School	Lalgadh Leprosy Hospital Service Center
		Nava Kshitiz Secondary Boarding School	
		Shree Adarsha Rastriya Madhyamik	
Mahottari	Bardibas	Janata Higher Secondary School	
		Shree Deurali Secondary School	DNB Medicare Center
		Ecverest Boarding School	Bal Maitri Hospital
		Bardibas Boarding School	
		Nobel Academy	
		Sapta Kabindra Shiksya Niketan	
		Nava Kshitiz College, Bardibas	
Sarlahi	Lalbandi	Community Welfair English School	
		Rockvale Secondary Academy	
		Everest Secondary Academy	
		Oxford Academy	
		Janajyoti Bahumukhi Campus, Lalbandi	
	Nawalpur	Shree Navajeewan Higher Secondary School	Nawalpur Sarpadansa Upachar Kendra
		Peace Zone English Boarding School	Sarlahi Lifeline Health Center
	Harion	Chaturbhujeshwor Janata Multiple Campus	Sasapur Health Post
		Mahadev Janta Higher S.School	Harion Health Post
		Samata School	Model Hospital Harion Pvt. Ltd.
			Harion Hospital Pvt.Ltd.
	Nayaroad	Gyan Jyoti Awashiya Vidhyalaya	Dayanti Hospital Private Ltd.
	Bagmati (East)	Elite English Boarding School	
Rautahat	Bagmati (West)	Namuna Primary Boarding School	Nunthar Hospital
	Chndrapur	Shree Bashanta Panchami Lower Secondary School	Eye and Ear Care Center, Chapin
		Moonlight Academy Higher Secondary School	
		Shree Durga Secondary School	Chandrapur Hospital Pvt. Ltd.
Bara	Nijgadh	Vidhya Sagar E. Boarding School	Primary Health Center
		Shree Bakaiya Thakur Madhyamik Bidhyalaya	
		Gaurishanker Campus, Nijgadh	
		Shree Gauri Sanker Higher Secondary School	Tilganga Eye Hospital, Nijgadh
		Bidhya Sagar English Boarding School	
	Pathlaiya	Sheer Nepal Higher Secondary School	Central Medical Store
Total Numbers		**47**	**23**

Annexure 7.1: Road Safety Management Plan

Road Safety Management Plan

Background

Road safety assessment (RSA) and Road safety audit are used interchangeably in road safety investigation domain of any highway. Road safety assessment is primarily been undertaken to assess the degree of safety been perceived by the road users that being discerned based on pre-specified parameters and pre-requisites. It is a formal process to evaluate the safety performance of an existing or a planned road project. This assessment of road safety is of utmost importance; be it the design stage, construction stage or the maintenance stage of given facility.

The road safety assessment (RSA) or road safety audit has been done by the consultant for the Kamala-Dhalkebar-Pathlaiya (KDP) section (130km) of Mahendra Highway both prior to the design stage and post design stage. Pre-design stage road safety audit report of existing KDP highway had been completed in July 2022. Post design stage RSA has been conducted based on the degree of improvements been proposed and inducted in the detailed design.

Accident / Crash Analysis and Result

During road safety audit, Accident data was obtained and analysed. Post analysis it was found that 43% of accidents from FY 2015-16 to 2020-21 occurred in Mithila, Chandrapur and Charnath (Mithila-17%, Chandrapur-15% and Charnath-11%). Lalbandi and Harivan in Sarlahi district experienced 9% and 8% of total accidents on the stretch. While bridge locations had around 9% of total accidents.

Table 1: Accident proportion by Place

S. No.	Place	Region	Proportion of Total Accidents (%)
1.	Mithila	Dhanusha	17%
2.	Chandrapur	Rautahat	15%
3.	Charnath	Dhanusha	11%
4.	Lalbandi	Sarlahi	9%
5.	Harivan	Sarlahi	8%
6.	Bridge Locations	Combined	9%

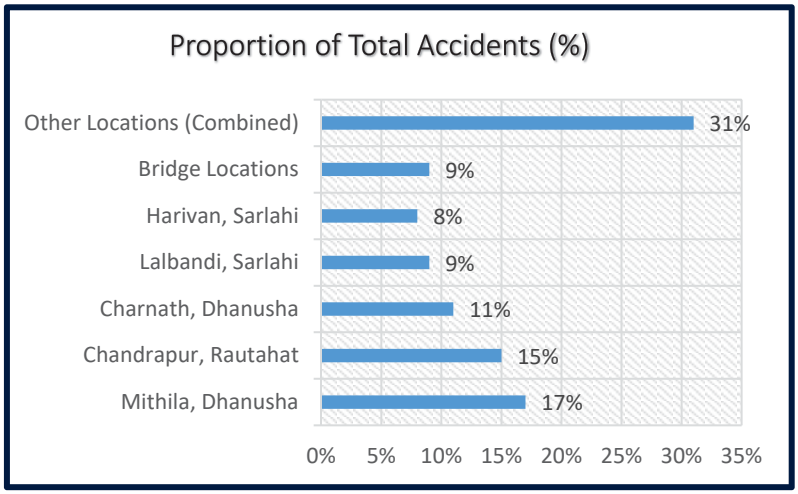


Figure 1: Proportion of Accidents by Place

Narrow Bridges to be retained

The List of Narrow bridges having width less than 7m but to be widened to 7m during construction is provided in the **Table 2** below.

Table 2: Narrow Bridges to be Retained (Width to be extended to 7m)

S. No.	Chainage	Carriageway Width <7m at present (to be extended to 7 m during upgradation)
1	268.134	Bhapsi
2	277.004	Maraha
3	282.73	Bankhe
4	300.671	Lakhandei
5	312.07	Bagmati East
6	313.615	Bagmati West
7	354.656	Barahakilo
8	362.952	Baijura
9	364.553	Dhungre - 1
10	364.776	Dhungre - 2

After safety audit and various discussions with all stakeholders it has been decided that in the final design no bridges will have carriageway width of <7m. All together in the final design twenty-three (23) number of bridges will be retained for future traffic movement out of which 13 number of bridges already have carriageway width of 7m or more and as explained above carriageway width of 10 number of bridges which have carriageway width less than 7 m at present will be extended to the carriageway width of 7 m. Design proposal for bridges shown in the **Table 3** below.

Table 3: Design Proposal for Bridges

SN	D/S Bridge Type	U/S Bridge Type	Name of Bridges	Number of Streams	Number of Bridges						Number of Existing Bridges to be Retained for use		
					Type 1 (11.85 m)	Type 2 (17.55 m)	Type 3 (9.1 m)	Pedestrain Bridge Type 4 (2.1 m)	Six Lane Bridge Type 5 (26 m)	Special Type Bridge (17.55 m)	Yes/No	Number of Bridges to be retained	Number of Bridges to be discarded
1	1	1	Atabe, Jangapul-1, Jangapul-2, Gadhanta, Belgachi, Tuteshwor-1, Tuteshwor-2, Kholsi pul, Dholan, Jarlahi, Batuwa, Amuwa, Kalinjor-1, Kalinjor-2, Paurahi, Lachkan, Kathko Pul, Jungle Tol, Amu-1, Amu-2, Kathi, Lamaha, Kali Khola, Lamo Pul, , Terakilo, Pasaha, Pasaha Branch, Bangandi, Balganga	29	58						No	0	29
2	2	2	Sukhajor, Phuljor, Dumdume, Chapani, Rai Bridge, Damajor, Gairi, Chandi, Bhamara, Rampul, , Unasi, Tin Number	12		24					No	0	12
	5		Ratu	1					1		Yes	1	0
3	2	3	Kamala Canal, Aurahi, Basai, Bhapsi, Lakhandehi Bagmati East, Bagmati West,	7		7	7				Yes	7	0
4		5	Barhari	1					1		Yes	1	0
5	1	4	Charnath, Baluwa, Jagdav Branch, Jagdav, Jalad, Maraha, Bakhe, BaraKilo, Baijura, Dhungre-1, Dhungre-2	11	11			11			Yes	11	
6		1	Dhansar	1	1						Yes	1	
7	2 (Special Type)		Kamala	1						1	Yes	1	
8	2 (Special Type)		Bagmati, Bakeya	2						4	No	0	2
9	Change to culvert		Ratu Chahara, Betni, Bastipur, Bastol, Sukhapokhari, Godari, Gairi Khola, Dhou, Dui Number, Ek Number	10							No		0
10	No proposal		Dudhaura	1							Yes	1	
Total				76	70	31	7	11	2	5		23	43

Road side Settlement and Ribbon Development

Table 4: Settlement / Urbanized locations

S. No.	Settlement

1	Portha
2	Godar
3	Birendra Bazar
4	Bhimban
5	Dharapani
6	Kanchhi Bazar
7	Sripur
8	Dhalkebar
9	Janunibas
10	Badhari
11	Lalgarh
12	Bardiwas
13	Lalbandi
14	Navalpur
15	Harivan
16	Nayaroad
17	Bagmati
18	Chandrapur
19	Chapur
20	Pathalaiya

Major Junctions

There are total 386 major and minor junctions developed along the Project Highway. The junctions are reviewed from traffic point of view during RSA for their geometry and traffic conflicts. The Consultant also reviewed Major junctions and based on traffic density, geometry, turning movement counts, line of sight and accident history; appropriate recommendation has been made. The improvements of identified Major junctions have already been finalized and the proposed design is included in this Draft Design Report. The proposal to provide either flyover or Vehicular Underpass with Pedestrian Underpass in the approaches has been made for selected Major junctions and geometric design has been carried out accordingly.

Human behavior consideration

Human behaviour / psychology, being a prime factor in road safety, has been predominantly kept in mind while designing highway facilities, and prior to finalizing the geometrics. Drivers, no matter of which transportation mode, have always different level of perception (e.g. mental conditions during DUI), differing reaction times to a given situation and have different type of responses. Although these and responses to such other parameters don't have large deviation from mean. At the same time these responses also depends on type of vehicle and condition of vehicle including roadway condition.

The road geometry including horizontal and vertical profile has been designed adopting best practices and codes, in order to best align large driver population mean behaviour for ensuring safe and smooth mobility on project highway. The proposed four lane carriage way is proposed to be newly constructed from Subgrade level, which shall have smooth riding quality for safe and comfortable movement of road user.

Sharp Curves and Poor Line of Sight

During RSA, several locations were observed with deficient / sharp curve radius and poor line of sight. Sharp curves are very unsafe especially in the night time since they do not have proper curve delineation. Also curves on high embankments without delineation and barrier protection to check vehicle run-off at high speed on curves are on very high risk and shall be modified on priority. Sharp curves and other obstructions like trees and corner buildings also hinder proper visibility and restrict safe sight distances for stopping and overtaking.

Prevailing factors appraised and contemplated in design for safer design of proposed highway post safety audit;

1. Location specific accident statistics and analysis (accident data can't be acquired discrete to intersections, villages, urban agglomerate, bridges etc),
2. Pedestrians' location specific count and pedestrian movement behaviour,

3. Pedestrian friendly design like footpaths, footpaths with railing, zebra crossing with ramps at junctions and foot-over-bridge (FOB),
4. Bicycling behaviour centric locations,
5. Bus alighting and boarding points,
6. Clear visibility while maintaining safe stopping sight distance to be minimum in non-urban sections,
7. Additional and special safety provisions at locations - 'to be retained' narrow bridges at par to best practices,
8. Proposed flyovers and VUPs / PUPs to lower down conflicts points, thereby improve overall safety, enhance the capacity of junctions and Level of Service (LOS),

Table 5 shows the summary of safety issues and measures adopted in Design

Table 5: Summary of Safety Issues and Measures adopted in Design

S. No.	Primary Factors Contemplated	Measures Proposed	Specification and Codes adopted for Design
1.	Region / District level accident data analysis and safety measures proposed. Location specific accident statistics and analysis (accident data can't be acquired discrete to intersections, villages, urban agglomerate, bridges etc)	Crash barriers, Impact attenuators	Nepal Road Standard (NRS) – 2070, Indian Road Congress (IRC): 119 – 2015, IRC: SP 84
2.	Pedestrians' location specific count and pedestrian movement behaviour	Zebra crossing, Foot-over-bridge, Traffic calming measures etc.	Traffic Sign Manual, Dept. of Roads (DoR), NRS – 2070 and IRC: 35 - 2015
3.	Bicycling behaviour centric locations	Bicycle tracks and relevant signages	NRS – 2070, IRC: 11 - 2015
4.	Bus alighting and boarding points	Bus-bays and stops	Nepal Road Standards - 2070
5.	Clear visibility and/ or obstructions while maintaining safe stopping sight distance to be minimum in non-urban sections	Improved geometric design, hazard warning of unusual layout ahead, adequate signage and pavement marking	Nepal Road Standards – 2070, IRC: 73, Traffic Sign Manual (DoR), IRC: 67 – 2012, IRC: 35 - 2015
6.	Additional and special safety provisions at locations - 'to be retained' narrow bridges	Crash barriers, Impact attenuators, adequate hazard warnings, signage and pavement marking	Nepal Road Standard (NRS) – 2070, Indian Road Congress (IRC): 119 – 2015, IRC: SP 84, Traffic Sign Manual (DoR), IRC: 67 – 2012, IRC: 35 - 2015
7.	Lower down conflicts points, thereby improve overall safety, enhance the capacity of junctions and Level of Service (LOS)	Junction improvement, provision of flyovers, VUP / PUP, adequate signage and pavement marking	Nepal Road Standards (NRS) -2070, IRC: SP – 41, Traffic Sign Manual (DoR), IRC: 67 – 2012, IRC: 35 - 2015
8.	Insufficient information for the road users	Improved signage plan and pavement marking	Traffic Sign Manual (DoR), IRC: 67 – 2012, IRC: 35 - 2015
9.	Fixed hazards on or by the roadside	Removal of hazards to the extent possible. For narrow bridge locations; improvements added as suggested in point 6	Nepal Road Standard (NRS) – 2070, Indian Road Congress (IRC): 119 – 2015, Traffic Sign

S. No.	Primary Factors Contemplated	Measures Proposed	Specification and Codes adopted for Design
		above	Manual (DoR), IRC: 67 – 2012, IRC: 35 – 2015
10.	Cattle and Animal crossings	Elephant and cattle underpass being provided	
11.	Access control	Direct access has been minimized specially in urban areas via service road and / or footpath and curb	Nepal Road Standard (NRS) – 2070, IRC: 62
12.	Night visibility in urban regions	Street lighting has been proposed in urban / habituated locations including major junctions, bridges, flyovers / VUP / PUP, Bus bays and truck lay-byes	IS: 1944 (Part-V) – 1981 and other international standards
13.	Traffic control and adequate delineation of project highway	Signages, Pavement markings, Highway delineators are proposed as per codes and requirement for traffic safety	Nepal Road Standards – 2070, Traffic Sign Manual (DoR), IRC: 67 – 2012, IRC: 35 - 2015

Geometric Layout of Proposed Highway

The project highway has been designed for the Design Speed of 100 kmph. The specifications and codes used for the same are detailed in the last section of this chapter. The alignment has been designed considering available existing Right of Way (ROW) of 50m and aligning with existing geometry to the maximum extent possible. For attaining the design speed of 100 kmph and maintaining the safe stopping sight distance of 180 m and intermediate sight distance of 360 m; curve improvements have been made with few exceptions where land acquisition constraints persists. Following are the curves designed for the alignment. The statistics of the curves designed for the project highway has been provided vide **Table 6** below.

