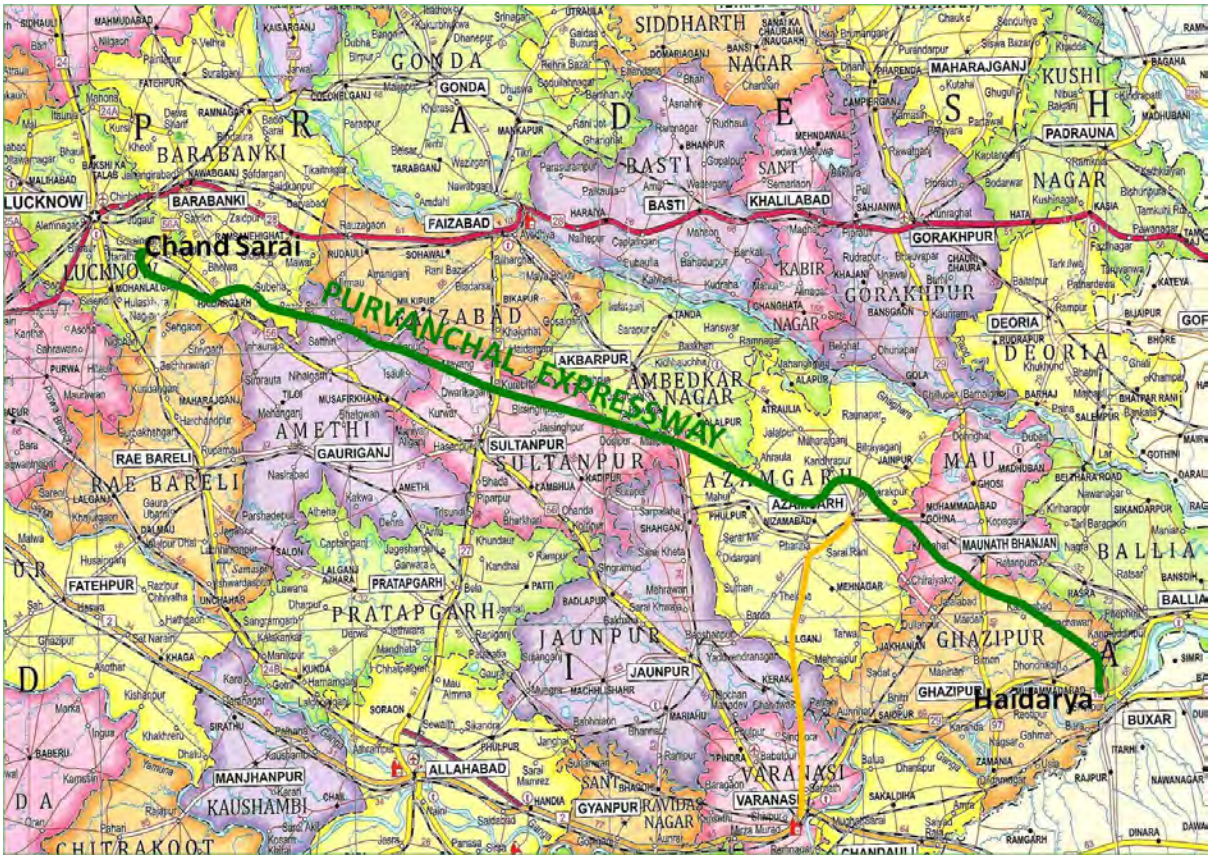
Traffic, Toll & Financial Studies

"THE PURVANCHAL EXPRESSWAY"

Development of Purvanchal Expressway Project in the State of UttarPradesh on EPC Basis



Package-I to Package-VIII

Submitted to:

Uttar Pradesh Expressways Industrial Development Authority

C-13, 2nd Floor, PARYATAN Bhawan,

Vipin Khand, Gomti Nagar,

Lucknow-226010.

Tele :0522-4108184 / 2301492

Submitted by:

IIDC Ltd.

(Formerly known as IL&FS-Infrastructure Development Corp. Ltd)

4.B, S.K.Puri, Patna: 800001

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Chapter-4

TRAFFIC, TOLL & FINANCIAL STUDIES

4.1 Introduction

This Chapter examines three inter-linking subjects:

(a) traffic and traffic forecast (Chapters 4.1 to 4.5);

(b) "Toll Studies" (Chapter 4.6) – which section contains the Consultants' analyses of system options and which section after drawing together the conclusions from Chapter 4.7 (Financial Analyses) and Chapter 6 *"Economic Studies"*, makes recommendations regarding the level of toll to be applied to different vehicle categories – capital and operating costs are indicated in Chapter 5, *"Cost Estimates"*;

(c) "Financial Analyses" (Chapter 4.7) – which chapter indicates the expected financial returns with a number of construction and tolling options and the degree of subsidy/top-up finance required (with some recommendations resources for such funding).

The presently available routes for traffic between Chand Sarai (Start Point of Expressway) & Haidariya (End Point of Expressway) are indicated on Figure 4.1. The expressway is access controlled with only entry/exit at Nodes (*intersecting points of National Highway or State Highway with the proposed Expressway Alignment*) are lettered "A" to "L" as listed on Table 4.1:

Table 4.1: Details of Nodes for entry / exit proposed on the Expressway

Toll Nodes	Expressway Chainages	Intersecting Road No.	Details of the Intersecting Road	Project Structure
A	-0+270	NH 56 (NH731)	National Highway NH56/731	Trumpet Interchange
B	36+870	SH 13	Haidergarh - Barabanki Road	Slip Roads with toll booth
C	58+380	SH 31	Inhauna - Ruduali Road	Slip Roads with toll booth
D	81+900	SH 15	Rae-Bareli - Faizabad Road	Interchange with Toll Plaza
E	121+860	SH 9	Sultanpur - Faizabad Road	Interchange with Toll Plaza
F	138+150	NH 232 (NH-128)	Sultanpur - Akbarpur Road	Interchange with Toll Plaza
G	182+360	SH 5	Akbarpur - Jaunpur Road	Slip Roads with toll booth
H	234+650	NH 233 (NH-28)	Azamgarh - Tanda Road	Interchange with Toll Plaza
I	253+850	SH 34	Azamgarh - Mau Road	Slip Roads with toll booth
J	294+200	NH 29 (NH-24)	Mau - Ghazipur Road	Interchange with Toll Plaza
K	329+500	Ballia Link	Ballia Link Road *(future)*	Slip Roads with toll booth
L	340+500	NH 19 (NH-31)	National Highway Road NH19	Trumpet Interchange

Matrices showing distances between various origins and destinations, that traffic which have trip distance more than 100 Kms and that are likely to use the sections of expressway between these lettered nodes "A" to "L" are provided as follows:
(a) on the presently available network of alternative routes – Table 4.2; and
(b) as estimated on the Proposed Expressway – Table 4.3.

Table 4.2 shows for each pair of Traffic Zones, the distances (more than 100 Km) travelled by *"passenger cars"*. Distances travelled by truck are occasionally longer – these vehicles must use especially-designated truck routes.

Figure 4.1 Presently Available Routes for Through Traffic between Lucknow and Ballia