Table 6: Curve Statistics on Project Highway

S. No.	Radius (m)	Length of Curve (m)	Frequency of Curve Occurrence (Nos.)	Percent frequency of Curve Occurrence	Percent length
1	10000	184.685	5	4%	0.49%
2	8000	502.816	13	10%	1.34%
3	5000	4817.54	15	11%	12.79%
4	4000	1293.54	2	2%	3.44%
5	3200	1288.2	1	1%	3.42%
6	3050	1387.53	1	1%	3.69%
7	3000	3801.54	12	9%	10.10%
8	2950	1444.98	1	1%	3.84%
9	2800	635.299	1	1%	1.69%
10	2600	2193.19	2	2%	5.82%
11	2500	3061.71	7	5%	8.13%
12	2220	1949.09	1	1%	5.18%
13	2000	5074.47	34	26%	13.48%
14	1850	278.596	1	1%	0.74%
15	1500	1318.55	2	2%	3.50%
16	1000	1264.05	6	5%	3.36%
17	980	669.304	1	1%	1.78%
18	710	612.774	1	1%	1.63%
19	700	342.434	2	2%	0.91%
20	600	102.322	1	1%	0.27%
21	550	452.584	3	2%	1.20%

S. No.	Radius (m)	Length of Curve (m)	Frequency of Curve Occurrence (Nos.)	Percent frequency of Curve Occurrence	Percent length
22	530	138.625	1	1%	0.37%
23	500	3727.09	12	9%	9.90%
24	460	344.339	1	1%	0.91%
25	400	454.732	4	3%	1.21%
26	360	73.945	1	1%	0.20%
27	160	102.008	1	1%	0.27%
28	80	136.35	1	1%	0.36%

As per Nepal Road Standard – 2070, 370m is the minimum radius with max. super elevation while 530m is the minimum from passenger comfort criteria. While IRC: SP 84, allows 400m desirable minimum and 250m as absolute minimum radius in plain and rolling terrain. The Geometric alignment of the project highway has been designed having almost 80% curves with radius >900m, 95% curves with radius >450m and around 5% curves (2% in terms of length) of radius <=400m.

Curves of radius 2000m covers 34 locations (26%) with 13.48% of total curve length, which is good from high speed traffic safety viewpoint. The few locations had design restrictions specifically due to land constraints and are designed with compromised speed. Such locations having restricted and acceptable speed are mentioned below in **Table 7**.

Table 7: Curves with Radius < 450m

S. No.	Chainage (Km)	Curve Radius (m)	Length of Curve (m)	Restricted Speed (kmph)	Location
1	245+360	400	153.464	75	Near Baluwa Khola (Dhanusa)
2	339+488	400	31.986	75	Forest Area
3	339+638	400	36.615	75	Forest Area

There is a location on the highway near Dhalkebar intersection, where a flyover has been proposed. However, the existing alignment is having sharp S curve and traverses through urban area. As the Land/ Structure acquisition is difficult in this stretch and also the Client have desired not to have any land/ structure acquisition, the flyover has been designed considering same alignment having sharp S-curve compromising the safety and defying the very intent of the proposed highway. The detail of Sharp curves in this stretch is presented vide **Table 8** below.

Table 8: Very Unsafe Curves

S. No.	Chainage (Km)	Curve Radius (m)	Length of Curve (m)	Restricted Speed (kmph)	Location
1	257+053	160	102.008	40	Dhalkebar Flyover
2	257+184	80	136.35	40	Dhalkebar Flyover

All the curves having radii up to 450m and all high embankments with height 3m or more are being provided with safety barriers at the outer edge of the Carriageway for protection against vehicle run-off from the highway.

Vertical curves have been introduced in flyovers, VUPs / PUPs junction and end points of both approaches in order to provide smooth riding to the road user. Remaining sections are in mostly on plain and rolling terrain and natural topography, wherever needed, has been tweaked to adjust vertical curves in order to maintain adequate clear sight distances, safety and comfort as per specifications and codes.

Locations of narrow bridges that need to be retained; alongside providing appropriate safety measures, a taper of 1 in 50 and a minimum of 1 in 20 has been used as per IRC: SP 84 to gradually merge or diverge from and to proposed highway.

Speed Management and Control

The Speed Management Technique is presented vide **Figure 2** for ready reference.

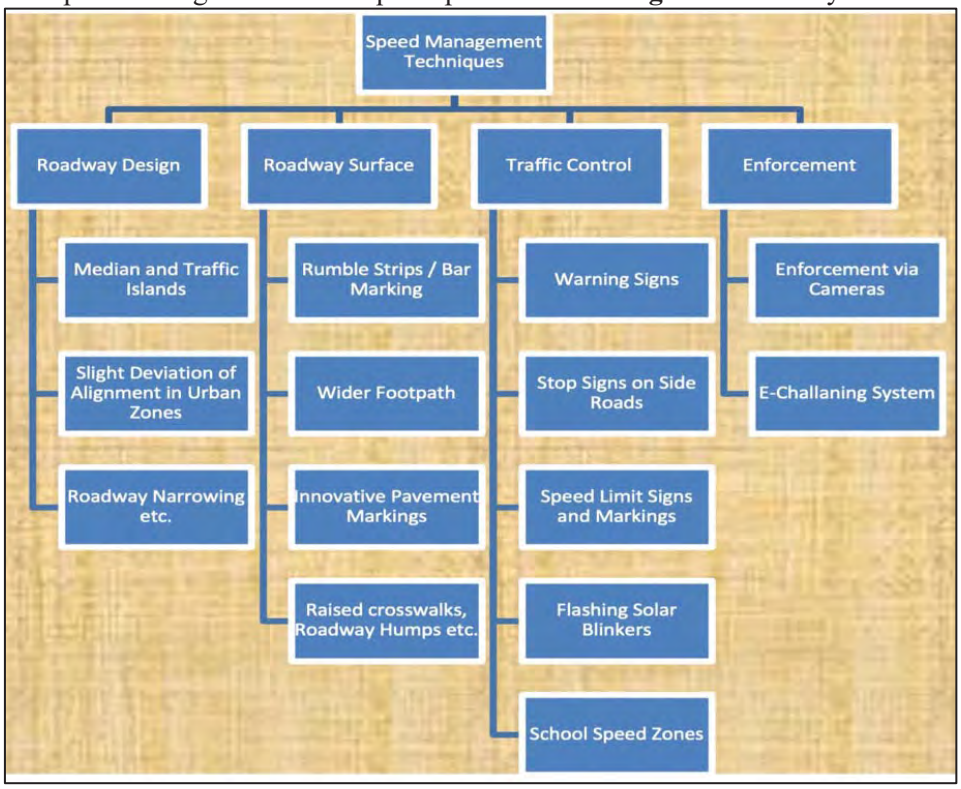


Figure 2: Speed Management Techniques

Speed management and control measures adopted on the proposed highway are as below:

1. Reduced speed regulation specific zones
2. Traffic calming techniques
3. Traffic regulatory signage like stop, yield, side road etc.
4. Roadway design
5. Public awareness
6. Law enforcement

Reduced speed regulation specific zones

Along the project road, speed reduction zones have been identified and shall be regulated by fixing reduced speed signage for speed control. The reduced speed zones and normal speed zones are tabulated in **Table 9** below.

Table 9: Reduced Speed Locations

S. No.	Chainage (Km)	Restricted Speed Limit (Kmph)	Region
1	237+400 – 240+500	65	Kamala Bridge, Portaha, Godar
2	242+400 – 245+600	65	Birendra Bazar
3	247+000 – 249+300	80	Dharapani, Kanchhi Bazar
4	251+300 – 253+600	80	Puspalpur, Lalbhitti
5	256+400 – 258+400	40	Dhalkebar Flyover
6	259+400 – 260+400	80	Jamunibas
7	266+100 – 268+800	80	Bardibas
8	289+800 – 292+000	80	Raniganj, Saralahi
9	293+200 – 296+700	80	Lalgad, Sarlahi
10	298+500 – 301+400	65	Nawalpur
11	303+100 – 306+300	80	Narayanpur

S. No.	Chainage (Km)	Restricted Speed Limit (Kmph)	Region
12	312+000 – 316+200	80	Rautahat
13	325+600 – 328+300	80	Chapur
14	343+ 000 – 349+600	80	Lachaktol, Nihgadh Bazar
15	365+000 – end of Project	40	Pathlaiya

Traffic calming techniques

There are methods of alerting the drivers of probable hazard ahead. Some of them have been proposed along the project highway in order to control speeding in urban areas / settlement areas, narrow bridges, geometrically compromised locations etc. some of the methods are given below;

- Bar marking / Rumble strips
- Zig zag hazard marking
- Footpaths with steel railing
- RRPM across the roadway
- Yellow Box marking at At-Grade junctions
- Gateway effect

The schematic layout showing bar marking to be applied on the Road as per IRC 35 is presented vide **Figure 3** below.

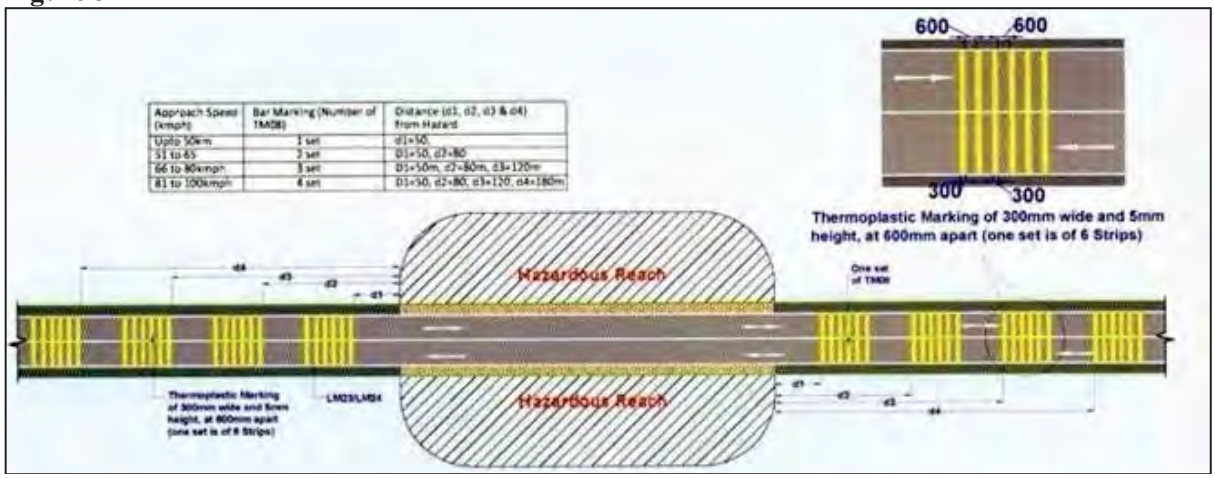


Figure 3: Bar Marking in Hazardous Locations (Source: IRC-35)

Thermoplastic Bar marking (as shown in figure 4) along with RRPM (Retro-reflectorized Raised Pavement Marker) at the end of last set (across the traffic movement) shall be provided both sides of hazardous reaches like Dhalkebar, Narrow bridges, Urban / Settlement zones, dangerous curves and other such locations.

The Zigzag hazard pavement marking is also proposed at Dhalkebar flyover section (as shown in figure 10.5). Such type of pavement marking gives an impression on driver of some hazard ahead and the driver gradually applies breaks and move cautiously, which serves the purpose of Speed restriction. Similarly, the bar marking alerts driver, as the vehicle moves over a set of bars. The Slight vibrations and sound will be felt by the driver when vehicle crosses over the bar markings. The presentation of Zigzag hazard marking to be provided in the congested urban sections is made vide **Figure 4** below.

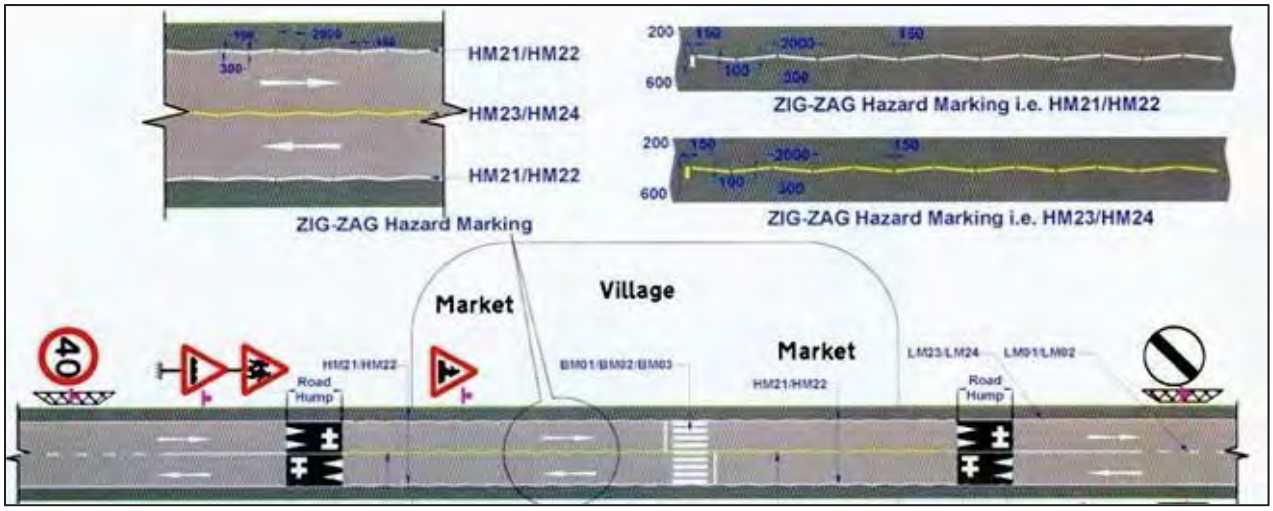


Figure 4: Zigzag Hazard Marking (Source: IRC-35)

Pedestrian footpath with or without railing in urban and habituated / settlement zones, also works as speed reduction treatment while providing safe refuge and mobility for the pedestrian and physically disadvantaged. The Footpaths along with steel railing and ramps (at major junctions only) has been proposed to be provided at selected locations which are listed vide **Table 10** below.

Table 10: Locations where Footpath is provided

Kamala Bridge, Portaha, Goddar
Birendra Bazar
Dharapani, Kanchhi Bazar
Puspalpur, Lalbhitti
Dhalkebar Flyover
Jamunibas
Bardibas
Raniganj, Saralahi
Laalbandi, Sarlahi
Nawalpur
Harion
Rautahat
Chapur
Lachaktol, Nijgadh Bazar
Pathlaiya

Retro-reflectorized raised pavement markers (RRPM) shall be provided on start of grade-separators, flyovers, bridges, taper sections at both end of narrow bridges, end of last set of bar markings – across the traffic movement (additional may also be provided for extra effect), junctions, both sides of zebra crossings and at curves. The RRPM Treatment proposed on curve locations is presented vide **Figure 5** below.