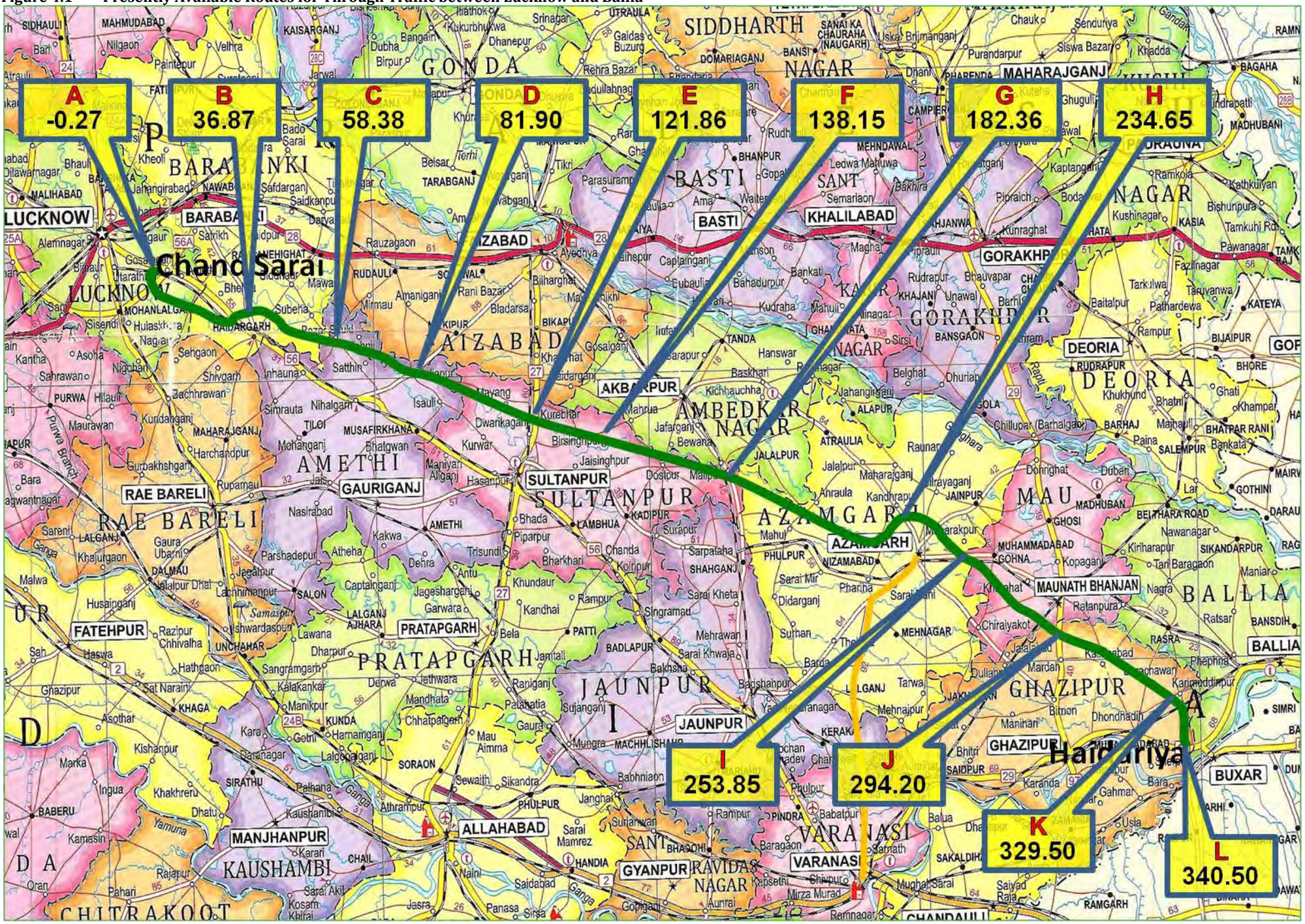

Table 4.2: Distance Matrix between Zones (Origins & Destinations)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
1					83	135	139	153			165	129			205	270	319	189	272	334	397	338	319	399							526	414	564	392	636	726	989	989	1334												596			135		338	189	529
2					103	147	120	153			146	234			217	282	331	201	284	346	409	357	301	380							538	421	545	404	648	707	970	970	1346												608			147		357	201	541
3					189	225					221	303			297	362	411	279	374	413	489	429							581	452	576	484	729				1426												688			225		429	279	622
4															188	254	303	149	219	258	327								484	364		376	620				1319												569						149	513
5						56		92				144			145	209	258	116	186	224	294	248	225			338			529	576	420	300	455	332	576	685	881	881	1275												527			56		248	116	468
6										141						186	235		130	169	238	192				377			491	721	365	245	404	309	549	566	830	830	1248												502	135	141			192		445
7										143						217	266		161	200	270	224									396	276	431	340	584	593	857	857	1279												533	139	143			224		473
8										176							236		147	185	255					374		273	507	718	381	262	399	320	547	561	825	825	1245				685	735	933	933					542	153	176					439
9																388	445		369	408	497									567	446		511	755				1454																			647
10												243		226				160	246	308	371	312	345	424						500	388	558			720	984	984	1309															141		312	160	503
11												143							146	207	271	211	228	365						400	264	451			613	884	884														165				211		403
12																				106	176				187	456		349	630	800											767	814	1015	1015						129	243					356
13																302	318																																								356
14																																																					226					466
15																															234	452			604	867	867												205			188			
16																															182	399	1	1	552	815	815												270		186	254			
17																																											884	935	1134	1134						319		235	303			
18																			83	127	200	148	146			436	505	275	558	656	347	217	404		465	557	820	820		858			747	797	996	996						189	160		149	148		
19																					119	66			195	518	561	352	641	733	261	136	332			485	748	748		915			824	875	1079	1079						272	246	130	219	66	83	
20																										557	599	396	680	778	211	87	304			457	720	720					868	919	1118	1118						334	308	169	258		127	
21																										652	694	469	775	851						963	1014	1213	1213												397	371	238	327		200	
22																									261			417	685	915							873	924	1123	1123												338	312	192			148	
23																									277			423																								319	345				146	
24																																																					399	424					
25																															459	340	585			738	923	923																	261		
26																															754	615	737																						377			436	
27																																		708	956																						505	
28																															642	486	675			828	1091	1091																	417	275	
29																															875	736	858	760	1008																			491		685	558	
30																															1099	937	1082	860	1017	1235	1498	1498																	721		915	656	
31																																											1061	1111	1310	1310						526	500	365	484		347	
32																																											926	976	1175	1175						414	388	245	364		217	
33																																																			564	558	404			404	
34																																														1833	1833	1833			392		309	376			
35																																														1833	1833	1833			636		549	620		465	
36																																																			726	720	566			557	
37																																																			989	984	830			820	
38																																																			989	984	830			820	
39																																																			1334	1309	1248	1319			
40																																																							858	
41																																																								
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56																																																								148	
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58																																																								

Table 4.3 Distance Matrix between Toll Nodes (Nodes "A" to "L")

(Distance in Kms)

Toll Node	A	B	C	D	E	F	G	H	I	J	K	L
A	0.000	37.326	58.836	82.356	122.316	138.606	182.816	235.106	254.306	294.656	329.956	340.956
B		0.000	21.510	45.030	84.990	101.280	145.490	197.780	216.980	257.330	292.630	303.630
C			0.000	23.520	63.480	79.770	123.980	176.270	195.470	235.820	271.120	282.120
D				0.000	39.960	56.250	100.460	152.750	171.950	212.300	247.600	258.600
E					0.000	16.290	60.500	112.790	131.990	172.340	207.640	218.640
F						0.000	44.210	96.500	115.700	156.050	191.350	202.350
G							0.000	52.290	71.490	111.840	147.140	158.140
H								0.000	19.200	59.550	94.850	105.850
I									0.000	40.350	75.650	86.650
J										0.000	35.300	46.300
K											0.000	11.000
L												0.000

Note: Distance for reverse routes shall have same diagonal values

4.2 Traffic Surveys

4.2.1 Introduction

The Consultants' traffic surveys were of three main types:

(a) origin and destination surveys (which included willingness-to-pay *"stated-preference"* questions and, in one instance where this type of survey was possible, a *"revealed-preference"* survey – see below);

(b) classified count surveys; and

(c) speed-time surveys on the presently available alternative routes.

All three survey types were conducted in accordance with the guidelines specified in IRC 9-1972, IRC 102-1988 and IRC SP19-2001.

4.2.2 Consultants' Origin and Destination Surveys

The Consultants' origin and destination surveys were the most important traffic surveys - as it is from these that the **Candidate Traffic** was derived. The surveys were conducted at points close to where the proposed Expressway would intersect with the National, State and other highways and other locations from which, traffic that may eventually use the Expressway either partly or entirely. The traffic survey locations are shown on Figure 4.2 and listed on Table 4.4.

Table 4.4: Locations for Consultants' Road-Side Origin and Destination (O-D) Surveys

S.No.	Road Name	Location of Survey	Day & Date of O-D Survey
1	NH-2	Km 482+000; Village Rooma	Wednesday, the 28th October 2015
2	NH-28 (NH-27)	Km 39+000; Village Lakshvar	Friday, the 30th October 2015
3	NH-56 (NH-731)	Km 81+800; Village Mahanpur	Friday, the30th October 2015
4	NH-56 (NH-731)	Km 211+000; Village Sekhapur	Friday, the 30th October 2015
5	NH-28 (NH-27)	Km 143+000; Village Lolpur	Monday, the 9th November 2015
6	NH-29 (NH-24)	Km 84+000; Village Ghusurupur	Monday, the 9th November 2015
7	NH-233 (NH-28)	Km 130+100; Village Hasanpur	Thursday, the 5th November 2015
8	SH-13	Km 13+000; Village Chausa	Friday, the 6th November 2015

Examples of the Consultants' data recording forms are provided in Annex A1. There are two different forms. At all sites, the questions, besides *"origin"* and *"destination"*, ascertained trip purpose, numbers of persons travelling in the vehicle (Vehicle Occupancy) and, for freight vehicles: the nature of any loads and the tonnage carried.

For the purpose of analysing the data from origin and destination surveys, all of the areas on either sides of the proposed alignment were divided into 15 Zones in order to arrive at the candidate traffic and homogeneous traffic sections for the proposed alignment. Traffic with origin and destinations in this area are considered more likely to use certain sections of the expressway and a percentage of it that may use the entire length of the expressway. The rest of the areas were divided into 22 Zones lying within the State of Uttar Pradesh and into 21 Zones for rest of India. These served principally to assess the proportion of traffic that travels more than 100 Kms using existing roads that may divert to the expressway (refer Table 4.5).

Figure 4.2 Consultants' Traffic Survey Sites

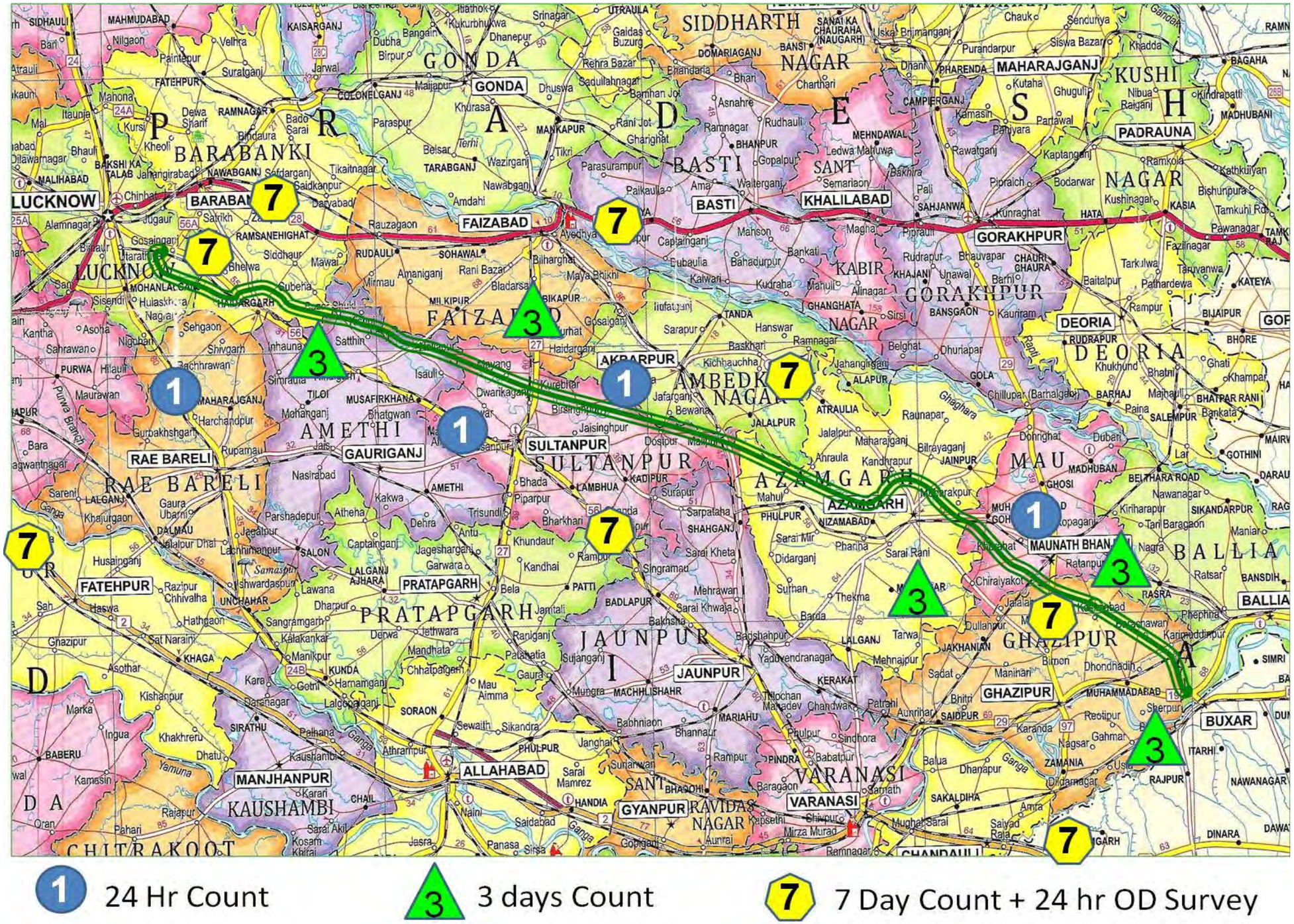

Table 4.5 Zoning Definitions

Zone	Place/Region	District/ State	Final (District/State)
1	Lucknow, Charbagh, Gomti Nagar, Alambagh, Chinhat, Mubarakpur	Lucknow	Uttar Pradesh
2	Mohanlalganj	Lucknow	Uttar Pradesh
3	Kanpur, Unnao, Akbarpur, Azad Nagar	Kanpur, Unnao, Akbarpur	Uttar Pradesh
4	Raebareilly, Maharajganj, Azadpur	Raebareilly	Uttar Pradesh
5	Jagdishpur	Sultanpur	Uttar Pradesh
6	Sultanpur	Sultanpur	Uttar Pradesh
7	Amethi	Amethi	Uttar Pradesh
8	Pratapgarh	Pratapgarh	Uttar Pradesh
9	Fatehpur, Banda, Chitrakoot, Bindki	Fatehpur, Banda, Chitrakoot	Uttar Pradesh
10	Barabanki	Barabanki	Uttar Pradesh
11	Faizabad, Ayodhya	Faizabad	Uttar Pradesh
12	Jaunpur, Badlapur	Jaunpur	Uttar Pradesh
13	Kaushambhi	Kaushambhi	Uttar Pradesh
14	Allahabad	Allahabad	Uttar Pradesh
15	Basti	Basti	Uttar Pradesh
16	Gorakhpur	Gorakhpur	Uttar Pradesh
17	Deoria, Kushinagar	Deoria, Kushinagar	Uttar Pradesh
18	Akbarpur (Ambedkar Nagar)	Ambedkar Nagar	Uttar Pradesh
19	Azamgarh	Azamgarh	Uttar Pradesh
20	Mau	Mau	Uttar Pradesh
21	Balia	Balia	Uttar Pradesh
22	Ghazipur	Ghazipur	Uttar Pradesh
23	Varanasi	Varanasi	Uttar Pradesh
24	Chandrauli, Mirzapur, Sonbhadra	Southern UP	Uttar Pradesh
25	Gonda, Bahraich, Sravasti, Balrampur, Siddhart Nagar, Maharajganj district	Eastern UP	Uttar Pradesh
26	Etawah, Auraiya, Kannauj, Etah, Firozabad, Mainpuri, Kasganj	West - Central UP	Uttar Pradesh
27	Jalaun, Jhansi, Lalitpur, Hamirpur, Mahoba	South-West UP	Uttar Pradesh
28	Hardoi, Sitapur, Lakhimpur Kheri, Shahjahanpur, Pilibhit, Bareilly, Budaun	North-Eastern UP	Uttar Pradesh
29	Agra, Mathura, Hathras, Aligarh, Noida (GB Nagar), Bulandshahr	Western UP	Uttar Pradesh
30	Northwest UP (Saharanpur, Meerut, Muzaffarnagar, Ghaziabad, Shamli, Baghpat, Muzaffarnagar, Moradabad, Bijnor, Amroha), Uttarakhand	North-western UP	Uttar Pradesh
31	Patna, Jahanabad, Nalanda, Arwal, Sheikhpura,	Patna, Central Bihar	Bihar
32	Buxar, Bhojpur, Rohtas, Kaimur, Sasaram, Arrah	Western Bihar	Bihar
33	Nawada, Aurangabad, Gaya	Southern Bihar	Bihar
34	Paschim Champaran, Gopalganj, Siwan, Chhapra, Motihari	Northern Bihar	Bihar
35	Rest of Bihar	Eastern Bihar	Bihar
36	Jharkhand, Dhanbad, Ranchi, Jamshedpur, Tata Nagar	Jharkhand	Jharkhand
37	Kolkata	West Bengal	West Bengal
38	Rest of West Bengal	West Bengal	West Bengal
39	Assam, North-East States	North-Eastern States of India	North-Eastern States of India
40	Madhya Pradesh	Madhya Pradesh	Madhya Pradesh
41	Chhatisgarh, Raipur	Chhatisgarh	Chhatisgarh
42	Orissa	Orissa	Orissa
43	Delhi	Delhi	Delhi
44	Jaipur, Rajasthan	Rajasthan	Rajasthan
45	Haryana, Punjab, Chandigarh	Haryana, Punjab. Chandigarh	Haryana, Punjab. Chandigarh
46	Himachal Pradesh, J&K	Himachal pradesh, Jammu & Kashmir	Himachal pradesh, Jammu & Kashmir
47	Mumbai, Western Districts of Maharashtra	Maharashtra	Maharashtra
48	Rest of Maharashtra	Maharashtra	Maharashtra
49	Gujarat, Ahmedabad	Gujarat	Gujarat
50	Rest of India, South India, Goa	South India	South India
51	Nepal	Nepal	Nepal
52	Maharajpur, Rest of Local South of Location-1	NH-2	Uttar Pradesh
53	Rest of local South of Location-2 in Barabanki district	NH-28	Uttar Pradesh
54	Rest of local South of Location-3 in Sultanpur district	NH-56 in Sultanpur	Uttar Pradesh
55	Rest of local South of Location-4 in Lucknow district	NH-56 in Lucknow	Uttar Pradesh
56	Rest of local North of Location-6 in Ghazipur district	NH-29	Uttar Pradesh
57	Rest of local South of Location-7 in Ambedkar Nagar district	NH-233	Uttar Pradesh
58	Rest of local North of Location-8 in Bihar district	SH-13	Bihar

4.2.3 Classified Count Surveys

The principal purpose of the classified count surveys on Traffic Survey Locations (*existing alternate roads to the proposed Expressway*), was to establish **Expansion Factors** for the origin and destination data – thus permitting the Consultants to establish average daily traffic flows. Seven-day count were undertaken on the locations where Road Side Origin-Destination Surveys were carried out and three-day counts on other National Highways/State Highways and one day counts on other district roads – results (**Average Daily Traffic - ADT**) are shown on Tables 4.6.