Figure 5: RRPM Treatment on Curves, Junctions and Hazard locations

Yellow box markings may also be provided at At-Grade junctions to convey message to drivers to slow down and no-stopping at the junction. It also serves the purpose to alert drivers of possible hazard location. Its prohibitory type marking. The typical layout showing Prohibitory yellow marking at junction locations is presented vide **Figure 6** below

Figure 6: Prohibitory Yellow Junction Markings

All the above treatments including others near hazard location works as Gateway treatment. Gateway treatment may include pavement markings, signage, landscaping, footpaths, steel railings etc. This treatment is generally implemented at the beginning of any hazard location or zones where non-motorized traffic and vulnerable road users (VRUs) volume is significant compared to through traffic volume. The typical Gateway Treatment to be provided at such hazardous locations is presented vide **Figure 7**below

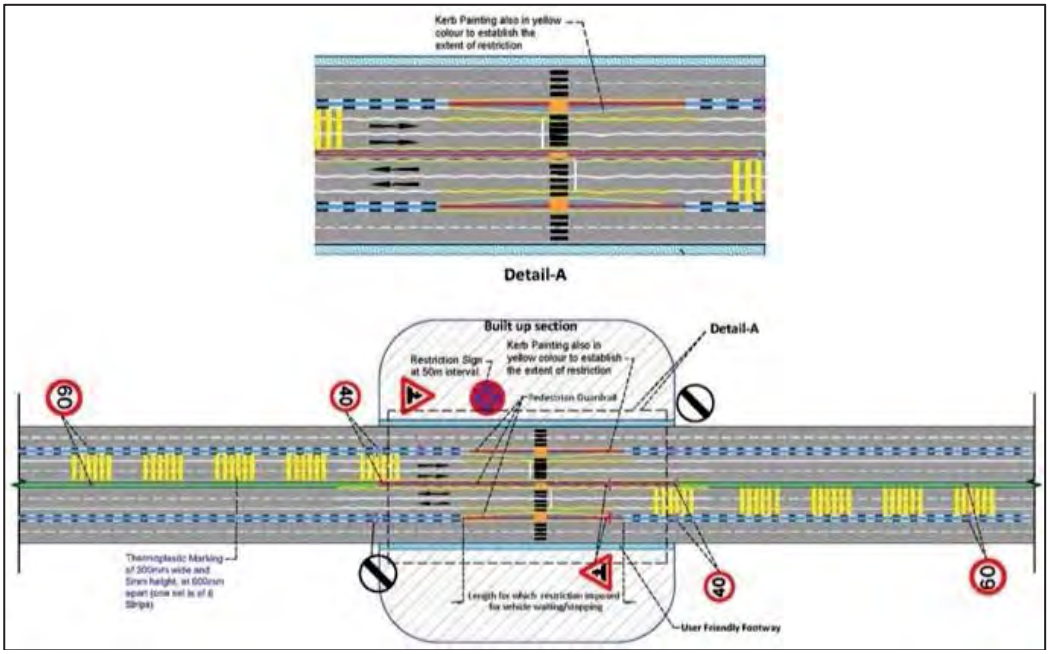


Figure 7: Gateway Treatment

Traffic Regulatory Signage

As evident from the name, traffic regulatory signage are used to reinforce, or designate traffic rules, regulations, requirements which either works all times or specific times. The disregard of these signage should be contemplated as traffic rule violation. Traffic regulatory signage like Yield, Stop, and Give Way signs, Speed limit and Vehicle control signs, Prohibitory signs, Compulsory direction signs, No Parking signs works as regulating the traffic and also tends to control speeding. These shall be provided along the highway as per specifications and requirement of site.

Access Realization and Control

Intersections

The project highway has been suitably designed to cater the need of user in the context of accessibility and mobility. While highway has been designed for faster mobility (designed for speed 100 kmph and posted speed maximum 80 kmph), accessibility to surrounding business areas, urban conglomerates, and

villages has been assured via designing service roads, slip roads, entry / exits, flyovers, vehicular underpass, pedestrian underpass, foot-over-bridges, zebra crossings and also design of major and minor junctions etc.

Intersection Design

Intersections on highways are points of accessibility / connectivity to adjoining community, villages, businesses, and contacts. Intersections are generally a major bottleneck to smooth flow of traffic and may become a major accident spot. They are the critical element of roadway design and their design depends on several factors. The Design factors considered for Intersection design are given in **Table 11** below.

Table 11: Intersection design factors

S. No.	Design Factors	Sub-Factors
1	Human factors	- Driving habits - Ability in taking decisions - Reaction time - Pedestrian use and habits
2	Traffic considerations	- Design and actual capacity - Design hour turning movement - Size and operating characteristics of vehicles - Types of movements - Vehicle speed - Public transit movement - Traffic mix
3	Road and environmental considerations	- Character and use of abutting property - Vertical and horizontal alignment at intersection - Sight distance - Angle of intersection - Conflict area - Geometric features - Traffic control devices - Lighting equipment - Safety features - Environmental conditions

Following points were kept in mind while designing the intersections;

- Uniformity and simplicity
- Minimise conflict points and potential severity of conflicts. General 4 arm junctions have 32 conflicts points. These may be reduced by introducing either 'space separation' or 'time separation' of traffic at the given intersection. The project highway shall not adopt time separation (signalized) because stopping the main carriageway traffic to complete halt may defeat the purpose of the improving level of service of the project road. Hence space separation (grade or at grade intersection design) method has been adopted.
- Cross road traffic shall be either 'STOP 'controlled or shall 'YEILD / GIVEWAY' to main project highway traffic depending on the availability of land for the provision of slip road / acceleration lane.
- Visibility funnel / clear intersection sight distances (IRC: 35) shall be ensured in case non-availability of land for dedicated deceleration / acceleration lanes.

Major Intersection – Layout and Details

Major intersections on the project highway have been identified based on the traffic survey and subsequent analysis. The traffic density of cross roads and that of main highway was the basis of selection of type of intersection. **Table 12** below shows the list of major junctions on the project highway including that of grade separated intersections.

Table 12: List of Major Intersections

Sr No	Name of Location	Chainage (km+m)	Intersection Type	Remarks
1	Goddar Bazar	239+740	Four Legged	

2	Bhiman Chowk	246+250	Four Legged	
3	Dharapani Chowk	247+650	Four Legged	
4	Kanxi Bazar	248+720	Four Legged	
5	Puspalpur Chowk	252+050	Four Legged	
6	Laalbhiti Chowk	254+000	Four Legged	Staggered
7	Shreepur Chowk	255+100	Four Legged	
8	Dhalkebar 400KV Substation Road	258+180	Four Legged	
9	Jamunibaas Bus Stop	259+800	Four Legged	
10	Bardibas-1	268+880	Three Legged	Right
11	Bardibas-2	270+350	Three Legged	Right
12	Bardibas-3	271+380	Four Legged	
13	Bardibas-4	281+500	Three Legged	Left
14	Ishworpur-1	283+180	Three Legged	Left
15	Ishworpur-2	289+230	Three Legged	Left
16	Ishworpur-3	290+000	Three Legged	Left
17	Ranigunj Chowk	291+300	Four Legged	Staggered
18	Lalbandi-1	294+900	Four Legged	Staggered
19	Lalbandi-2	295+700	Four Legged	
20	Lalbandi-3	300+760	Three Legged	Right
21	Hariwon-1	301+620	Four Legged	
22	Harion-2	303+000	Four Legged	
23	Bagmati-1	309+380	Three Legged	
24	Bagmati-2	309+850	Three Legged	
25	Bagmati-3	310+400	Four Legged	
26	Karmaiya Road Junction	311+900	Four Legged	
27	Bagmati River Bridge	313+400	Four Legged	
28	Chandrapur-1	314+720	Three Legged	Left
29	Chandrapur-2	317+400	Three Legged	Right
30	Chandrapur-3	324+540	Three Legged	
31	Nijgadh-1	339+100	Three Legged	Left
32	Nijgadh-2	342+120	Three Legged	Left
33	Nijgadh-3	343+180	Three Legged	Right
34	Nijgadh-4	346+000	Three Legged	Right
35	Nijgadh-5	346+720	Three Legged	Right
36	Nijgadh-6	347+600	Three Legged	Left
37	Nijgadh-7	350+950	Three Legged	
Sr No	**Name of Location**	**Chainage (km+m)**	**Intersection Type**	**Remarks**
38	Nijgadh-8	353+150	Three Legged	
39	Nijgadh-9	353+950	Three Legged	Left
40	Jitpur, Simara-1	355+900	Three Legged	Left
41	Jitpur, Simara-2	357+830	Three Legged	Left
42	Jitpur, Simara-3	362+080	Three Legged	Left

Total of forty-two (42) major junctions are identified on the Project Road as a at grade and ten (10) intersections are proposed as grade separated intersections. The list of intersections proposed with either Flyover or Vehicular Underpass with Pedestrian Underpasses is presented as **Table 13** below.

Table 13: List of Intersections proposed with Grade Separation

S.N.	Location	Chainage	Proposal for Grade Separation
1	Birendra Bazar-1	243+650	**VUP+2PUP**
2	Dhalkebar	257+250	**Flyover**
3	Bardibas	267+100 to 267+300	**Flyover**
4	Nawalpur Chowk	299+550	**VUP+2PUP**
5	Harion-1	304+200	**VUP+2PUP**
6	Naya Road	307+050	**VUP+2PUP**
7	Chapur	326+560	**Flyover**
8	Nijgadh-1	345+300	**VUP+2PUP**
9	Fast Track Junction	348+600	**Interchange**
10	Pathlaiya Junction	367+000	**Flyover**

Remaining seventeen major intersections have been designed at-grade junction with appropriate improvement proposal including waiting lane, island, improvement in angle for alignment of cross road, merging and diverging lane etc.

The Typical layouts adopted for improving at-grade major intersections have been shown in **Figure 8, Figure 9 and Figure 10** below.

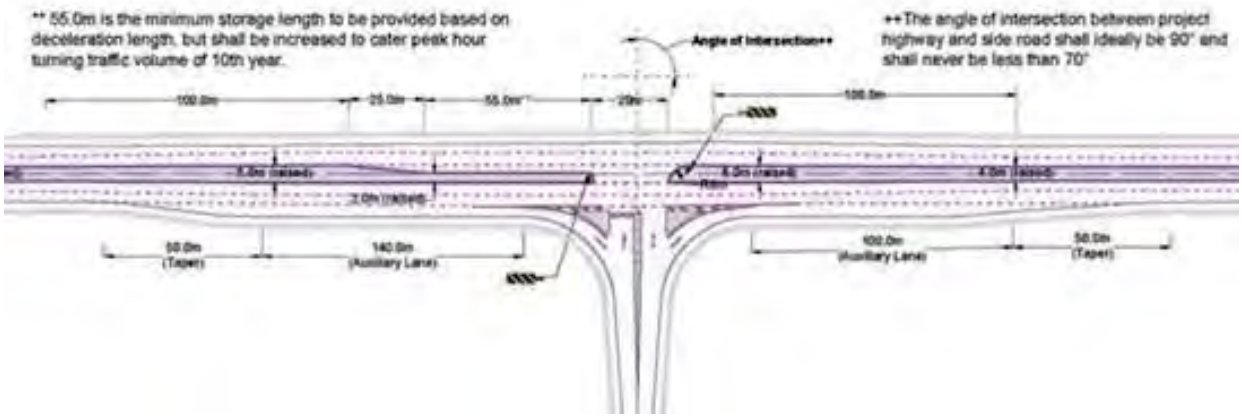


Figure 8: Typical T-Intersection

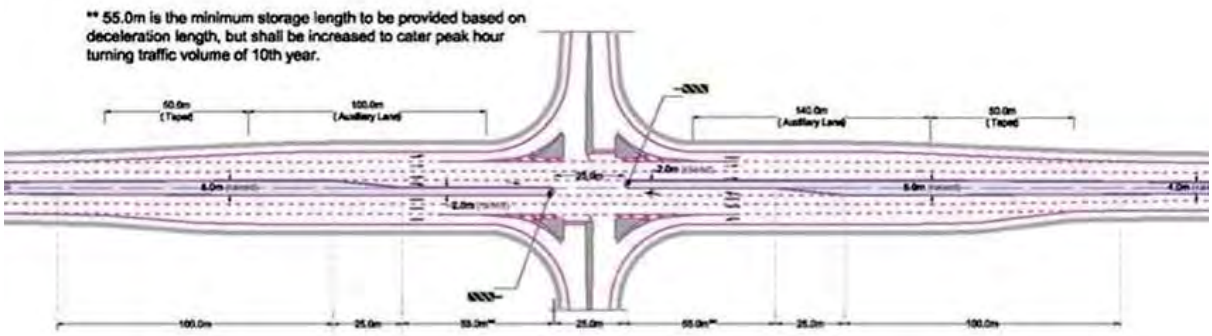


Figure 9: Typical Staggered 4-Legged Intersection

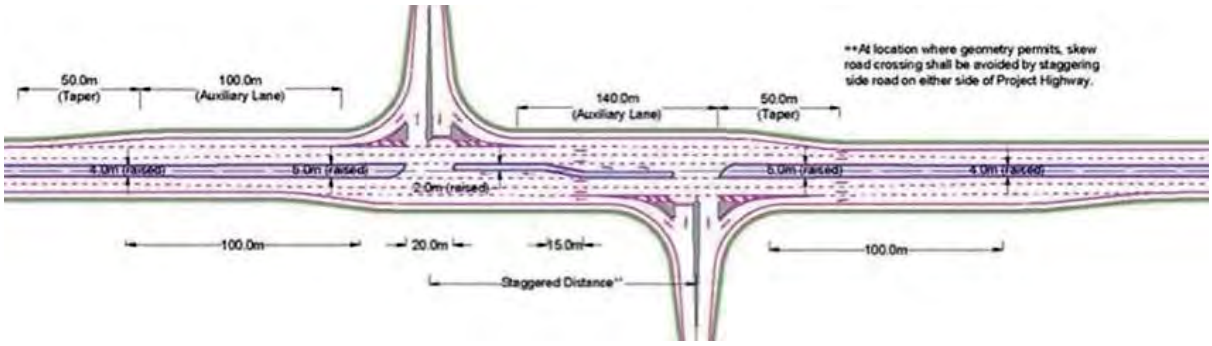


Figure 10: Typical 4-Legged Intersection

Service Road Plan and Operation

Location of service road both sides has been tabulated in **Table 14** below.

Table 14: Location of Service Roads

Kamala Bridge, Portaha, Godar
Birendra Bazar
Dharapani, Kanchhi Bazar
Puspalpur, Lalbhitti
Dhalkebar Flyover
Jamunibas
Bardibas
Raniganj, Saralahi
Lalbandi, Sarlahi
Nawalpur
Harion
Rautahat
Chapur
Lachaktol, Nihgadh Bazar
Pathlaiya

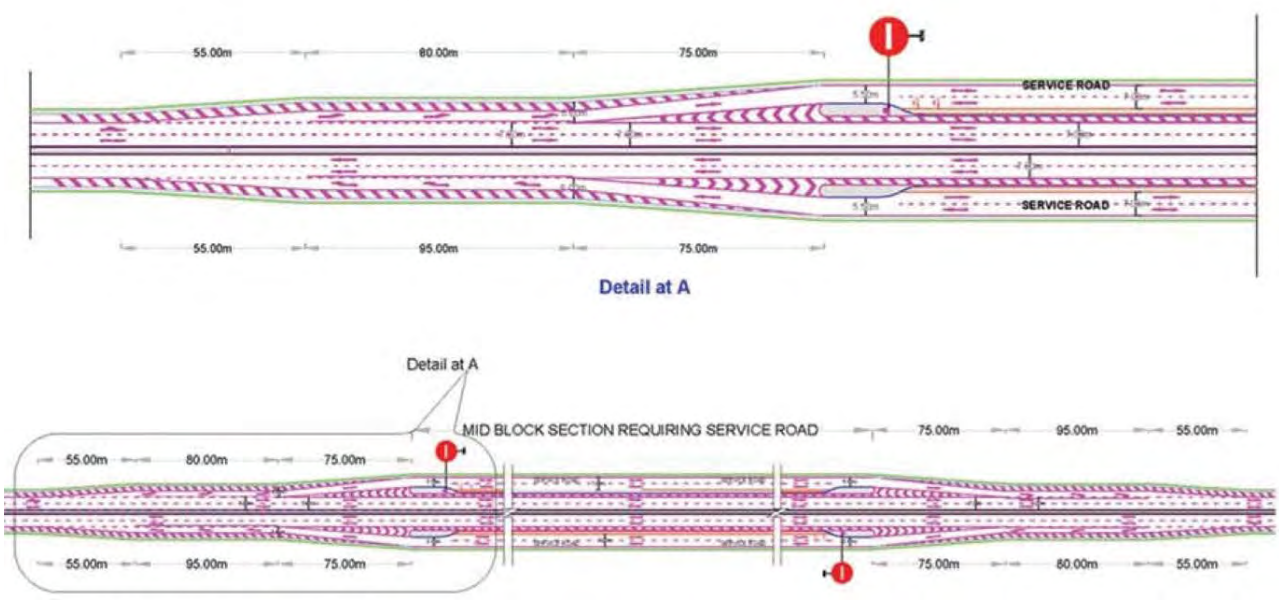


Figure 11: Typical Entry / Exit arrangement with Service Road

Suitable entry / exit points have been identified and designed based on guidelines in NRS 2070 and IRC: SP-84. Taper of minimum 1 in 15, deceleration lane at entry and acceleration lane and exit taper has been provided. For longer service road sections; intermittent entry / exit have been provided at minimum 500m intervals. Adequate traffic control devices and safety provisions have been ascertained while designing service road locations, entry / exit points and intermittent entry / exits. Type of cross-section (as mentioned in geometric design section) and the length of section of service roads have been detailed in the **Table 15** below.