The Consultants' survey form, which is provided in Appendix, divided vehicles into the normal classifications for such surveys in India. The larger trucks were, however, further divided into following sub-categories:

(a) 2-axled;
(b) 3-axled;
(c) 4 to 6-axled; and
(d) 7+axled vehicles

This latter category, although infrequently observed at present, can be expected to grow in importance and the Consultants wished to assess whether, or not, it would be appropriate to charge such vehicles a higher toll.

The classified counts were undertaken at the same locations as the origin and destination surveys and were for periods which incorporated the days in which the origin and destination surveys were undertaken. The classified count information, besides providing the above-referred to expansion factors, was used to indicate the hours of the week that might be categorised as:

(a) *"peak"*;
(b) *"shoulders"* to the peak; and
(c) *"off-peak"* periods.

These are important data, needed when calculating likely journey time-savings and vehicle operating cost savings. When congestion is less comparatively, a smaller proportion of through-traffic will be prepared to pay tolls.

A summary of the hourly variations in flow by direction is also shown on Table 4.7. There is very little difference in the pattern of in-bound and out-bound flows (to Lucknow city) and, for this reason, all further analyses are in terms of total two-directional flows.

The Consultants' division of the hours of the week into these three periods is shown on Table 4.8 and summarised below:

(a) *"Peak"* hours: 08:00 to 19:00 (77 hours total per week)
(average two-way flows on the Sultanpur Road (at Km 211 of NH56 (NH731)) near Sekhanpur Village are **1283 vehicles/hour**)

(b) *"Shoulder"* hours: 19:00 to 23:00 & 6:00 to 8:00 (42 hours total per week)
(average two-way flows on the Sultanpur Road (at Km 211 of NH56 (NH731)) road near Sekhanpur Village are **603 vehicles/hour**)

(c) *"Off-Peak"* hours: 23:00 to 06:00 (49 hours total per week)
(average two-way flows on the Sultanpur Road (at Km 211 of NH56 (NH731)) road near Sekhanpur Village are **293 vehicles/hour**).

The time divisions are assumed to be the same for all sections of the proposed Purvanchal Expressway.

Table 4.6: Average Daily Traffic (ADT) on Existing Alternate Roads

Survey Location* of Classified Count	Vehicle Classification	Restricted Traffic		Tollable Traffic											Restricted Traffic		Toll Exempted Traffic			Slow Moving Traffic				Summary				Total Traffic	
	Date / Period of Classified Count	2 Wheeler	3 Wheeler	Car/ Jeep/ Van	Taxi	Mini LCV	Mini Bus	Private Bus	Govt. Bus	LCV	2-Axle Truck	3-Axle Truck	MAV (4 to 6)	OSV (More than 6)	Tractor	Tractor Trailer	Govt. / Police Car	Ambulance / Police Mini Bus	Military Truck/ Fire Brigade	Bi-Cycle	Cycle-Rickshaw	Animal-Drawn	Hand-Drawn	Slow Moving Traffic	Toll Exempted Traffic	Restricted Traffic	Tollable Traffic	Total Vehicles	Total Passenger Car Units
	Base Year (2015)	*0.5*	*1*	*1*	*1*	*1*	*1.5*	*3*	*3*	*1.5*	*3*	*3*	*4.5*	*4.5*	*1.5*	*4.5*	*1*	*1.5*	*3*	*0.5*	*2*	*5.5*	*6*	*(Vehicle nos.)*					*PCUs*
Km 483, NH2	26th Oct - 1st Nov	3681	880	3657	272	869	267	181	310	706	555	723	508	7	91	193	14	67	29	996	14	5	0	1014	110	4845	8056	14025	18364
Km 39 on NH28	26th Oct - 1st Nov	6121	377	6947	877	1312	126	170	537	1074	606	1922	1197	12	75	161	29	244	24	407	23	14	0	444	297	6734	14780	22254	31140
Km 81 on NH56	26th Oct - 1st Nov	4511	487	1590	502	524	57	55	114	394	169	982	582	13	43	90	12	64	6	2011	34	13	0	2057	82	5131	4982	12253	14408
Km 211 on NH56	26th Oct - 1st Nov	**7495**	**302**	**3629**	**413**	**853**	**39**	**37**	**363**	**976**	**648**	**1734**	**1092**	**2**	**30**	**150**	**4**	**121**	**12**	**1801**	**59**	**22**	**0**	**1881**	**137**	**7977**	**9786**	**19782**	**25822**
Km 143 on NH28	3rd Nov - 9th Nov	4021	196	3681	308	796	99	160	459	1138	623	2324	2414	4	98	58	9	170	18	405	4	2	0	411	197	4373	12006	16987	31370
Km 84 on NH29	3rd Nov - 9th Nov	2395	557	1601	179	307	88	62	158	231	265	586	382	2	28	74	5	23	6	1429	5	9	0	1444	34	3054	3860	8392	10468
Km 133 on NH233	3rd Nov - 9th Nov	2717	128	455	32	235	20	57	3	61	17	68	9	2	20	28	2	9	2	1306	53	12	0	1371	12	2893	958	5234	3799
Km 13 on SH13	3rd Nov - 9th Nov	3924	364	581	240	311	25	113	1	126	65	500	155	7	38	135	27	16	18	1129	11	3	0	1144	62	4461	2124	7790	7828
Km 38 on NH24B	29th - 31st Oct	3532	182	3623	256	805	94	28	512	482	307	730	456	16	46	173	1	221	13	204	3	4	0	210	235	3933	7310	11688	15702
Km 38 on NH29	5th Nov - 7th Nov	2636	690	1929	215	361	95	135	219	367	95	410	273	2	50	70	1	30	0	1185	6	3	0	1194	32	3446	4103	8775	10087
Km 110 on NH56	29th - 31st Oct	2883	398	1592	181	527	8	15	211	534	299	1266	457	5	18	56	1	77	2	1639	19	2	0	1660	80	3355	5093	10187	13670
Km 33 on NH232	29th - 31st Oct	2591	66	336	44	108	57	7	7	37	23	37	6	3	13	55	0	8	0	928	28	9	0	965	9	2725	666	4365	3097
Km142.5 on NH56	28th Oct	6303	746	3110	428	744	47	51	272	804	349	1742	662	20	26	119	51	9	0	1783	71	31	0	1885	60	7194	8229	17368	21683
Paroma, NH96	5th Nov	1345	110	1354	67	319	38	33	76	368	152	582	386	3	12	37	18	0	0	725	16	4	0	745	18	1504	3378	5645	8032
Kusadhana,SH67	5th Nov	1759	217	1297	73	243	132	47	98	108	83	509	257	3	10	47	18	0	2	598	3	28	0	629	20	2033	2850	5532	7229
Bhawarkol, NH19	6th Nov	2473	198	2091	161	670	148	69	12	698	86	445	214	5	21	16	8	0	2	609	0	1	0	610	10	2708	4599	7927	8872
Haldharpur, SH34	6th Nov - 12th Nov	2867	238	2408	236	415	64	82	124	385	107	506	285	7	34	78	18	0	0	716	16	7	0	739	18	3217	4619	8593	10030

* New number of NHs are followed by closed parentheses NH 28 (NH 27); NH 56 (NH-731); NH 29 (NH-24); NH 233 (NH-28); NH 24B (NH-30); NH 29 (NH-24); NH 232 (NH-128); NH96 (NH-330); NH19 (NH-31)

Table 4.7: Direction Flows Average Daily Traffic (ADT) on Existing Alternate Route (Km211 on NH56 (NH-731))

Date/Day	Direction	Motorized Vehicles															Toll Exempted Vehicles			Non-Motorized Vehicles					Vehicles			PCUs		
		2 - Wheeler	3 - Wheeler	Car / Jeep	Taxi	Mini LCV	Mini Bus	Private Bus	Govt. Bus	LCV	2 - Axle Truck	3 - Axle Truck	MAV (4-6)	OSV (More than 6)	Tractor	Tractor Tralior	Govt. / Police Car	Ambulance / Police Mini Bus	Military Truck/ Fire Brigade	Bi-Cycle	Cycle Rickshaw	Bullock Cart	Horse Cart	Hand Cart	Motorized	Non-Motorized	Total	Motorized	Non-Motorized	Total
26-Oct-15 to 1-Nov-15	Lucknow to Sultanpur	3,696	147	1,870	190	394	18	6	179	469	357	867	608	1	20	77	2	65	7	964	30	0	11	1	8,973	1,005	**9,979**	12,644	610	**13,253**
	Sultanpur to Lucknow	3,799	156	1,759	222	459	21	31	184	507	291	866	484	1	10	74	2	56	5	837	29	0	9	1	8,927	876	**9,803**	12,035	533	**12,569**
	Both Directions	**7,495**	**302**	**3,629**	**413**	**853**	**39**	**37**	**363**	**976**	**648**	**1,734**	**1,092**	**2**	**30**	**150**	**4**	**121**	**12**	**1,801**	**59**	**0**	**20**	**2**	**17,901**	**1,881**	**19,782**	**24,679**	**1,143**	**25,822**

Table 4.8 Hourly Variation of Traffic Count over the Week on Km 211 on NH56 (NH-731)

(Vehicles per hour)

Date & Hour of Day	26-Oct-15 Monday	27-Oct-15 Tuesday	28-Oct-15 Wednesday	29-Oct-15 Thursday	30-Oct-15 Friday	31-Oct-15 Saturday	01-Nov-15 Sunday
08:00 - 09:00	1,123	1,183	1,948	965	1,377	1,406	1,252
09:00 - 10:00	1,160	1,448	1,664	1,008	1,252	1,471	1,186
10:00 - 11:00	1,283	1,374	1,250	1,141	1,130	1,221	1,167
11:00 - 12:00	1,355	1,459	1,178	1,319	1,236	1,374	1,373
12:00 - 13:00	1,300	1,373	1,027	1,142	1,569	1,232	1,275
13:00 - 14:00	1,595	1,530	971	1,177	1,380	1,186	1,174
14:00 - 15:00	1,451	1,340	1,006	1,272	1,473	1,118	1,095
15:00 - 16:00	1,721	1,373	1,014	1,479	1,491	1,289	1,173
16:00 - 17:00	1,513	1,411	1,134	1,365	1,573	1,231	1,109
17:00 - 18:00	1,430	1,234	968	1,320	1,637	1,353	1,194
18:00 - 19:00	1,129	939	836	1,133	1,542	1,122	1,093
19:00 - 20.00	886	753	682	852	884	880	828
20:00 - 21:00	822	728	644	680	588	651	632
21:00 - 22:00	610	561	504	642	503	707	644
22:00 - 23:00	439	501	435	530	303	488	423
23:00 - 24:00	355	322	330	496	307	455	316
24:00 - 01:00	299	245	216	333	319	313	224
01:00 - 02:00	284	224	204	257	281	321	259
02:00 - 03:00	196	235	172	225	380	421	234
03:00 - 04:00	216	215	290	239	248	303	283
04:00 - 05:00	209	251	262	246	203	250	260
05:00 - 06:00	202	356	296	219	263	348	306
06:00 - 07:00	440	481	492	381	276	599	580
07:00 - 08:00	672	838	714	584	525	845	761
Total (nos.)	**20,690**	**20,374**	**18,237**	**19,005**	**20,740**	**20,584**	**18,841**

Factors for seasonal corrections were also obtained from the sale of fuel (petrol for passenger vehicles like cars, two wheelers and diesel for commercial vehicles like light commercial vehicles, trucks and larger vehicles) at fuel pump stations available on alternate roads to the proposed Expressway. Derived correction factors for the Survey Period are shown on Table 4.9.

Table 4.9: Seasonal Correction Factor for Traffic on Existing Alternate Routes

Seasonal Correction Factors			
S.No.	**Section**	**SCF-Petrol**	**SCF-Diesel**
1	National Highway - NH2	1.009	1.053
2	National Highway - NH28 (NH-27)	0.994	1.215
3	National Highway – NH56 (NH-731) (Sultanpur – Jaunpur)	1.112	0.961
4	National Highway – NH56 (NH-731) (Jaunpur –Varanasi)	0.899	1.023
Overall		**1.003**	**1.063**

Note: The details of the sale of fuel is given in Appendix

Annual Average Daily Traffic (AADT) on existing alternate routes to the proposed expressway is established considering the Seasonal Correction Factors of 1.003 for Passenger Vehicles and 1.063 for commercial vehicles – results (**Annual Average Daily Traffic - ADT**) are shown on Table 4.10.

Table 4.10: Annual Average Daily Traffic (AADT) on Existing Alternate Roads

Survey Location of Classified Count	Vehicle Classification	Restricted Traffic		Tollable Traffic											Restricted Traffic		Toll Exempted Traffic			Slow Moving Traffic				Summary				Total Traffic	
	Date / Period of Classified Count	2 Wheeler	3 Wheeler	Car/ Jeep/ Van	Taxi	Mini LCV	Mini Bus	Private Bus	Govt. Bus	LCV	2-Axle Truck	3-Axle Truck	MAV (4 to 6)	OSV (More than 6)	Tractor	Tractor Trailer	Govt. / Police Car	Ambulance / Police Mini Bus	Military Truck/ Fire Brigade	Bi-Cycle	Cycle-Rickshaw	Animal-Drawn	Hand-Drawn	Slow Moving Traffic	Toll Exempted Traffic	Restricted Traffic	Tollable Traffic	Total Vehicles	Total Passenger Car Units
	Base Year (2015)	*0.5*	*1*	*1*	*1*	*1*	*1.5*	*3*	*3*	*1.5*	*3*	*3*	*4.5*	*4.5*	*1.5*	*4.5*	*1*	*1.5*	*3*	*0.5*	*2*	*5.5*	*6*	*(Vehicle nos.)*					*PCUs*
Km 483, NH2	26th Oct - 1st Nov	3681	880	3657	272	921	267	181	310	748	589	767	539	7	97	205	14	67	29	996	14	5	0	1014	110	4863	8258	14245	18909
Km 39 on NH28	26th Oct - 1st Nov	6121	377	6947	877	1391	126	170	537	1139	642	2037	1269	12	79	170	29	244	24	407	23	14	0	444	297	6747	15147	22635	32146
Km 81 on NH56	26th Oct - 1st Nov	4511	487	1590	502	555	57	55	114	418	180	1041	617	13	46	95	12	64	6	2011	34	13	0	2057	82	5139	5142	12421	14870
Km 211 on NH56	26th Oct - 1st Nov	7495	302	3629	413	905	39	37	363	1035	687	1838	1157	3	31	159	4	121	12	1801	59	22	0	1881	137	7987	10105	20111	26728
Km 143 on NH28	3rd Nov - 9th Nov	4021	196	3681	308	843	99	160	459	1207	661	2463	2559	4	103	61	9	170	18	405	4	2	0	411	197	4381	12444	17434	32728
Km 84 on NH29	3rd Nov - 9th Nov	2395	557	1601	179	326	88	62	158	245	281	621	405	2	30	79	5	23	6	1429	5	9	0	1444	34	3061	3966	8504	10786
Km 133 on NH233	3rd Nov - 9th Nov	2717	128	455	32	249	20	57	3	65	18	72	10	2	21	30	2	9	2	1306	53	12	0	1371	12	2896	982	5261	3846
Km 13 on SH13	3rd Nov - 9th Nov	3924	364	581	240	329	25	113	1	134	69	530	165	8	40	143	27	16	18	1129	11	3	0	1144	62	4471	2194	7870	8043
Km 38 on NH24B	29th - 31st Oct	3532	182	3623	256	853	94	28	512	511	326	774	483	17	49	184	1	221	13	204	3	4	0	210	235	3947	7478	11869	16159
Km 38 on NH29	5th Nov - 7th Nov	2636	690	1929	215	382	95	135	219	389	101	435	290	2	53	74	1	30	0	1185	6	3	0	1194	32	3453	4194	8873	10330
Km 110 on NH56	29th - 31st Oct	2883	398	1592	181	558	8	15	211	566	317	1342	484	5	19	59	1	77	2	1639	19	2	0	1660	80	3359	5278	10377	14173
Km 33 on NH232	29th - 31st Oct	2591	66	336	44	115	57	7	7	40	25	39	7	4	14	58	0	8	0	928	28	9	0	965	9	2729	679	4382	3136
Km142.5 on NH56	28th Oct	5988	709	2955	407	737	45	48	272	796	346	1725	655	20	26	118	51	9	0	1783	71	31	0	1885	60	6841	8004	16789	21182
Paroma, NH96	5th Nov	1345	110	1354	67	338	38	33	76	390	161	617	409	3	13	39	18	0	0	725	16	4	0	745	18	1507	3487	5757	8332
Kusadhana,SH67	5th Nov	1759	217	1297	73	258	132	47	98	114	88	540	272	3	11	50	18	0	2	598	3	28	0	629	20	2037	2922	5608	7444
Bhawarkol, NH19	6th Nov	2473	198	2091	161	710	148	69	12	740	91	472	227	5	22	17	8	0	2	609	0	1	0	610	10	2710	4726	8056	9136
Haldharpur, SH34	6th Nov - 12th Nov	2867	238	2408	236	440	64	82	124	408	113	536	302	7	36	83	18	0	0	716	16	7	0	739	18	3224	4721	8702	10302

* New number of NHs are followed by closed parentheses NH 28 (NH 27); NH 56 (NH-731); NH 29 (NH-24); NH 233 (NH-28); NH 24B (NH-30); NH 29 (NH-24); NH 232 (NH-128); NH96 (NH-330); NH19 (NH-31)

Expansion Factors were derived from the percentage of tollable vehicles interviewed during the origin and destination surveys to that of the AADT arrived for respective existing alternate roads. The values of expansion factors for tollable traffic type at each of the origin & destination survey locations are given shown on Table 4.11.