Table 15: Service Road cross section type, location and length

S. No.	Location	Chainage	Type of Cross-Section	With or Without Footpath	Length (m)

S. No.	Location	Chainage	Type of Cross-Section	With or Without Footpath	Length (m)
1	Kamala Bridge	236+702 – 237+342	Type – 4	LHS SR with Footpath	640
2	Approach of Kamala Bridge (West Side)	237+500 – 237+970	Type – 4 and Transition	B/s SR with Footpath & Cycle Track	470
3	Portaha	237+970 – 238+400	Transition, Kamala Canal and Type – 5	B/s SR with Footpath & Cycle Track	430
4	Portaha, Goddar Semi-Urban	238+400 – 239+200	Transition and Type - 6	B/s SR without Footpath	800
5	Goddar Urban	239+200 – 240+200	Transition and Type - 5	B/s SR with Footpath & Cycle Track	1000
6	Birendra Bazar Urban	242+765 – 244+820	Type – 5, Transition, Type -8, 9, 8, 10, 8, 9, 8, Transition and Type – 5	B/s SR with Footpath & Cycle Track	2055
7	Bhiman Urban	246+000 – 247+750	Type – 5	B/s SR with Footpath & Cycle Track	1750
8	Bhiman Semi-Urban	247+750 – 249+075	Transition and Type – 6	B/s SR without Footpath	1325
9	Pushpalpur Urban	251+500 – 251+990	Type - 5	B/s SR with Footpath & Cycle Track	490
10	Laalbhiti, Shreepur, Bishrampur Semi-Urban	253+200 – 256+900	Type – 6, Transition, Aurahi Bridge, Transition, Type – 6	B/s SR without Footpath	3700
11	Dhalkebar Urban	255+950 – 257+960	Type – 5, Transition, Basai Bridge, Transition, Type – 5, Transition, Type – 11, 12, 11, Transition, Type - 5	B/s SR with Footpath & Cycle Track	2010
12	Dhalkebar, Jamunibas Semi-Urban	258+010 – 260+660	Type – 6, Transition, Sukhajor Bridge, Transition, Type – 6	B/s SR without Footpath	2650
13	Jamunibas Urban	260+710 – 261+260	Type – 5, Transition, Barahari Bridge, Transition, Type – 5	B/s SR with Footpath & Cycle Track	550
14	Lalgadh Semi - Urban	261+310 – 262+960	Type - 6	B/s SR without Footpath	350
15	Lalgadh, Bardibas Urban	263+010 – 268+117	Type – 5, Transition, Ratu Bridge, Transition, Type – 5, Transition, Type – 11, 12, 11, Transition, Type - 5	B/s SR with Footpath & Cycle Track	5107
16	Phulijor Bridge, Raniganj Urban	290+110 – 291+490	Phulijor Bridge, Transition, Type - 5	B/s SR with Footpath & Cycle Track	1380
17	Laalbandi Urban	293+520 – 296+320	Type – 5, Transition, Type – 8, 9, 8, 10, 8, 9, 8, Transition, Type – 5, Transition, Dumdume Bridge, Transition, Type - 5	B/s SR with Footpath & Cycle Track	2800

S. No.	Location	Chainage	Type of Cross-Section	With or Without Footpath	Length (m)
18	Nawalpur, Harion, Nayarod Urban	298+900 – 308+500	Type – 5, Transition, Type – 8, 9, 8, 10, 8, 9, 8, Transition, Type – 5, Lakhandei Bridge, Transition, Type – 5, Transition, Chapani Bridge, Transition, Type – 5, Transition, Type – 8, 9, 8, 10, 8, 9, 8, Transition, Type – 5, Transition, Type – 8, 9, 8, 10, 8, 9, 8, Transition, Rai Bridge, Transition, Type – 5	B/s SR with Footpath & Cycle Track	9600
19	Milanchowk Semi - Urban	308+550 – 309+500	Type - 6	B/s SR without Footpath	950
20	Karmaiya Urban	309+550 – 310+500	Type – 5, Transition, Dumajor Bridge, Transition, Type - 5	B/s SR with Footpath & Cycle Track	950
21	Bagmati Semi - Urban	310+550 – 311+950	Type – 6	B/s SR without Footpath	1400
22	Bagmati Urban	312+000 – 315+950	Type – 7, Transition, Bagmati East Bridge, Transition, Bagmati Bridge, Transition, Bagmati West Bridge, Transition, Gairi Bridge, Transition, Type - 5	B/s SR with Footpath & Cycle Track	3950
23	Chandranigahpur (Chapur) – Urban	324+400 – 327+630	Type – 5, Transition, Chandi Bridge, Transition, Type – 5, Transition, Type – 11, 12, 11, Transition, Type - 5	B/s SR with Footpath & Cycle Track	3230
24	Nijgarh Urban	344+380 – 347+850	Type – 5, Transition, Type – 8, 9, 8, 10, 8, 9, 8, Transition, Type – 7, Transition, Bakaiya Bridge, Transition, Type - 5	B/s SR with Footpath & Cycle Track	3470
25	Pathlaiya Urban	366+015 – 366+750	Type – 5, 7	B/s SR with Footpath & Cycle Track	735

Note: Length of Service roads on few bridges have not been completely included in above table.

Street Lighting

Street lighting is very much important in the night time to enhance visibility of the drivers and hence minimizing accidents and crashes specially in the settlements / urbanized areas where high volume of local traffic including pedestrians and VRUs1.

Street lighting has been proposed all around the settlements / urbanized locations, major / minor intersections, bridges, flyovers, VUPs / PUPs, Bus Shelter, and Truck Lay-byes etc. as per the respective codal provisions.

[1] *Vulnerable Road Users*

- Rural highways should be designed with an open cross section and horizontal and vertical alignment of a fairly high type. Accordingly, they offer an opportunity for near maximum use of vehicle headlights, resulting in reduced justification for fixed highway lighting.
- Provision of artificial lighting shall be made on all stretches near populated areas, on major bridges, bus shelters, roads and railroads intersections (up to a distance of 250m from the point of intersections), and toll plazas
- Light mounting poles shall be at least 9m high (but mounting heights of 10 to 15 m are usually preferable). They shall be located outside the edge of the roadway or on wide central medians.
- Level of illumination shall be 30 lux.
- The ratio of minimum to average illuminations shall be about 0.4.

Figure 12: Street Lighting

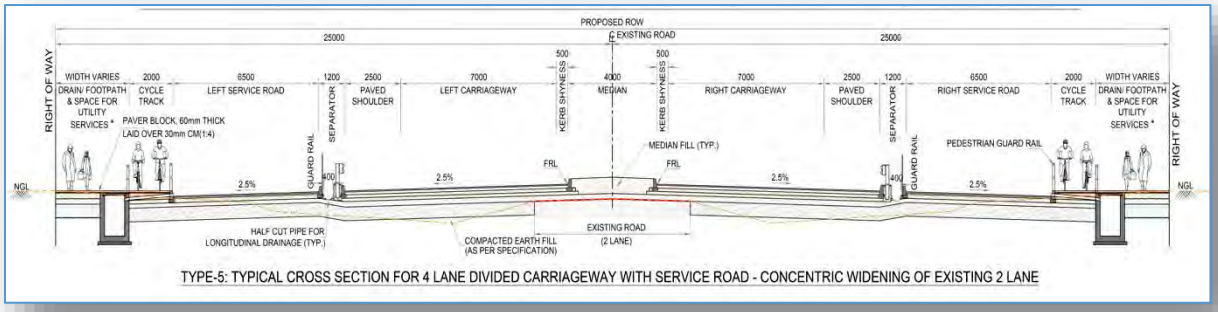
Safety of Vulnerable Users Groups and Pedestrian Crossings

Globally, pedestrians constitute 22% of all road traffic fatalities, and in some countries this proportion is as high as two thirds of all road traffic deaths. Millions of pedestrians are non-fatally injured – some of whom are left with permanent disabilities. These incidents cause much suffering and grief as well as economic hardship.

Road traffic-related injuries and fatalities can be reduced by bringing changes to the road environment, reducing speed and traffic volume, and separating motorised vehicles from pedestrians and non-motorised vehicles. However, Nepal's current efforts are inadequate to lower traffic-related fatalities or injuries in the foreseeable future.

Safety of pedestrians and other vulnerable road users like that of bikes, cycles users other village local traffic like cattle-driven vehicles etc. have been kept in mind while designing the project highway. NRS – 2070 including IRC manuals have been referred for safe design for vulnerable road users. Based on the output of safety audit on the project highway and subsequent surveys, pedestrian and VRU friendly safe facilities have been designed on the project highway. Provisions of facilities for safety of vulnerable road users (VRUs) on the project highway are given below:

- Service roads designed at lower speed of 50 kmph
- Pedestrian friendly footpath
- Cycle / bike tracks
- Pedestrian guardrails
- Pedestrian zebra crossings at designed at most probable crossing points
- Foot-over-bridges at high volume of ped-crossing points
- Pedestrian underpass
- Safety measures near school zones
- Traffic control devices



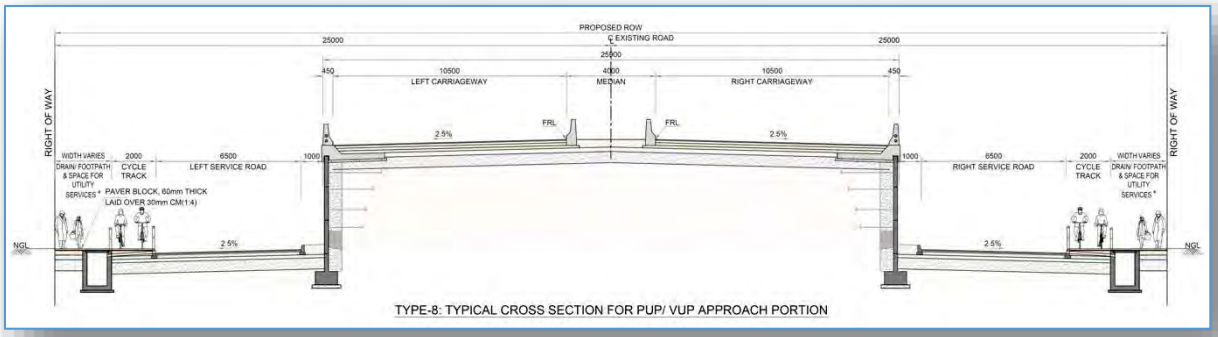


Figure 13: Proposed pedestrian and VRU friendly cross-sections

Pedestrian Guardrails, footpath, median railings

Pedestrian guardrails have also been proposed (min. 1.2m ht. from footpath level) along the footpath and cycle track to keep the pedestrians away from entering the carriageway as well as guiding and channelizing them to the safe crossing points (e.g. zebra crossings or VUP/PUP or foot-over-bridge). In the urban / built-up areas; steel railing of min. 1.5m height shall also be provided in median in order to discourage on-road crossing of pedestrians except from dedicated crossing locations.

Pedestrian Zebra crossings

Pedestrian zebra crossing as per the specifications and guidelines of NRS and Traffic Sign Manual have been proposed on all at-grade intersections (major and minor) as well as on median opening locations which are close to villages and urban / built-up sections. Crossing across the median shall be designed inside the median nose as shown in **Figure 10-26** below.

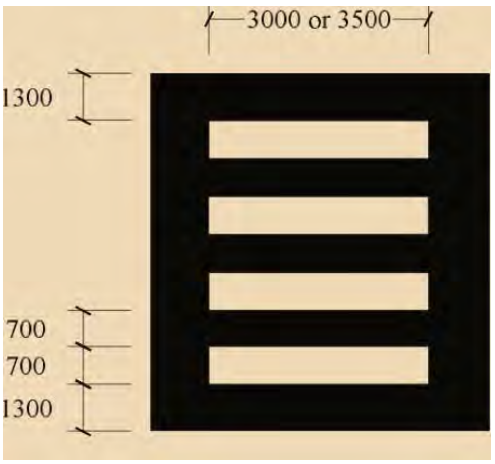


Figure 14: Pedestrian zebra crossing

Foot-over-bridge (FoB)

Foot-over-bridge have been provided following guidelines from NRS-2070. Based on pedestrian volume, traffic volume, safety audit and intersection capacity, locations of FoB have been decided. FoB shall be provided either with wheel-chair friendly ramps or lift facility to enable easy crossing for the physically disadvantaged. **Table 10.18** below shows the list of FoB selected.

Table 16: Acceleration, Deceleration and Taper Length (NRS - 2070)

S. No.	Chainage	Location of FoB
1	247+700	Dharapani Settlement
2	258+200	Dhalkebar 400kV substation
3	295+700	Laalbandi Chowk 2

Pedestrian underpass

Pedestrian underpasses have been provided for the safe crossing of pedestrians, 2-wheelers, and other VRUs. These are designed in VUPs both sides via service roads. Pedestrian zebra crossings and crossing access from footpaths, have been also provided at these locations. It shall considerably reduce any probability of future VRU accidents and thereby enhance safety at the same time won't disturb the free flow movement of through traffic.

Safety Measures near school zones

Special treatment for school zones have been provided in the design. It includes following;

- Traffic alert
- Traffic calming
- Traffic control devices

School signage including reduce speed limit signs shall be provided minimum 200m and near school along with traffic calming techniques like bar markings with studs at the end bar marking set.

Safety Measures: Road and Roadside

Adequate safety measures have been proposed along the project road and roadside as per the best practices and standards. NRS 2070, and Traffic Sign Manuals, DoR have been referred. Indian Road Congress specifications and International standards have also been used wherein local standards are silent or international standards results in higher safety provisions for the project highway.

The Plan of Intersection for Urban Sections

Intersections in urban locations are either converted into grade-separated (VUP / Flyover) depending upon the intersection traffic volume and local traffic density or are designed as at-grade intersections as described in chapter 10.6.1. Intersections have been planned keeping following factors in mind.

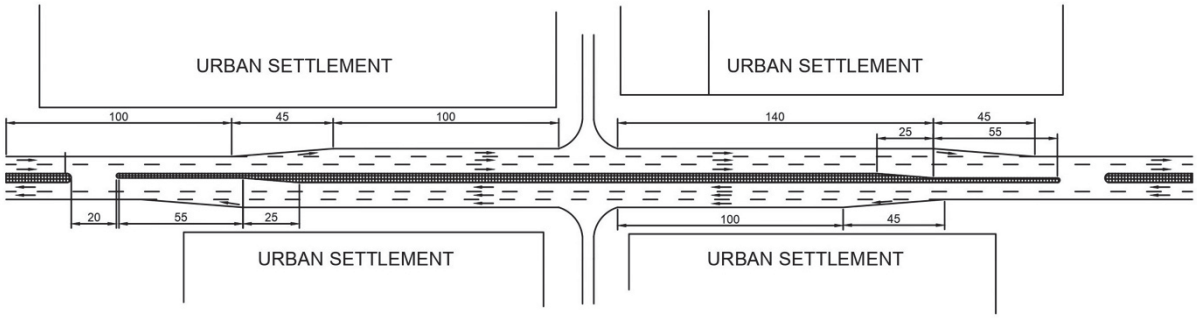


Figure 15: Plan of intersection in Urban Locations

1. Reducing conflicts
2. Minimize the severity of conflicts
3. Availability of adequate sight distance
4. Ease of access
5. Safety of pedestrian and VRUs

Please refer to chapter 10.6.1 for details.

Safety Treatments along Urban Sections

Urban locations along the project highway as identified during survey and safety audit, have been designed ensuring the safety of local traffic specially pedestrians, 2-wheelers, 3-wheelers, and physically disadvantaged persons. Urban locations have been listed in section above and other sections of this report.

Safety treatments specially been provided in urban sections have been given below;

1. Grade-separation (Flyover / VUP / PUP)
2. Reduced speed zone
3. Traffic calming techniques (Bar marking, Zig-zag markings etc.)
4. Service roads
5. Footpath
6. Cycle tracks
7. Pedestrian guard rails
8. Median railings
9. RCC Crash barriers on bridges / flyover / VUP / PUP
10. Street lighting
11. Pavement markings
12. Signage
13. Road edge delineation

Figure 16: Typical urban section of highway

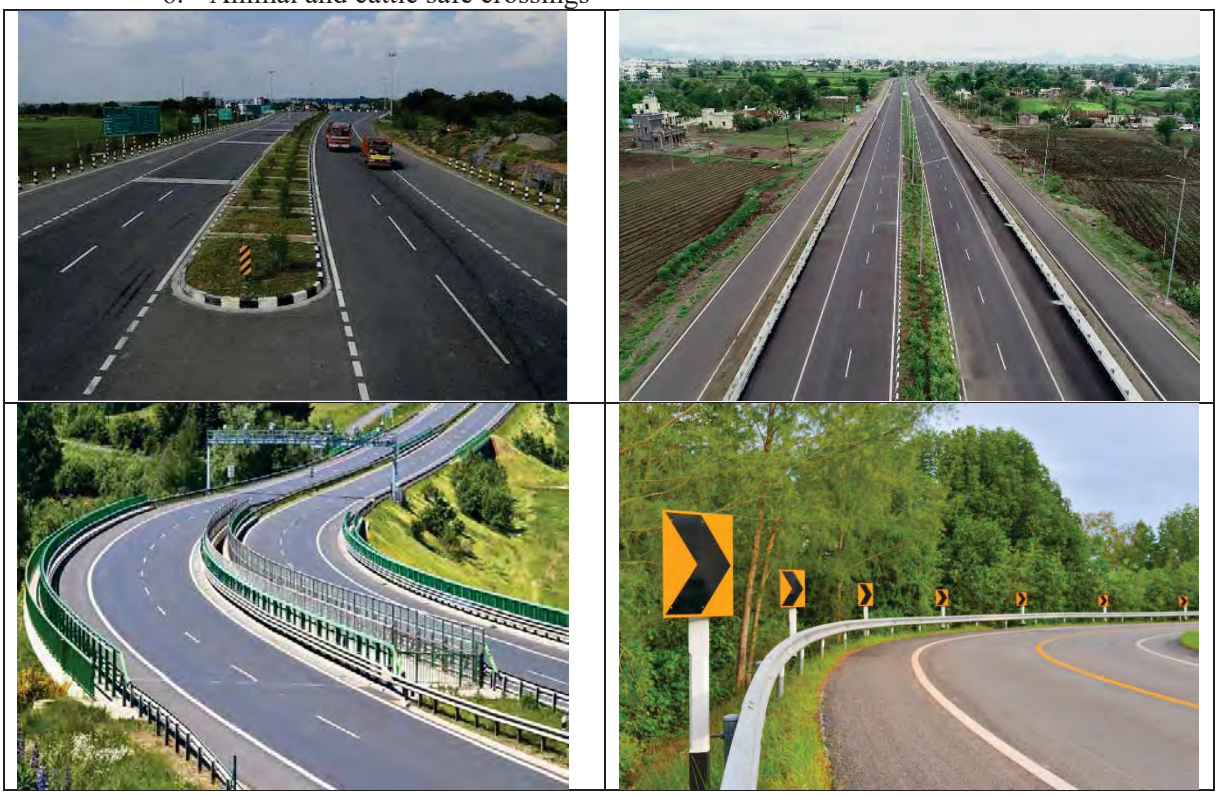
Figure 17: Typical section with footpath and cycle track without service road

Figure 18: Median Wired railing

Safety Treatments along Rural Sections

Rural sections of the project highway have been designed with following treatments for the safe movement of high speed traffic;

1. Crash Barriers (MBCB) on high embankments and curves with radius <=450m
2. Curve delineation and chevron signs
3. Object hazard marker signs and chevron markings ahead of fixed objects
4. Retro-reflectorized pavement markings as per specifications
5. Traffic signages
6. Animal and cattle safe crossings



Considerations in the Designing of Traffic Safety Facility

Traffic safety instruments or facilities should be designed and selected judiciously and carefully as they shall be on the roadway to keep the traffic and life safe along with help them stay alert and informed. Following parameters have been considered while designing traffic safety facilities for the project highway;

1. Traffic safety facilities shall have maximum clarity and visibility in conveying the message intended to the roadway users.
2. They shall have economic justification of installation and the same should have been validated.
3. Roadway safety facilities / instruments shall have the uniformity and consistency not only throughout the project highway but they shall be in conformity with safety facilities provided in the region and state of Nepal. This uniformity and consistency shall keep probability of mis-judgement among drivers / roadway users at-bay during the time of judgement / decision-making.
4. The safety facilities shall be conspicuous and easily discernible by the average roadway user and driver.
5. They should have high visibility and reflectivity during night time as well as during day-time.
6. They shall be installed on the project highway considering the roadway users' behaviour and characteristics.

Traffic Signs

Traffic signs are to be placed for keeping the traffic regulated, informed and maintaining smooth flow while ensuring the safety of users all the time. Roadway traffic signs shall always be kept un-obstructed and the unobstructed sight distance to view sign is called the clear visibility distance. Sight line of signs should be clear of any vegetation / tree / bushes and other object like other traffic safety devices or building, wall, etc. The roadway traffic signage are divided into following three categories;

1. Regulatory / Prohibitory signs
2. Warning / Cautionary signs
3. Information or Guidance signs

Regulatory / Prohibitory Signs

These signs are intended to regulate the law or prohibit the driver of certain condition. The regulatory / prohibitory / mandatory signs for example are STOP and GIVE Way signs, SPEED LIMIT or Vehicle Control signs, Compulsory direction signs, No Parking, No Stopping signs, Prohibitory signs etc.
Regulatory / prohibitory signs should be carefully placed for the location of restriction and also the begin and end of restriction and direction of restriction shall be clearly known before placement of signs. These signs are normally sited at or near the place where the instruction applies.

Warning / Cautionary Signs

These signs as clear from the name, warns or cautions the drivers of hazard ahead. The common examples of warning signs are Sharp Curve Ahead, Steep Gradient Ahead, Narrow Bridge Ahead, Side Road, Cross Road, Traffic Merge Ahead, Reduced Carriageway, Pedestrian Crossing, Gap in Median, Rumble strip, Speed breaker, Hazard marker, Chevron signs etc.

Information / Guidance Signs

These signs are intended to give information to the road user regarding their location or facilities available in the vicinity or about the destination. Major classification of information and guidance signs is, Direction and place identification signs, Facility information signs, Parking signs, other useful information signs, Flood gauge etc.

Pavement Marking

Pavement marking is the most important, simple to comprehend, clearly visible and a psychological obvious safety barrier guiding road users throughout the length of highway.

Visibility Enhancement Facility

Visibility enhancement facilities have been provided along the project highway for the safety of traffic not only during day-time but also during night time. These facilities are retro-reflective and alert and guide the drivers of the pavement edges, curve edges, high embankment, hazardous fixed object to keep away etc.

Delineators

These are structures to guide vehicles safely and smoothly by guiding road alignment or changing the geometric condition in front using reflecting objects in linear or circular road zone in day and at night. These structures therefore Inform drivers visually the road alignment in combination with road surface signs.

Chevron Signs

These signs notify drivers of the alignment and degree of curve of the road at sharp horizontal curve areas where vision is limited. These signs can provide more efficient vision guidance than vision guide signs depending on the road and topographic condition.

Raised Pavement Markers (Road Studs)

Raised pavement marker (Road Studs) have also been detailed in the section 10.5 (Speed Management and Control). These devices help to execute the function of road surface sign during night time or bad weather condition. These devices also warn erring drivers that veer too close to the road edge through audible noise when the vehicle tires come in contact with these devices.

Emergency Parking

These are areas for emergency shelter when a vehicle is out of order on a road with limited shoulder. These prevent traffic volume decrease by removing defected vehicle from the main lane and hence prevent crashes.

Bus Shelters in the Service Road

The list of bus shelter and bus bay with bus shelter have been listed in the **Table 10.19** below

Table 17: List of Bus shelter and Bus Bay

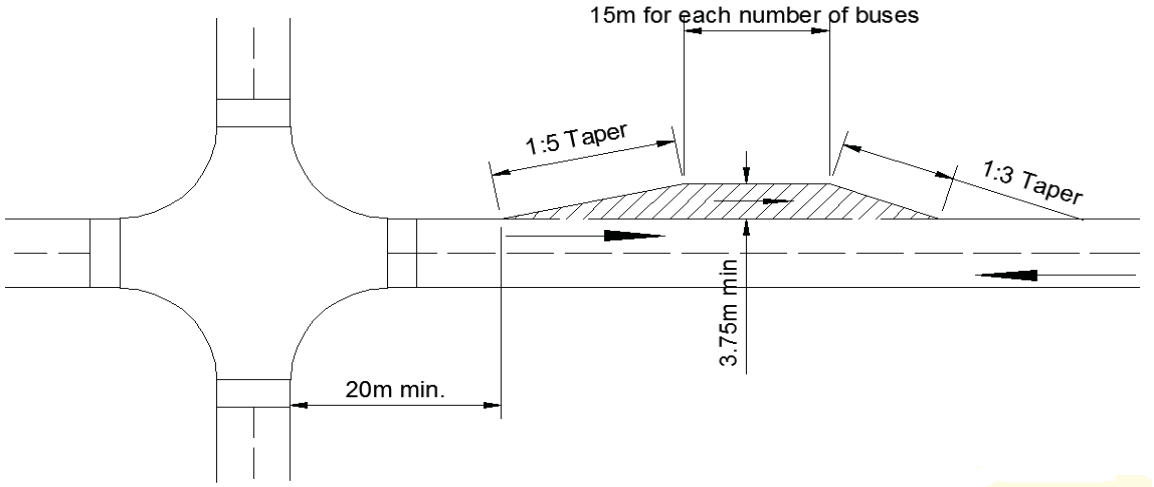
SN	Chainage (m)	Description	Side of Road
1	238+200	Bus Shelter	Left
2	239+600	Bus Shelter	Left
SN	**Chainage (m)**	**Description**	**Side of Road**
3	239+800	Bus Shelter	Right
4	243+300	Bus Shelter	Left
5	243+350	Bus Shelter	Right
6	246+200	Bus Shelter	Left
7	246+350	Bus Shelter	Right
8	247+550	Bus Shelter	Right
9	247+750	Bus Shelter	Left
10	248+650	Bus Shelter	Right
11	248+800	Bus Shelter	Left
12	251+800	Bus Shelter	Left
13	251+950	Bus Shelter	Right
14	253+900	Bus Shelter	Right
15	254+100	Bus Shelter	Left
16	255+200	Bus Shelter	Left
17	256+950	Bus Shelter	Left
18	257+400	Bus Shelter	Right
19	258+250	Bus Shelter	Left
20	258+300	Bus Shelter	Right
21	259+700	Bus Shelter	Right
22	259+900	Bus Shelter	Left
23	261+100	Bus Shelter	Left
24	263+900	Bus Shelter	Right
25	264+850	Bus Shelter	Left
26	265+100	Bus Shelter	Right
27	266+250	Bus Shelter	Left
28	267+400	Bus Shelter	Left
29	267+400	Bus Shelter	Right
30	268+150	Bus Shelter	Right
31	268+750	Bus Shelter with Bay	Right
32	270+200	Bus Shelter with Bay	Left
33	270+500	Bus Shelter with Bay	Right
34	271+250	Bus Shelter with Bay	Left
35	271+250	Bus Shelter with Bay	Right
36	272+300	Bus Shelter with Bay	Right
37	275+100	Bus Shelter with Bay	Left
SN	**Chainage (m)**	**Description**	**Side of Road**
38	275+500	Bus Shelter with Bay	Right
39	279+200	Bus Shelter with Bay	Right
40	279+850	Bus Shelter with Bay	Left

41	281+600	Bus Shelter with Bay	Left
42	281+600	Bus Shelter with Bay	Right
43	283+300	Bus Shelter with Bay	Left
44	283+300	Bus Shelter with Bay	Right
45	289+100	Bus Shelter with Bay	Left
46	289+500	Bus Shelter with Bay	Right
47	289+920	Bus Shelter with Bay	Left
48	289+920	Bus Shelter with Bay	Right
49	290+630	Bus Shelter with Bay	Left
50	290+730	Bus Shelter	Right
51	291+200	Bus Shelter	Right
52	291+450	Bus Shelter	Left
53	293+650	Bus Shelter	Left
54	293+650	Bus Shelter	Right
55	294+800	Bus Shelter	Left
56	294+950	Bus Shelter	Right
57	295+620	Bus Shelter	Right
58	295+800	Bus Shelter	Left
59	299+450	Bus Shelter	Left
60	299+700	Bus Shelter	Right
61	300+730	Bus Shelter	Right
62	300+810	Bus Shelter	Left
63	301+580	Bus Shelter	Right
64	301+690	Bus Shelter	Left
65	302+950	Bus Shelter	Right
66	303+050	Bus Shelter	Left
67	304+150	Bus Shelter	Right
68	304+250	Bus Shelter	Left
69	307+000	Bus Shelter	Right
70	307+090	Bus Shelter	Left
71	309+500	Bus Shelter	Right
72	309+600	Bus Shelter	Left
SN	**Chainage (m)**	**Description**	**Side of Road**
73	311+800	Bus Shelter	Right
74	311+950	Bus Shelter	Left
75	313+350	Bus Shelter	Right
76	313+500	Bus Shelter	Left
77	314+800	Bus Shelter	Left
78	317+220	Bus Shelter with Bay	Right
79	324+430	Bus Shelter	Right
80	326+510	Bus Shelter	Right
81	326+620	Bus Shelter	Left
82	339+000	Bus Shelter with Bay	Left
83	342+000	Bus Shelter with Bay	Left
84	345+220	Bus Shelter	Right
85	345+350	Bus Shelter	Left
86	346+800	Bus Shelter	Right
87	347+700	Bus Shelter	Left
88	353+000	Bus Shelter with Bay	Left
89	356+100	Bus Shelter with Bay	Left

90	357+950	Bus Shelter with Bay	Left
91	361+950	Bus Shelter with Bay	Left
92	366+400	Bus Shelter	Left
93	366+600	Bus Shelter	Right

Bus Bay in the Main Carriageway

Typical bus shelter with lay bye has been shown in figure below:



Truck Lay-Bye

Truck lay-byes have been proposed in the following locations which are shown in **Table 10.20** below as rest areas for the commercial (truck) traffic. The typical layout, design and other details shall be provided in the separate drawings. Pavement markings, signages etc. shall be as per the standard and specifications.