Table 4.11: Expansion Factors for O-D Matrices (Tollable Traffic)

Survey Location	Tollable Vehicles	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
OD1	% Interviewed	21.30	11.03	25.94	3.02	9.73	36.92	25.13	19.88
	Expansion Factor	4.70	9.07	3.86	33.07	10.28	2.71	3.98	5.03
OD2	% Interviewed	13.47	67.90	7.15	12.47	23.69	27.86	12.25	12.74
	Expansion Factor	7.43	1.47	13.98	8.02	4.22	3.59	8.16	7.85
OD3	% Interviewed	40.85	100.0	40.40	31.63	28.44	60.21	21.30	32.81
	Expansion Factor	2.45	1.00	2.48	3.16	3.52	1.66	4.70	3.05
OD4	% Interviewed	23.78	100.0	6.52	31.13	39.01	58.95	29.07	42.56
	Expansion Factor	4.21	1.00	15.33	3.21	2.56	1.70	3.44	2.35
OD5	% Interviewed	19.69	100.0	15.70	1.90	13.22	24.80	11.26	18.33
	Expansion Factor	5.08	1.00	6.37	52.51	7.56	4.03	8.88	5.46
OD6	% Interviewed	30.76	100.0	23.53	33.22	33.71	31.64	26.90	14.80
	Expansion Factor	3.25	1.00	4.25	3.01	2.97	3.16	3.72	6.76

O-D Matrices

O-D matrices for Tollable Traffic (vehicle types as listed in Table 4.11) are generated from the information recorded during the Origin-Destination Surveys, and expanded by multiplying with corresponding Expansion Factors to arrive at the Expanded O-D Matrix (Vehicle Type, Existing Alternate Road) and results are annexed to Appendix.

Candidate Traffic for Proposed Expressway (All trip lengths)

Candidate Traffic is that traffic on the alternate existing roads whose travel pattern (origin-destination) can be serviced by the proposed expressway. Origin-Destination pairs that can be serviced by the proposed expressway are extracted from the Expanded O-D Matrix, and thus form the Candidate Traffic for Proposed Expressway. Derived *"Candidate"* traffic for Tollable Traffic are shown on Tables 4.12 to Tables 4.17. For cars and trucks, these volumes were obtained from:

(a) a careful examination of the Consultants' origin and destination data and the elimination of trips that would not find travel by the proposed Expressway useful (mainly trips to and from Zones North/South perpendicularly to the proposed Expressway alignment); and

(b) by multiplying the above-derived numbers by the earlier-described Expansion Factors and applying the appropriate Seasonal Correction Factors.

For buses, these volumes were obtained from an examination of advertised origins and destinations. Only those services known to be on journeys to and from points beyond Chand Sarai and Azamgarh & Haidariya were considered and, of these, the candidate traffic was deemed to comprise:

(a) more than 80% of the long-distance "stage-carrying" Government sponsored services – Lucknow is an important on-route destination and it is likely that many would choose to visit the city; and

(b) 90% of the long-distance "private-hire" buses – which services generally have no need to make intermediate stops.

Table 4.12: Candidate Traffic (All trip lengths) from Survey Location OD1

Movements between Nodes	Car	Mini Bus	Bus	Mini – LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
Through	93	21	12	0	65	31	30	4
AR1A	420	26	41	25	56	32	35	15
AR1B	0	0	0	0	0	0	0	0
AR1C	260	16	36	354	202	107	129	86
AR1D	24	0	0	45	17	2	3	0
AR1E	9	0	0	0	0	2	0	0
AR1D'	99	32	12	25	25	19	57	60

Table 4.13: Candidate Traffic (All trip lengths) from Survey Location OD2

Movements between Nodes	Car	Mini Bus	Bus	Mini – LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
A – G	136	21	12	0	65	31	30	4
A – G'	14	26	41	25	56	32	35	15
A – F	115	0	0	0	0	0	0	0
A – E	239	16	36	354	202	107	129	86
A – D	284	0	0	45	17	2	3	0
A – C	741	0	0	0	0	2	0	0
A – C'	725	32	12	25	25	19	57	60
A ' – C	0	21	12	0	65	31	30	4
A' – C'	136	21	12	0	65	31	30	4
A – G	14	26	41	25	56	32	35	15
A – G'	115	0	0	0	0	0	0	0

Table 4.14: Candidate Traffic (All trip lengths) from Survey Location OD3

Movements between Nodes	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
A – G	19	0	0	3	49	12	204	198
A – F	10	0	0	3	3	4	34	3
A – E	0	0	0	3	0	0	9	0
A – D	386	26	60	91	178	64	352	181
C – G	37	1	0	3	16	7	47	39
C – F	3	0	0	0	0	3	9	0
C – E	0	0	3	0	0	0	0	6
C – D	1530	27	103	416	144	78	290	143

Table 4.15: Candidate Traffic (All trip lengths) from Survey Location OD4

Movements between Nodes	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
A – G	0	0	0	3	24	30	125	106
A – F	0	0	0	0	0	0	4	0
A – E	114	1	54	22	110	63	262	157
A – D	140	3	21	43	105	60	225	123
A – C	1268	14	68	401	275	149	489	274
A – B	2317	18	255	377	453	339	612	417

Table 4.16: Candidate Traffic (All trip lengths) from Survey Location OD5

Movements between Nodes	Car	Mini Bus	Bus	Mini – LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
A – G	110	0	17	0	16	38	54	196
A – G’	0	0	0	0	43	42	285	152
A – F	27	1	0	0	0	0	36	11
C – G	47	0	0	0	31	56	43	81
C – G’	35	0	0	0	0	12	36	19

Table 4.17: Candidate Traffic (All trip lengths) from Survey Location OD6

Movements between Nodes	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
A – G	4	0	0	6	2	15	17	0
A – F	16	2	0	148	106	130	235	112
F – G	31	0	0	6	16	9	44	46
C – F	37	0	4	9	4	6	12	6
C – G’	96	11	4	27	26	16	50	32

Candidate Traffic for Proposed Expressway (minimum 100 Km trip lengths)

However, the Consultants chose to restrict the generate the Candidate Traffic of those traffic whose trip lengths would be minimum of 100 Kms, this is basically to reflect the users choice of not intending to the Expressway for shorter trip length (shorter trip lengths may not incur time savings / perceived cost savings, i.e. does not trigger route choice).

The Consultant's Distance Matrix between Zones (Origins & Destinations) as shown on Table 4.2 served as base matrix, with Trip Matrix for O-D pairs as shown in Table 4.18 was used to generate the Candidate Traffic between designated Toll Nodes of the Proposed Expressway.

While movement "AE" shown in the matrix from Zone 1 to Zone 5 represents traffic that will use the Expressway from Node A to Node E and "EA" shown in the matrix from Zone 5 to Zone 1 represents traffic that will use the Expressway from Node E to Node A.