Table 18: Locations of Proposed Truck Lay-Byes

Sr No	Chainage (km+m)	Side of Road
1	269+000	Left
2	323+000	Right
3	329+300	Left
4	350+800	Left
5	365+170	Right

Star Rating for the Proposed Design Highway

Star rating as identified by the iRAP star rating has been revisited again after the proposed design of the Kamal-Dhalkebar-Pathlaiya to four-lane standard as detailed in this report. This design shall improve the rating of the proposed highway as obvious but there are still few sections to be immediately addressed to improve star rating further. Star rating of the proposed design KDP highway has been detailed in the **Table 19** below.

Table 19: Star Rating of Proposed Design Highway

S. No.	Parameters Revisited	2Before Improvement[1]		After Improvement (Design Highway)	
		Highway Characteristics	Star Rating	Highway Characteristics	Star Rating
1	Operational speed	Average 50 kmph	3 Star (80% Length)	Average 75 kmph	4 Star (85% Length)
2	Road section geometry	60% - 70% Straight	5 Star (65% Length)	Almost 80% straight or close to straight without superelevation	4 Star (85% Length)

[2] *From iRAP Study of Strategic Roads in Nepal, May 2022*

S. No.	Parameters Revisited	2Before Improvement[1]		After Improvement (Design Highway)	
		Highway Characteristics	Star Rating	Highway Characteristics	Star Rating
3	Intersection density	Almost all are directly in access of main traffic	2 Star (50% length)	Almost all are now being designed as indirect access via SR – Best Safety	4 Star (50% Length)
4	Narrow Bridges	Narrow	2 Star (50% length)	They shall have now one-way traffic but shall pose threat of accident because of sudden merge for at least 23 bridges at higher speed.	2 Star (50% Length)
5	Centre line median	99% – Nil	2 Star (99% Length)	Throughout the Stretch	5 Star (99% Length)
6	Road delineation	Pathetic	2 Star (99% Length)	Throughout the Stretch	4 Star (99% Length)
7	Road side Hazards	Considerable	3 Star (50% Length)	Almost nil or with adequate safety measure	4 Star (90% Length)
8	Dhalkebar Junction	Busy and unsafe	2 Star (Junction)	Hazardous location – compromised horizontal and vertical curve	2 Star (Junction)
9	Road condition	Pathetic	2 Star (90% Length)	Smooth and better riding quality	5 Star (99% Length)
10	Roadside encroachments	Considerable	2 Star (10% Length)	Removal of encroachments	4 Star (99% Length)
11	Pedestrian facilities etc	Nil	2 Star (99% Length)	FoB, PUP, Zebra crossings, footpaths, bycle track etc.	4 Star (90% Length)

The table above shows that post improvement of the project highway, the project highway shall have high level of service (LoS) for the traffic that shall ply on the highway and also these improvements shall reflect in the reduction of accident probability on the highway. Following points have been concluded from the analysis and table above;

1. Post improvement Dhalkebar junction and narrow bridges may be hazardous locations for the project highway.
2. Post improvement, almost 90% project length shall have 4 star ratings in terms of operational speed, road geometry, intersection density, road delineations, roadside hazard, pedestrian and VRUs facilities etc.
3. These measures shall reduce accidents statistics to almost by 50% specially for pedestrians and VRUs. These statistics may be justified based on data analysis but the accident data was not available for highway stretch wise.
4. Only Dhalkebar junction, narrow bridges and higher speed may be a threat to accidents in these regions.

Annexure 7.2: Occupational Health and Safety Plan

Occupational Health and Safety Management Plan

The purpose of the Health and Safety Management Plan is to foster a responsible attitude towards occupational health and safety and to comply with the provisions of the Law of Nepal. For proper execution of health and safety following measures will be adopted

i. Ensure the systematic identification of existing and new hazards on work site(s) and at depots, storage facilities, in offices or wherever activities are undertaken;
ii. Ensure the mitigation of significant hazards, where elimination and isolation are impractical;
iii. Ensure the provision and use of appropriate protective measures;
iv. Include emergency procedures for dealing with accidental spillage, pollution or imminent danger;
v. Ensure regular review and assessment of each hazard identified and monitor own staff and subcontractor's exposure to these hazards;
vi. Ensure reporting and recording of work site safety incidents so health and safety problems can be addressed quickly and regularly. It is a requirement of this Contract that any such incident be advised promptly to the Engineer;
vii. Comply with all other health and safety aspects requirements of Nepalese law and regulations.

Following measures will be adopted for addressing sound occupational health and safety environment.

Emergency Response Plan: An emergency response plan will be prepared including temporary evacuations to deal with accidents and emergencies, including environmental/public health emergencies associated with hazardous material spills and similar events. Availability of firefighting, ambulance, medical and rescue facilities at the site will be part of emergency response plan. This plan needs to be approved from the Engineer.

Job Hazard Analysis: A job hazard analysis will be conducted at the new construction site to identify potential hazards that may arise from the proposed works or working conditions to the project workers and implement necessary control measures. The job hazard analysis will be part of the method statements, which will be reviewed and approved by the supervision consultants.

First Aid Base: Fully equipped first aid box and arrangements for emergency medical services will be made as per the satisfaction of the Engineer.

On-Site Safety Publicity: Adequate posters and charts in Nepali and English including health and safety information will be prepared and installed in different locations as per Engineer's advice for making workers and public aware on health and safety issues.

Safety Equipment and Clothing: Safety equipment, materials and protective clothing are required to be available on the site at all times and measures for the effective enforcement of proper utilization and necessary replacement of such equipment and clothing, and all construction plant and equipment used on or around the site shall be fitted with appropriate safety devices. These shall include but not be limited to:

- Effective safety catches for crane hooks and other lifting devices;
- Functioning automatic warning devices and, where applicable, an up-to-date test certificate, for cranes and hoists;

Functioning beeping devices in all trucks and other equipment while reversing as well as operating flashing lights attached to all equipment while in motion.

Annexure 7.3: Labour Camp Management Plan

Labour Camp Management Plan

Agricultural lands near the construction sites will be rented for contractor's camp and labour camps.

Following measures will be adopted for proper camp management:

Setting up of Camps

i. All camps will be of temporary structures.
ii. Work and labour camps will have basic requirements for workers and labors, adequate bed, spacing, ventilation, canteen, laundry etc.

Sanitation and Hygiene

i. Adequate number of toilet and bathroom facilities will be provided in the camps.
ii. Camps will be kept clean, hygienically and measures are taken to prevent breeding of vectors.
iii. Staff will be designated for proper housekeeping and maintenance and cleaning the camps and toilets daily.

Water Supply

i. For domestic water supply, ground water with treatment facilities will be used.
ii. Regular monitoring of the water quality will be done to ensure supply of potable water. National Drinking Water Quality Standard to be followed.

Storm water and Waste-Water Management

i. Proper drainage system will be developed for managing storm water so that there will be no water logging issues.
ii. For waste-water management, proper septic tanks with soak pits will be constructed.

Water supply, waste water and sewage treatment

Un-contaminated water for drinking, cooking and washing, health care, latrines and urinals, system for conveyance, treatment and disposal of sewage and solid waste; adequate and clean washing and bathing places shall be provided. Wastewater shall be discharged to the existing sewage network or soak pits, which should be at least 500 m away from any water body.

Solid Waste Management

Solid waste generated will be collected and transported to local municipal bins for onward disposal to disposal site by municipality. Solid waste management facilities will be arranged by the construction contractors.

Health care awareness and clinics

Construction workers are more prone to Infectious diseases such as Covid, Flu, HIV/AIDS etc. It should be prevented by following actions: Counselling, community events, clinic, and co-ordination with local health authorities.

Welfare of Labour on construction site

Shelter: At every workplace, shelter shall be provided free of cost, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5 m2 per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The contractor shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

First aid facilities: At every camp, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances will be provided. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital.

Day Crèche Facilities: At every construction site, provision of a day crèche shall be made so as to enable women workers to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least one temporary structure with sufficient openings for light and ventilation for use of children under the age of 6 years belonging to such women. There shall be adequate provision of sweepers and maid servants to keep the places clean.

Safety of Labour

Construction works shall be executed as laid down in the Safety Health and Environment (SHE) manual prepared by the Contractor and approved by Project Authority.

The SHE manual:

i. Describes the SHE interfaces between Employer and the Contractor
ii. Details the processes by which the contractor shall manage SHE issues while carrying out the work under the contract.
iii. Describes by reference, the practices and procedures

Annexure 7.4: Standard Operating Procedures for Pollution Spills and Management of Fuels and Hazardous Substances

Standard Operating Procedures for Pollution Spills and Management of Fuels and Hazardous Substances

Hazardous materials comprise such material as cement, lime, bitumen and emulsion, paint, fuels, oils, battery acids, pesticides and herbicides, and any type of toxic material. The Environment Specialist will exercise control over the storage, use and disposal of substances hazardous to health and to the environment including solvents, petroleum products and toxic chemicals or solutions. Hazardous materials if any to be used will be prior identified and list will be prepared. Only required amount of hazardous materials will be ordered so as to minimize the wastes to be produced.

All personnel handling with hazardous materials will be provided with adequate PPEs. List of hazardous substances response kit will be kept in place. If any waste of such materials produced will be stored in safe place in puncture proof containers and disposed of in accordance with Engineer's instructions. Where possible chemicals will be purchased under a buy-back policy from the suppliers to avoid the storage and handling of waste chemicals.

Following steps will be adopted for controlling pollution spills and management of fuels and hazardous substances:

Chemicals handling planning

i. The person planning the transfer of chemicals will be informed of quantities to be transferred, the type of packaging and the scheduled locations when assessing the methods and means necessary for the handling.
ii. The person in charge of the transfer and/or handling of chemicals will clearly identify the chemical and be aware of the hazards involved, consult Safety Data Sheet or seek expert advice when in doubt, ensure that the chemicals being sanctioned for transfer are stored and stacked in a correct and safe manner as detailed in the subsequent clauses of this Standard Operating Procedure (SOP) to avoid accidental spills and possible injuries.
iii. The personnel handling hazardous chemicals will be provided with Personal Protective Equipment (PPE), adequate means of transportation and spill control materials.

General Safety Requirements

i. Where necessary, the contractor will supply with risk assessment and a safe work method statement for all tasks / works prior commencement of works.
ii. Contractor to ensure that personnel are trained in chemical handling and spill management.
iii. Contractor to ensure that adequate manpower is assigned to the task in order to carry out the job safely.
iv. Contractor to ensure that the competent personnel are provided with the appropriate PPE.
v. Adequate materials will be readily available for spill management and the action to be taken in case of Oil and/or Chemical Spills will include:
    - Use of appropriate PPE
    - Ensure that the necessary spill kit material is handy and used

- Isolate source
- Inform responsible person so he can inform the required personnel so that the spill can be contained with minor consequences.
- Contain spill as far as possible, especially if it can go into the road or drains
- Recover spill using suitable means: (i) Bucket & shovel / dustpan work well on smooth floors, (ii) Absorbent pads which can each absorb (approx..) 1 liter (iii) Sand or other oil absorbing particulates
- Recovered chemical and absorbent material is to be dealt as "hazardous waste".

Chemicals Usage

i. Wherever possible, chemicals and their compounds used shall be free from Mercury, Chromium and Zinc
ii. Use CFC and HCFC-free sprays and products.
iii. All chemicals used will be accompanied by the "Material Safety Data Sheet (MSDS)".
iv. Wherever possible, the use of toxic and very toxic substances as well as carcinogenic substances shall be avoided.
v. Preference will be given to products with less dangerous characteristics: for example, water-based paints instead of solvent-based paints, paints without "heavy metals" (such as lead or chromium), cleaning products with a low chlorine content.
vi. Contractor to ensure that any chemicals used within project premises are not stored in a damaged container/drum and that they are labelled properly.

Handling Chemicals

i. Handler/end user will be trained in chemical handling prior any handling
ii. Use of PPE will be mandatory
iii. The specific Material Safety Data Sheets (MSDS) of the chemicals will always be consulted prior to the handling of a chemical.
iv. Mixing or pouring of chemicals will be performed on waterproof surfaces to prevent soil contamination
v. Handling of hazardous chemicals (transportation, change of containers, etc.) will always be kept to a minimum
vi. Chemical containers will not to be left open and will always to be kept closed when not in use
vii. Mixing of hazardous chemicals will be avoided since mixing of incompatible chemicals can induce emissions of toxic gases and other dangerous reactions
viii. The right amount of product will be used (check product instructions to dilute chemicals)
ix. Hazardous chemicals will never to be left unattended

Storage of Chemicals

i. All dangerous chemicals will be located in the appropriate storage area unless currently in use.
ii. Storage areas will always be bunded and covered to avoid leaching of pollutants through rainwater.
iii. Any spill occurring within the bunded storage area will be isolated from the drainage and sewage systems.
iv. The capacity and characteristics of storage areas, shelves and any other device used to store chemicals will be ensured that they are adequate for the specific operation.
v. Good housekeeping will be ensured in storage areas
vi. Chemicals will not be stored and/or located in areas such as passageways, vehicles, and so on.
vii. It will be ensured that incompatible chemicals are segregated within the storage areas. Chemical products will be stored according to their compatibility. Acids will be stored away from bases (such as Alkalis). Flammable products will be stored away from all other products and especially away from potential fire hazards.
viii. Storage areas for explosives will be designed in such a way as to prevent hits, falls or any other potential cause of explosion and to protect the surroundings against explosions.
ix. Chemicals will ideally not be stored under direct sunlight, in warm areas or near heat sources.
x. When storing chemicals, the label and MSDS will be consulted for correct storage of each substance.
xi. Certain chemicals or substances will be stored in well ventilated areas or at a specific humidity and temperature as per requirement.
xii. It will be ensured that all containers such as drums and their lids are in good condition, are safe to use and there is no possibility for spills or leakages.

Control and Monitoring Activities

i. Check periodically for correct identification, handling, use and storage of process chemicals at point-of-use;
ii. Check periodically that all waterproof areas where chemicals are located are in good condition and that there are no surface irregularities or cracks. This is especially important for storage of large containers;
iii. Check periodically for spills and leaks;
iv. Check periodically on the correct use of products and give adequate training to personnel if deemed necessary.

Abnormal Conditions and Emergency Situations

In case of an accident or emergency such as spills, dangerous chemical reactions, etc., Contractor to ensure that the following recommendations are followed:

i. Necessary safety protection devices (gloves, glasses, etc.) will be worn
ii. The hazardous chemical causing the problem will be identified

iii. All valves will be isolated and taps turned off in order to stop the spill from spreading further out in the accident area as well as to contain the spill as much as possible and stop it from reaching unprotected areas, such as areas which are not waterproof, sewage discharges, etc.

iv. The Engineer/Client responsible person will be informed so as to intervene;

v. The accident area will be cordoned off;

vi. Given that the danger level is acceptable, appropriate materials will be used to clean up the spill. Rags, sawdust or other combustible materials will not to be used to collect combustible agents or flammable chemicals.

vii. Access to the area will only be allowed when the spill has been contained, cleaned and the area is risk free.

viii. In case the risk level is unacceptable the work will be halted until the risk level comes within acceptable range. The risk can be reduced through dilution, chemical treatment, absorption, etc.

ix. In case of damage to a container, this is to be replaced and it must be ensured that the damaged container is clearly and correctly identifiable and disposed of in the appropriate manner.

x. Proper absorbent materials will be readily available for use close to all chemical storage and handling areas.

Annexure 7.5: Solid Waste Management Plan

Solid Waste Management Plan

Human as well as construction activities generate wastes. For proper waste management, The Contractor will adopt following steps:

Identification and Segregation of Wastes: Different categories of wastes during different phases of and activities of construction will be identified. The Contractor will provide necessary color-coded containers required for temporary storage of segregated wastes as per identified categories.

Segregation of all waste streams by type or category will avoid potentially undesirable combined effects and will facilitate the reuse, recycling, recovery and/or disposal of the various wastes. All waste categories will be evaluated and the principle of the following 3R's applied:

Reduction Initiatives: Reducing the raw material consumption is the first step to reduce waste generation. To practice this principle all processes and material used will be evaluated on the basis of possible reduction in raw material usage;

Reuse Initiatives: Reuse of the material in other applications and /or by other parties is routinely examined by using the waste materials exchange;

Recycling Initiatives: Recycling is the next option considered for the successful management of the waste streams. Recyclable waste can be sold to scavengers too. Recyclable waste consists mostly of metal containers, glass products, scrap metal, used equipment and machinery. Quantities of these materials shipped off site for recycling will be recorded. Handling of recycled waste will include:

- **i.** Used Equipment – will be returned to vendor or given to a salvage contractor;
- **ii.** Scrap Metal Recycling – will be stockpiled at the waste transit station until a sufficient quantity is available for a scrap metal recycling contractor to pick up;
- **iii.** Metal and plastic containers (bind and drums) will be cleaned and reused for storage of waste chemical products, lubricants or oils.; and

Disposal: Disposal is the final option when the 3R's are no longer applicable or practical. To the extent practicable, sorting will take place at the source and the sorted waste will be stored at the site's waste transit station. Such waste will be sent to municipal disposal system with coordination with municipality. For organic wastes, onsite bin composting or burying in pit or feeding to livestock will be done.

Annexure 7.6: Traffic Management Plan

Traffic Management Plan

For efficient traffic management, construction zones will be divided into different components like: Traffic Control Zone, Transition Zone, Working Zone, Terminal Transition Zone etc. The guiding principles for safety in road construction zones are to:

1. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.
2. Warn the road user clearly and sufficiently in advance;
3. Provide safe and clearly marked lanes for guiding the road users;
4. Provide safe and clearly marked buffer and work zones; and
5. Provide adequate measures that control driver behaviour through construction zones.

Traffic Control Zone: It includes all those areas of carriageway in advance of the actual work site which are required for advanced warning of the hazard as well as safety zones, the transition zones and the working zone itself.

The Traffic Control Zone can be further divided into three components, which are the Advance Warning Zone, the Transition Zone, and Working Zone. All construction zones will have a working zone, which is flanked by a Transition Zone for each direction of approaching traffic, and an advance warning zone will precede these in turn Advance Warning Zone.

The "advance warning zone", is the area to warn the road user of the approaching hazard and to prepare them for the change in driving conditions. It is essential for traffic control in the construction zone. It will provide information on:

1. The presence of the hazard through the 'Men at Work" sign, accompanied by the distance to the hazard;
2. Any changes affecting traffic arrangements (such as a reduction in the number of lanes and/or in the speed limit) within the traffic control zone;
3. Extent of the hazard (for example; the length of restriction); and for general information;
4. The type of hazard.

The advance warning zone is also where the reduction in speed of vehicles should be notified. The drivers will be advised to reduce their speed so as to achieve the desired approach speed before reaching the approach transition zone. The information in this zone is conveyed through a series of traffic signs along the length of the zone.

Transition Zone: The transition zone is the area in which the traffic is guided into the altered traffic flow pattern around the working zone. This is one of the most crucial zones as far as traffic safety aspects are concerned because most of the movements involved are merging / turning in nature. The transition zone has two components: The Approach Transition Zone and Terminal Transition Zone.

The initial part of the transition zone called Approach Transition Zone should further reduce the approach speed of vehicles and channelize them into the narrower and /or restricted number of lanes, if this is necessary.

At other construction zones, it may be necessary to divert traffic away from the original carriageway and the design of the temporary road geometry through the transition zone should consider the following factors:

1. The turning radius of the longest vehicle that generally uses the road should be the ruling radius for curves;
2. Where changes in vertical profile are required these should be shallow enough to allow safe passage of animal drawn vehicles (if these are present in significant numbers);
3. The zone should have a good drainage to avoid any stagnation of water on the road surface.
4. Sources of dust should be minimized. This is not only essential for good visibility but also for proper maintenance of signs and barricades in the zone.

The traffic is taken across the transition zone mostly with the help of signs, barricades, channelizes and pavement markings.

Working Zone: The working zone is the zone where actual construction is being undertaken. It contains the work area and a working space, as well as lateral and longitudinal buffer zones to create the safety zone to protect both the workforce from wayward vehicles entering the area of actual work and the road users from construction equipment areas.

Speeds should continue to be controlled in this zone because of the close proximity of moving construction plant and site operatives. Further, there may also be a difference in the elevation of the road and the diverted path in the zone.

The path of the traffic must be very clearly delineated through the traffic control zone to avoid vehicle intruding into the work area. Delineators and channelizers discussed further below must be used effectively for this purpose. Where the work site uses machinery with revolving booms like cranes or excavators the intrusion of moving parts must be considered when determining the lateral clearances for the buffer or safety zone.

Terminal Transition Zone: The Terminal Transition Zone (TTZ) provides a short distance to clear the work area and to return to normal traffic lanes. It extends from the downstream end of the work area to the sign indicating the end of works.

A downstream or closing taper may be placed in the TTZ. It may be useful in smoothening of the flow of traffic. However, it may not be advisable when the trucks carrying material move into the work area by reversing from the downstream end of working zone. The length of the downstream taper may be 25-30 m.

Other Aspects: The distance between two traffic control zones should be such that the flow of traffic can return to normal stream between them. Separation should permit fast moving traffic to overtake slow vehicles so that platoons can be dissipated and traffic normalized. These distances could vary from 2 Km on urban roads to 5 Km or 10 Km on rural roads according to gradients, traffic levels or traffic operation schemes.

Traffic Control Devices: Traffic control devices are the equipment and installations over and, on the road, which individually and collectively perform the following tasks:

1. Warn the road user;
2. Inform the road user;
3. Guide the road user;
4. Modify road user behaviour;
5. Protect the road user and the vehicle;
6. Ensure safe passage to the road user; and
7. Provide a safe working area.

The primary traffic control devices used in work zones are signs, delineators, barricades, cones, Pylons, pavement markings and flashing lights.

A detailed Traffic Control Plan will be prepared and submitted before commencement of the work.

Annexure 7.7: Rehabilitation and Reinstatement Management Plan

Rehabilitation and Reinstatement Management Plan

The primary objective of the plan is to rehabilitate the affected land area, facilities, construction sites, muck/spoil disposal sites, quarry sites, storage and mechanical yards, temporary camp sites, solid and liquid waste storage and treatment sites etc. once the construction works and its utility for the construction period is over in the designated site. This activity is envisaged to clean up the pollution created by the construction activities on land, water and air and help to restore the general aesthetic of the area similar to pre-construction period. For this, following measures will be adopted:

- **i.** Rehabilitation of the excavated land of the construction areas using appropriate bio-engineering measures/enrichment plantation /vegetative cover
- **ii.** Rehabilitation of the drainage networks as to the requirement (some area might need strengthening while in some it might have to demolished completely to give the land and drainage to natural condition)
- **iii.** Demolition of all unnecessary structures, their foundations and clean up and reclaim the sites to pre-construction phase
- **iv.** Rehabilitation of the quarry area in such a way that puddles and depressions are not left out
- **v.** Rehabilitate the temporarily acquired cultivable land by tilling and spreading the topsoil saved.
- **vi.** Handover of the leased land sites to the respective owner and get a certificate of handover

Annexure 7.8: Soil and Erosion Control Plan

Sediment and Erosion Control Plan

Embankment erosion and riverbank cuttings are noticed in many locations due to high embankment. The project design is complied with the safety standards and guidelines of DOR for controlling sediment and erosion. To control the sediment and erosion, following measures will be adopted.

i. Existing natural drainage system will not be disturbed by providing temporary measures (such as humepipe), and construction near/inside rivers, streams, ponds will be avoided during the rainy season;
ii. The excess spoil will be stockpiled in designated location outside of the river bed;
iii. Bridge and cross drainage work at river/streams will not be undertaken during the peak monsoon season.
iv. Source the material from the dry river beds and the non-perennial streams
v. Contractor will prepare borrow pits and quarry sites operation and restoration plan and submit for approval from Engineer before beginning the quarry activity;
vi. Destruction of vegetation in the right of way will be minimal as far as applicable
vii. Proper drainage system will be established within the construction sites. The excavated surface will be protected against the water erosion by adequate vertical and horizontal drainages and the water collected from the excavation areas will be discharged into safe area.
viii. Direct disposal of side surface lead off drains upon private cultivated lands and properties will be avoided.
ix. Surface runoff and side lead off drains will be maintained properly.
x. New embankments will be properly compacted, and exposed surfaces will be covered with vegetation to avoid slope washout and soil erosion. Soil erosion will be stabilized by applying bioengineering techniques (Grass plantation, Brush layering, and Tree/Shrub plantation) in combination with civil engineering (retaining) structures as per requirement.

Annexure 7.9: Action Plan for HIV/AIDS

Action Plan for HIV AIDS

The main objectives of this action plan for HIV AIDS is to develop a systematic framework that could support the successful implementation and monitoring of HIV prevention interventions for KDP Road Project. Action plans for HIV AIDS for KDP road project are listed below

Preparatory Steps

1. Including HIV prevention clauses in contract documents

   Contractors will conduct HIV/AIDS awareness activities including

   i. conducting education campaigns with all staff and contract workers and surrounding communities;
   ii. providing condoms for all site staff and laborers as appropriate; and
   iii. providing for STI and HIV/AIDS screening, diagnosis, counseling, and referral to a dedicated national STI and HIV/AIDS program.

2. Including HIV prevention indicators in contract monitoring and supervision systems

   For HIV contract clauses to be effective, it is important to monitor the efforts of the contractors to comply with these clauses. Based on the contractual obligations, a monitoring form need to be developed by supervision consultants for HIV/AIDS activities and then integrated into the overall safety management form.

3. Convening advocacy meetings for company leaders on HIV prevention

   High-level understanding of the importance of HIV prevention and support for prevention activities is critical to program success. Early in the project, the TA team will hold an HIV prevention advocacy meeting for people in charge of different contract sections, and professional safety officers and senior staff from the supervision office.

4. Establishing an HIV Prevention Team (HPT) in each work section

   Each contractor will form an HTP. The core team will usually consist of a team leader (the company leader in charge of safety production), a deputy team leader (office director or professional safety officer), and project safety officers.

   As recommended by the TA team, the HPT will have a very clear division of work, matching tasks against the skills of different team members. The team leader will be responsible for overseeing all the HIV prevention work to ensure effective implementation. The deputy team leader will be in charge of work plan implementation, coordinating the implementation of all tasks, and supervising and inspecting the HIV prevention work done by each construction team. Each work team leader will be in charge of organizing specific HIV prevention education activities.

Implementation Steps

5. Training of HPT members by experienced health educators

   Adequate training of the HPT members is crucial to ensure the development and effective implementation of HIV prevention work on the site. Core HPT members for each section will undertake tailored training on HIV/AIDS and how to respond in a road construction context. The trainers will include TA team members in close cooperation with specialist local trainers drawn from a wide range of organizations.

6. Formulating HIV prevention policies

A site-specific prevention policy sets out a contractor's overall commitment to HIV prevention, including with regard to workers living with HIV. A workplace HIV/AIDS policy is strongly recommended by the Code of Practice on HIV/AIDS and the World of Work, published by the International Labour Organization (ILO), which also provides a checklist for what the policy should contain. This includes conducting HIV and STI prevention education based on accurate HIV prevention information, encouraging positive behavior change to reduce risks of HIV/AIDS, providing information on testing and support services, ensuring access to condoms, and guaranteeing the right of privacy of people living with HIV/AIDS to continue working and to be free from discrimination. All contractors involved in the project will develop and disseminate a workplace HIV policy.

An example of site HIV Prevention Policy:

i. The HIV prevention team will publicize knowledge related to HIV/AIDS and sexually transmitted infections to all workers and laborers.
ii. The project office will ensure sufficient funds are available for activities, and that there is strong management and regular supervision.
iii. Regular information will be provided on good HIV interventions, including promotion of the correct use of condoms.
iv. Workers will be encouraged to have regular checkups, and respect the privacy of other workers.
v. Staff will maintain confidentiality on any worker's HIV testing and results.
vi. There will be no discrimination against workers and others with HIV/AIDS or people suspected of being infected with HIV.

7. Refining and finalizing HIV and STI prevention plans

A detailed work plan helps HPTs plan, implement, and monitor activities, as well as ensuring that all key strategies are incorporated. The approach piloted and refined by the project should be beyond the dissemination of information and emphasize on adoption and maintenance of safe behaviors. This will be achieved through information dissemination/education on HIV and other STIs, promoting safe behaviors and maintaining a supportive environment for safe behaviors.

8. Providing HIV prevention training for site management staff

Contractors will have great importance to HIV education for laborers, and this is very important. However, it is also important that management staff are covered. While managers often have high levels of HIV knowledge, this does not necessarily mean that they practice safe behaviors. Higher incomes and access to vehicles often make it easier for them to engage in risky activities.

Training will be provided for management staff by the HPTs. This will begin with the contents of the training provided for laborers so that staff will develop a sound understanding of the reality of HIV/AIDS and assess their own potential risks and how to reduce them. This will be followed by more in-depth information relevant to their work roles. The obligations of the contractor will be covered in detail as well as the importance of all staff supporting HIV prevention work whether or not they will directly involve.

9. Including HIV prevention in induction training for all site laborers

Including an HIV component in induction training itself ensures that all workers are exposed to at least some form of HIV/AIDS education, helping to offset one of the biggest problems with HIV prevention—high turnover of construction workers. Major activities under this section includes:

i. Integrating HIV prevention knowledge into safety and technology induction for all management staff and laborers; this is to be included in the site rules and regulations
ii. Including HIV/AIDS information in monthly safety meetings
iii. Putting up posters and slogans with HIV prevention information around the site
iv. Distributing condoms to workers
v. Informing workers about health service institutions for STI services and voluntary counseling and testing
vi. Formulating the site HIV prevention policy
vii. Selecting three field educators from each construction team
viii. Training field educators
ix. Assisting field educators to develop HIV prevention activities among their coworkers
x. Supervising field education work
xi. Collecting relevant records of site HIV prevention activities
xii. On-site monitoring by HPT members

10. Identifying and training field educators

Peer education is a key strategy in HIV workplace programs around the world. Peer education involves the use of people from a similar age group, background, experience, and language to educate and inform each other about HIV/AIDS. The rationale behind peer education is that peers can strike a chord on the basis of trust and are seen as a credible source of information. Further, as they share similar experiences and challenges, they are well placed to understand barriers faced by their colleagues in adopting and maintaining safe behaviors.

11. Integrating the monitoring of site HIV prevention work into routine safe production management

A strong monitoring system is a foundation for ensuring work is carried out and completed effectively.

12. Establishing and maintaining site HIV prevention records

The collection and recording of information on site HIV prevention activities helps monitor the implementation of work plan activities and identify problems, as well as documenting progress for reporting and monitoring purposes.

Annexure 7.10: Action Plan for GBV/SEA/SH

Gender Based Violence/ Sexual Exploitation and Abuse/ Sexual Harassment (GBV/SEA/SH) Risk Mitigation and Action Plan

GBV/SEA/SH Risk Assessment

The KDP Project plans to upgrade the Kamala-Dhalkebar-Pathlaiya (KDP) road of the Mahendra Highway (East West Highway) from 2-lane to 4-lane including associated brides. These works involve major civil works which can have adverse impacts on the communities, on children, women and girls can aggravate the potential risk of illicit crimes and multiple forms of GBV such as domestic violence, sexual abuse/exploitation, forced/ early marriages, human trafficking, dowry-related violence, and other communicable and sexually transmitted diseases.