Trip Matrix was matched with Expanded OD Matrices to arrive the Candidate Traffic (minimum 100 Km Trip Lengths); Movement Matrix-Tollable Traffic results are shown on Tables 4.19 to Tables 4.26

Table 4.18: Trip Matrix for O-D Pairs

Zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
1					AE	AE	AD	AE			AD	AG			AF	AH	AH	AF	AH	AI	AK	AJ	AH	AH						AL	AL	AL	AH	AK	AL	AL	AL	AL													AK			AE		AJ	AF	AL
2					AE	AE	AD	AE			AD	AG			AF	AH	AH	AF	AH	AI	AK	AJ	AH	AH						AL	AL	AL	AH	AK	AL	AL	AL	AL													AK			AE		AJ	AF	AL
3					AE	AE					AD	AG			AF	AH	AH	AF	AH	AI	AK	AJ								AL	AL	AL	AH	AK				AL													AK			AE		AJ	AF	AL
4															DF	DH	DH	DF	DH	DI	DK	DJ								DL	DL	DL	DH	DK				DL													DK					DF	DL
5	EA	EA	EA			AE		AE				AG			AF	AH	AH	AF	AH	AI	AK	AJ	AH						AL	AL	AL	AH	AK	AL	AL	AL	AL													AK			AE		AJ	AF	AL
6	EA	EA	EA		EA					EB						FH	FH		FH	FI	FK	FJ				EA			EA	EA	FL	FL	FL	FH	FK	FL	FL	FL	FL												FK	EA	EB			FJ		FL
7	DA	DA								DB						FH	FH		FH	FI	FK	FJ								FL	FL	FL	FH	FK	FL	FL	FL	FL													FK	DA	DB			DJ		DL
8	EA	EA			EA					EB						FH	FH		FH	FI	FK					EA		EA	EA	EA	FL	FL	FL	FH	FK	FL	FL	FL	FL				EA	EA	EA	EA					FK	EA	EB					
9																DH	DH		DH	DI	DK										DL	DL		DH	DK				DL																			
10						BE	BD	BE				BG		BE				BF	BH	BI	NK	BJ	BH	BH						BL	BL	BL			BL	BL	BL	BL															BE		BJ	BF	
11	DA	DA	DA									EG							EH	EI	EK	EJ	EH	EH						EL	EL	EL			EL	EL	EL																	EJ			
12	GA	GA	GA		GA					GB	GE										IK				GE	GA		GA	GA	GA													GA	GA	GA	GA					GA	GB					
13																FH	FH																																									
14										EB																																													EB				
15	FA	FA	FA	FD	FA																									HL	HL	HL			HL	HL	HL															FA					
16	HA	HA	HA	HD	HA	HF	HF	HF	HD				HF																		JL	JL	JK	JK	JL	JL	JL																				
17	HA	HA	HA	HD	HA	HF	HF	HF	HD				HF																														HA	HA	HA	HA						HA	HB	HE	HD			
18	FA	FA	FA	FD	FA					FB									GH	GI	GK	GJ	GH			FA	FA	FA	FA	FA	GL	GL	GL		GK	GL	GL	GL				FA	FA	FA	FA						FA	FB	FE	FD	FJ		
19	HA	HA	HA	HD	HA	HF	HF	HF	HD	HB	HE							HG			IL	IJ	IH		HE	HA	HA	HA	HA	HA	IL	IL	IL			IL	IL	IL				HA	HA	HA	HA						HA	HB	HE	HD	HJ	HG	
20	IA	IA	IA	ID	IA	IF	IF	IF	ID	IB	IE							IG								JA	JA	JA	JA	JA	JL	JL	JL			JL	JL	JL				JA	JA	JA	JA						JA	JB	JE	JD		JG	
21	KA	KA	KA	KD	KA	KF	KF	KF	KD	KN	KE	KI						KG	LI							KA	KA	KA	KA	KA												KA	KA	KA	KA						KA	KB	KE	KD		KG	
22	JA	JA	JA	JD	JA	JF	JF			JB	JE							JG	JI						JE			JA	JA	JA												JA	JA	JA	JA						JA	JB	JE			JG	
23	HA	HA			HA					HB	HE							HG	HI						HE			HA																								HA	HB				HG	
24	HA	HA								HB	HE																																											HA	HB					
25												EG							EH			EJ	EH							EL	EL	EL			EL	EL	EL																	EJ			
26						AE		AE				AG						AF	AH	AJ	AK									AL	AL	AL																						AE			AF	
27																		AF	AH	AJ	AK												AH	AK																						AF	
28								AE				AG						AF	AH	AJ	AK	AJ	AH							AL	AL	AL			AL	AL	AL																	AJ	AF	
29						AE		AE				AG						AF	AH	AJ	AK	AJ								AL	AL	AL	AH	AK																					AE		AJ	AF	
30						AE		AE				AG						AF	AH	AJ	AK	AJ								AL	AL	AL	AH	AK	AL	AL	AL																	AE		AJ	AF	
31	LA	LA	LA	LD	LA	LF	LF	LF	LD	LB	LE				LH			LG	LI	LJ					LE	LA		LA	LA	LA												LA	LA	LA	LA						LA	LB	LE	LD		LF	
32	LA	LA	LA	LD	LA	LF	LF	LF	LD	LB	LE				LH	LJ		LG	LI	LJ					LE	LA		LA	LA	LA												LA	LA	LA	LA						LA	LB	LE	LD		LF	
33	LA	LA	LA	LD	LA	LF	LF	LF		LB	LE				LH	LJ		LG	LI	LJ					LE	LA		LA	LA	LA																					LA	LB	LE			LF	
34	HA	HA	HA	HD	HA	HF	HF	HF	HD							KJ											HA		HA	HA																HA	HA	HA			HA		HE	HD			
35	KA	KA	KA	KD	KA	KF	KF	KF	KD							KJ		KG									KA		KA	KA																HA	HA	HA			HA		HE	HD		HF	
36	LA	LA			LA	LF	LF	LF		LB	LE				LH	LJ		LG	LI	LJ					LE			LA		LA																					LA	LB	LE			LF	
37	LA	LA			LA	LF	LF	LF		LB	LE				LH	LJ		LG	LI	LJ					LE			LA		LA																					LA	LB	LE			LF	
38	LA	LA			LA	LF	LF	LF		LB	LE				LH	LJ		LG	LI	LJ					LE			LA		LA																					LA	LB	LE			LF	
39	LA	LA	LA	LD	LA	LF	LF	LF	LD	LB																																											HA	HB	HE	HD			
40																																																								AF	
41																																																									
42																																																									
43								AE				AG					AH	AF	AH	AJ	AK	AJ								AL	AL																							AJ	AF	
44								AE				AG					AH	AF	AH	AJ	AK	AJ								AL	AL																							AJ	AF	
45								AE				AG					AH	AF	AH	AJ	AK	AJ								AL	AL																							AJ	AF	
46								AE				AG					AH	AF	AH	AJ	AK	AJ								AL	AL																							AJ	AF	
47																																	AH	AH																							
48																																	AH	AH																							
49																																	AH	AH																							
50																																																									
51	KA	KA	KA	KD	KA	KF	KF	KF																																														HA		HE	HD			
52						AE	AD	AE				AG			AF		AH	AF	AH	AJ	AK	AJ	AH	AH						AL	AL	AL	AH	AH	AL	AL	AL	AH													AH			AE		AJ	AF	AL
53						BE	BD	BE				BG		BE			BH	BF	BH	BJ	BK	BJ	BH	BH						BL	BL	BL			BL	BL	BL	BH															BE		BJ	BF	BL
54	EA	EA	EA		EA					EB						EH	EF	EH	EJ	EK	EJ				EA			EA	EA	EL	EL	EL	EH	EH	EL	EL	EL	EH													EH	EA	EB			FJ		FL
55																DH	DF	DH	DJ	DK										DL	DL		DH	DH				DH													DH					AF	AL
56	JA	JA	JA		JA	JF	JD			JB	JE						JF	JH							JE			JA	JA	JA												JA	JA	JA	JA						JA	JB	JF			JG	
57	FA	FA	FA	FD	FA					FB								GH	GJ	GK	GJ	GH				FA	FA	FA	FA	FA	FL	FL	FL		FH	FL	FL	FL		FA		FA	FA	FA	FA						FA	FB		FA	GJ		
58	LA	LA	LA	LD	LA	LF	LD																																													LA	LB	LF	LA			

Table 4.19: Movement Matrix (Minimum 100 Km Trip Lengths) – Car

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	682	1023	399	74	431	54	18	81	39
B	0	0	0	0	305	8	0	10	0	13	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	721	0	0	0	0	14	0	0	0	0	0	0
E	630	137	0	0	0	0	16	6	0	4	0	7
F	444	0	0	7	0	0	0	27	0	3	34	6
G	118	8	0	0	4	0	0	0	0	4	0	0
H	735	16	0	0	12	31	0	0	0	0	0	0
I	136	7	0	0	0	0	0	4	0	78	0	12
J	52	0	0	7	19	0	0	0	14	0	0	8
K	92	0	0	0	0	0	0	0	0	0	0	0
L	142	2	0	5	2	29	0	0	0	0	0	0

Table 4.20: Movement Matrix (Minimum 100 Km Trip Lengths) –Mini Bus

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	22	12	11	1	27	0	0	16	11
B	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0	0	0	0	0
E	16	2	0	0	0	0	0	1	0	0	0	0
F	13	0	0	0	0	0	0	0	0	0	0	1
G	3	0	0	0	0	0	0	0	0	0	0	0
H	37	0	0	0	0	2	0	0	0	0	0	0
I	7	0	0	0	0	0	0	8	0	2	0	0
J	0	0	0	0	0	0	1	0	1	0	0	0
K	4	0	0	0	0	0	0	0	0	0	0	0
L	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.21: Movement Matrix (Minimum 100 Km Trip Lengths) – Bus