The ESIA study of KDP road has assessed the SEA/SH-related risk to be 'Substantial' during construction phase and 'Low' during operation phase. An SEA/SH prevention and response mitigation measures action plan have been identified and developed as per the SEA/SH risk rating. The action plan focuses on corresponding mitigation measures such as sensitization of communities and stakeholders and awareness of GBV/SEA/SH, developing Code of Conduct (CoC) for all project personnel and workers, strengthening the institutional capacities by having a pool of appropriate resource person to specifically manage SEA/SH risks in all levels of implementation as well as survivor-centric approach to respond to cases of GBV/SEA/SH in the project grievance redress mechanism (GRM). The plan will apply to the implementing agency including the client, supervision consultant and contractors to cover Project's footprint and adjoining communities and stakeholders.

The SEA/SH risk will be reassessed throughout the project cycle. The recommended action is to be followed by the client. The SEA/SH action plan should also be part of the bid documents and other agreements between the Client, Contractors, and the World Bank.

GBV/SEA/SH Risk Mitigation Action Plan

Action to Address GBV/SEA/SH Risk	Timing of Action	Responsibilities	Risk Management
Project Preparation			
Sensitization of Implementing Agency (IA) addressing GBV/SEA/SH risk on project and the mechanism of implementation	• Preparation Phase • Implementation Phase	• Task Team	• Task team to monitor and provide additional guidance as necessary
Include the GBV assessment as a part of the social/ gender assessment in project's Environmental and Social Impact Assessment (ESIA) process • Conduct consultations and identify key SEA/SH risks in project areas and indicate the main mitigation measures	• Preparation Phase • Construction Phase (Before civil works commence) • Utilize ESIA (SEA/SH Risk Assessment Tool	• PCU (DCID) for social assessment and ESMP. • Contractor for C-ESMP. • Task Team for SEA/SH Risk Assessment Tool.	• Review during implementation support missions. • Update project ESMP and C-ESMP if risk situation changes.
Map out GBV prevention and response service on project area of influence. *Reference to be made from the service mapping that already exists at the national level*	• Preparation • Implementation	• PCU (DCID)	• Update mapping as appropriate.
Have GBV/SEA/SH risk adequately reflected in all safeguard instruments (i.e. Project ESMP, C-ESMP) particularly as a part of the assessment in ESA and integrated in the ESF activities	• Preparation • Implementation (before civil works commence). Consultations needs to be done throughout the project cycle, not just during preparation in line with SEP.	• PCU (DCID) for social assessment and ESMP • Contractor for C-ESMP	• Review during implementation support missions. • Update project ESMP and Contractor's ESMP (C-ESMP) if risk situation changes. • Monitoring of implementation of Stakeholder Engagement Plan. • Conduct consultations, particularly when C-ESMP is updated
Orientation and awareness on GBV with the project affected communities	• Preparation Phase • Construction Phase • Operation Phase	• PCU (DCID)	
Project Implementation			
Establish and strengthen an effective GRM that can respond to GBV/SEA/SH cases based on using the existing (Model 1 framework) • Identify a GBV focal at project level (female) within the GRM committee, and who will respond to all GBV/SEA/SH cases incurred by project	• Construction Phase • Operation Phase	• PCU (DCID) • Technical training by the WB and backstopping throughout.	• Monitoring and reporting of the GRM to verify that it is functioning as intended. • Monitoring of complaints and their resolutions

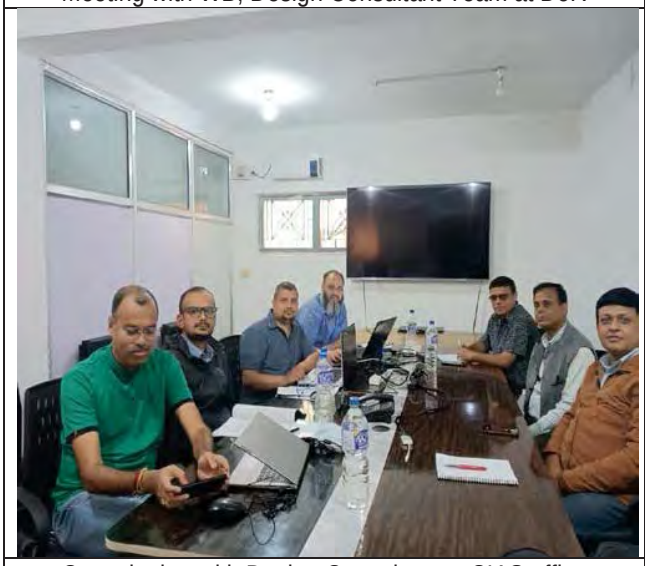
• Provide multiple channels to register complaints in a safe and confidential manner. • Provide appropriate GBV/SEA/SH response procedural training to the focal point, i.e., proper documentation for complaint registration and management; and confidential reporting with safe and ethical documenting of GBV/SEA/SH cases. The **focal point to coordinate and link** with Service providers – e.g; toll-free 24-hour helpline ***"Khabar-Garau 1145"***; other available local level services which are already mapped out.			
Develop separate CoC for the contractors and sub-contractors. • Ensure requirements in CoCs are clearly understood by those signing. • Have CoCs signed by all those with a physical presence at the project site. • Train project-related staff on the behavior obligations under the CoCs. • Disseminate CoCs (including visual illustrations) and discuss with employees and surrounding communities.	• Initiated prior to contractor mobilization and continued during implementation	• PCU (DCID) • Supervision Consultant • Contractor	• Review of GBV risks during project supervision (e.g., Mid-term Review) to assess any changes in risk. • Supervision consultant to report that CoCs are signed and that workers have been trained and understand their obligations. • The Civil works supervision consultant's monthly reports should confirm all persons with physical presence at the project site have signed a CoC and been trained. • Monitoring of GRM for GBV complaints. • Discussion during public consultations.
Orientation and training on GBV/SEA/SH to subcontractors and their employees	• Construction Phase • Operational Phase	• PCU (DCID)	Reporting
Review C-ESMP to verify that appropriate mitigation actions are included	• Implementation	• PCU (DCID)	• Review by IA • Review by Task Team
Review GRM processes to ensure it receives and processes complaints to ensure that the protocols are being followed in a timely manner, referring complaints to an established mechanism to review and address GBV complaints.	• Implementation	• Task Team, PCU (DCID)	• Reporting. • Monitoring of complaints and their resolution if any.

Undertake regular **M&E** of progress on SEA/SH prevention and response activities, including reassessment of risks as appropriate.	• Implementation	• PCU (DCID) • Contractors, Supervision Consultants.	• Monitoring of GRM. • Reporting.
Implement appropriate project-level activities to reduce SEA/SH risks prior to civil works commencing • Have separate, safe and easily accessible facilities for women and men working on the site. • Locker rooms and/or latrines should be located in separate areas, well-lit and include the ability to be locked from the inside. • Visibly display signs around the project site (if applicable) that signal to workers and the community that the project site is an area where GBV/SEA/SH is prohibited. • As appropriate, public spaces around the project grounds should be well-lit.	• Construction and Operational Phases	• Contractor (implementation) • Supervising Engineer (supervising/enforcing contract) • Task team	• Reporting • Review during implementation support mission
Procurement			
Clearly **define the requirement of SEA/SH action plan and CoC in the agreement** documents of the Contractor/Consultant.	• Procurement	• PCU (DCID)	• Review by WB
Clearly **itemize incurring costs for SEA/SH activities** in the agreement documents including contingency fund for undefined or comprehensive activities	• Procurement	• PCU (DCID)	• Review by WB

Project SEA/SH Action Plan of DCID which includes mapping of existing service providers can be assessed through following link.

https://dor.gov.np/dorfcb/publication/report-of-project-under-srctip-dcid/srctip-sea-sh-risk-prevention-and-response-action-plan

A. Consultation with Stakeholders

	
Meeting with WB, Design Consultant Team at DoR	Consultation with Local People (tea stalls)
	
Consultation with Design Consultant at CIAS office	Consultation with community people

	
Consultation with community people	Consultation with community people
	
Consultation with DFO Rautahat	Preparation for Household Survey

FGD at Newar Basti of Bagmati Municipality

Consultation with community people

Household Survey at Mithila Municipality

Consultation with Warden of PNP (Ashok Ram)

Household Survey at Dhalkebar, Mithila Municipality

Preparation for FGD at Ganeshman Charnath

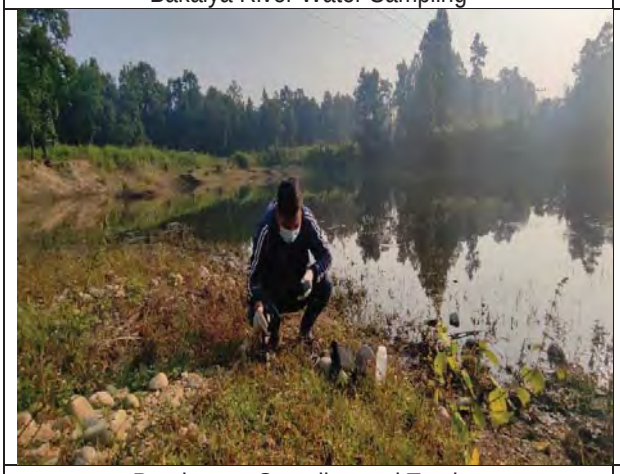
Consultation at PNP Office

	
Consultation with DFO Bara	Consultation with design Consultant Team at CIAS office
	
Consultation with design Consultant Team at CIAS office	

B. Environmental Monitoring for Air, Noise, Water and Soil

Bakaiya River Water Sampling

Soil Sampling Near Kamala River



Pond water Sampling and Testing

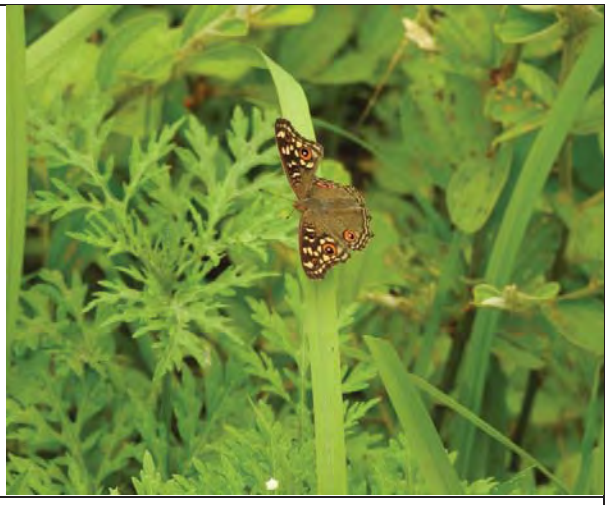
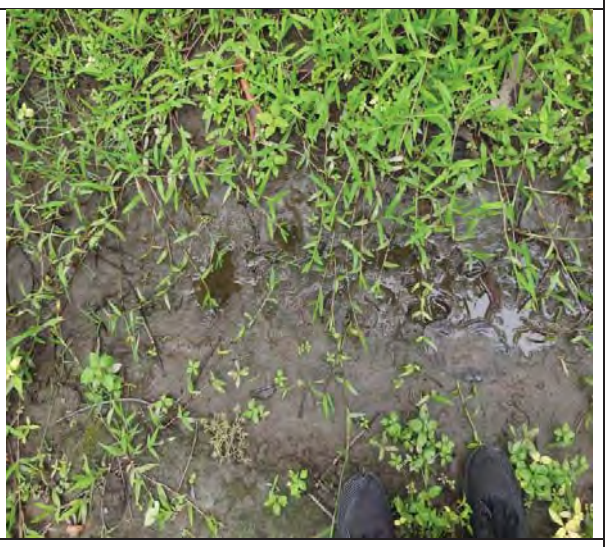
High Volume Air Sampler installation at Dudhaura

	
Air noise monitoring at Dhalkebar of Mithila Mun	Air noise monitoring at Lalbandi Municipality
	
Testing of Ratu River Water	Testing of Wetland Water

C. Flora & Fauna observed during field visit

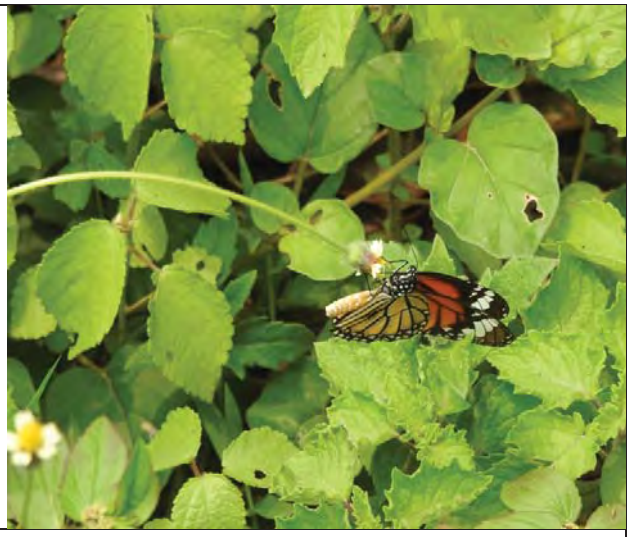
	
	

	
	
	Measuring and counting the trees

	
	Monkeys searching for food along the KDP road
	
	Sal forest



Butterfly

Monkey enjoying at premise of DoR Chandranpur

	
Cattle grazing at the road alignment	
	
	Locals selling Fish from Bagmati River

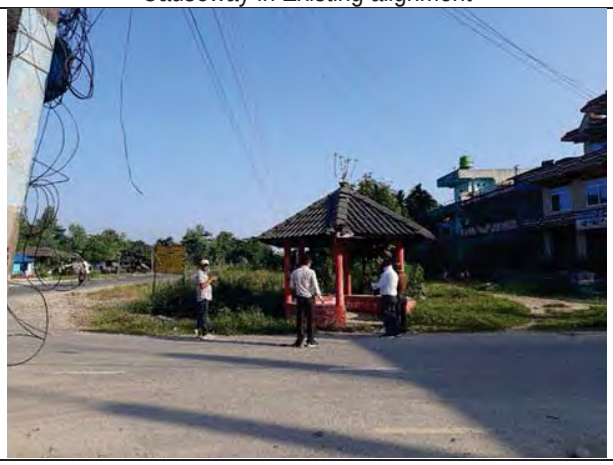
D. Features Along Existing KDP Road

Volume of traffic at Pasaha bridge

Locals harvesting firewood from the nearby forest

Solid Waste dumps at the edge of KDP road

Local vendors at the RoW

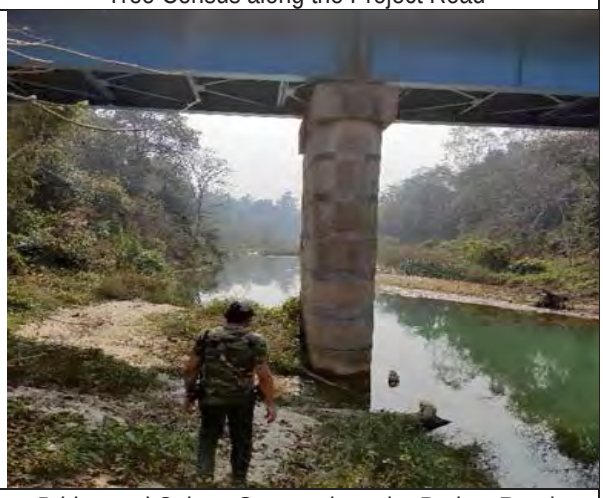
	
Causeway in Existing alignment	Condition of KDP Road
	
Field team in measurement of waiting shed	Pathalaiya Park, end section of KDP Road

E. Ecological and Quadrat Survey

Walkthrough Observation on the Project Road

Tree Census along the Project Road

Quadrats Survey along the Project Road



Bridge and Culvert Survey along the Project Road

	
Bridge and Culvert Survey along the Project Road	Nocturnal Survey along the Project Road