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	28	60	66	25	83	12	0	17	0
B	0	0	0	0	0	0	2	16	0	0	**0**	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	71	0	0	0	0	0	0	0	0	0	0	0
E	39	6	0	0	0	0	2	9	0	0	0	0
F	71	0	0	0	0	0	0	3	0	0	0	0
G	21	0	0	0	0	0	0	0	0	0	0	0
H	66	0	0	0	9	0	0	0	0	0	0	0
I	26	0	0	0	0	0	0	0	0	0	0	0
J	20	0	0	0	4	0	0	0	4	0	0	0
K	31	0	0	0	0	0	0	0	0	0	0	0
L	20	0	0	0	0	0	0	0	0	0	0	0

Table 4.22: Movement Matrix (Minimum 100 Km Trip Lengths) –Mini LCV

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	11	176	24	23	50	0	16	0	9
B	0	0	0	0	8	0	0	16	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	65	0	0	0	0	0	0	0	0	0	0	0
E	333	35	0	0	0	0	0	4	0	6	0	0
F	0	25	0	0	0	0	0	0	0	0	0	0
G	37	0	0	0	9	0	0	0	0	0	0	0
H	99	8	0	0	3	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	12	0	3	0	6
J	6	0	0	0	0	0	0	0	12	0	0	3
K	3	0	0	0	0	0	0	0	0	0	0	0
L	19	0	0	0	0	3	0	0	0	0	0	0

Table 4.23: Movement Matrix (Minimum 100 Km Trip Lengths) – LCV

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	71	118	35	95	199	0	19	0	59
B	0	0	0	0	8	3	0	0	0	0	0	10
C	0	0	0	0	0	0	0	0	0	0	0	0
D	65	0	0	0	0	0	0	0	0	0	0	0
E	141	5	0	0	0	0	0	0	0	0	0	19
F	53	0	0	0	0	0	0	19	4	0	0	3
G	97	0	0	0	4	0	0	0	0	0	0	0
H	126	0	0	0	8	24	0	0	7	0	0	0
I	50	0	0	0	0	0	0	2	0	12	0	2
J	5	0	0	0	0	0	0	0	4	0	0	0
K	36	0	0	0	0	0	0	0	0	0	0	0
L	91	8	0	0	16	8	0	0	0	7	0	0

Table 4.24: Movement Matrix (Minimum 100 Km Trip Lengths) – 2-Axle Truck

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	41	58	34	27	82	2	25	16	55
B	0	0	0	0	0	6	0	6	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	58	0	0	0	0	0	0	0	0	0	0	0
E	81	6	0	0	0	0	0	3	0	3	0	31
F	26	0	0	0	0	0	0	13	3	3	0	3
G	13	1	0	0	0	0	0	0	0	3	0	0
H	78	0	0	0	2	9	0	0	0	0	0	0
I	17	0	0	0	0	6	0	6	0	3	0	0
J	3	0	0	0	3	0	0	0	7	0	0	9
K	15	0	0	0	0	0	0	0	0	0	0	0
L	54	10	0	0	17	5	0	0	0	0	0	0

Table 4.25: Movement Matrix (Minimum 100 Km Trip Lengths) – 3-Axle Truck

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	133	164	238	110	249	14	23	68	199
B	0	0	0	0	7	7	0	0	0	7	0	7
C	0	0	0	0	0	0	0	0	0	0	0	0
D	184	0	0	0	0	0	0	0	0	0	0	5
E	280	48	0	0	0	0	5	5	0	0	0	0
F	156	0	0	0	0	0	0	70	7	5	15	15
G	67	0	0	0	17	0	0	0	0	4	0	0
H	263	14	0	0	30	45	0	0	13	0	0	0
I	0	0	0	0	0	0	0	4	0	8	0	4
J	26	0	0	4	3	0	0	0	24	0	0	8
K	32	0	0	0	0	0	0	0	0	0	0	0
L	208	58	0	0	0	22	0	0	7	13	0	0

Table 4.26: Movement Matrix (Minimum 100 Km Trip Lengths) – MAV

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	0	0	94	118	102	75	245	0	16	25	212
B	0	0	0	0	0	0	0	9	0	0	0	7
C	0	0	0	0	0	0	0	0	0	0	0	0
D	217	0	0	0	0	0	0	0	0	0	0	0
E	140	14	0	0	0	0	25	6	0	0	0	32
F	64	0	0	0	0	0	0	32	7	0	9	25
G	43	0	0	0	9	0	0	0	0	4	0	0
H	172	7	0	0	9	36	0	0	13	0	0	0
I	8	0	0	0	0	0	0	4	0	8	0	4
J	4	0	0	0	3	0	0	0	24	0	0	8
K	41	0	0	0	0	6	0	0	0	0	0	0
L	153	9	0	0	23	28	0	0	7	13	0	0

From the above tables; the Candidate Traffic (minimum 100 Km Trip Lengths) i.e. the sectional traffic loads on each section of the proposed Expressway i.e. between Node “A” to Node “L” is shown in Table 4.27

Table 4.27: Candidate Traffic (Minimum 100 Km Trip Lengths) for Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A - B	5871	190	656	870	1259	684	2413	1728	13670	27945
B - C	6376	191	680	963	1294	713	2562	1773	14553	29413
C - D	6376	191	680	963	1294	713	2562	1773	14553	29413
D - E	5006	159	581	887	1157	614	2255	1463	12122	24801
E- F	2981	131	500	355	933	529	1816	1299	8545	19313
F - G	2241	110	366	309	901	503	1594	1276	7300	17199
G - H	2024	107	315	240	705	465	1399	1129	6385	15101
H - I	759	48	130	73	338	279	741	631	3000	7700
I - J	663	36	96	83	293	254	745	640	2810	7407
J - K	457	32	68	43	261	214	663	603	2340	6487
K - L	251	12	20	40	224	182	548	522	1799	5243

4.2.4 Other Traffic Survey Data

Analyses of other data derived from the Origin and Destination Surveys (and used mainly in the financial and economic appraisals) are provided on Tables 2.8(i) to 2.8(vi) of Appendix (freight statistics) and Tables 2.19(i) to 2.19(vi) of Appendix (passenger freight statistics). For passengers, these data relate to the average occupancy of vehicles, trip purpose and the origin and destination of trips that are from/to Lucknow & Azamgarh and the immediate Study area. For freight, these data refer to commodities carried, average loads and the origins and destination of trips that are from/to Lucknow and Azamgarh and the immediate Study area.

4.2.5 Speed-Time Surveys

Estimated journey times (as recorded from truck drivers) for movements between designated Zones using the presently available network of alternative routes to the proposed Expressway alignment is shown for *"trucks routes"* on Tables 4.28.

Travel times have been estimated using passenger car for *"peak"* travel times and for those portions of each trip on toll roads, roads with free access from sides and urban sections on these roads. It can be seen that, during peak periods, the full length journeys are:

(a) ***for 4-lane configuration toll roads****:* requiring 41 minutes to complete the 54.45 km between Ahmadpur and Ronahi toll booths on National Highway NH28 (NH-27) – implying a spot speed of about **79.68 km/hour;** however, the **journey speeds** observed on alternate routes *(journey combines 4-lane National Highways, 2- lane State Highways & Major District Roads)* in the project influence areas, the average journey speed falls to **63.04 Km/hour**

(b) ***for 2-lane configuration in rural areas with free access to road from either sides****:* requiring 125 minutes to complete the average 112 km between Faizabad outer point and Azamgarh outer point – implying an average speed of about **53.77 km/hour**.

(c) ***for 2-lane/4-lane configuration in rural areas with heavily built up areas*** *:* requiring 14 minutes to complete the average 7.65 km within Faizabad urban area on Faizabad Azamgarh Road – implying an average speed of about **32.76 km/hour**.

Table 4.28: Average Journey Speed (Km/hour) for Trucks between Zones

Zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
1					43	46	54	52			76	26			63	61	61	57	60	62	61	57	57	55							56	60	59	63	62	62	60	60	56												56			46		57	57	62
2					64	60	59	57			60	53			63	62	61	57	61	62	61	59	60	57							56	58	60	63	62	63	61	61	56												56			60		59	57	62
3					57	58					55	60			58	58	58	58	61	80	61	64							58	63	64	60	60				57												54			58		64	58	60
4															59	60	60	56	55	54	54								51	56		61	60				56												56						56	61
5						49		50				46			60	59	59	51	52	51	52	53	47			68			71	55	50	54	52	61	60	59	55	55	56												55			49		53	51	60
6										53						54	56		53	52	53	54				66			60	63	50	55	52	58	59	57	56	56	55												54	46	53			54		59
7										53						55	60		54	53	53	55									51	56	52	58	59	57	56	56	55												54	54	53			55		59
8										52							49		52	51	52					66		56	62	64	50	54	53	53	56	58	57	57	54				62	61	65	65					54	52	52					55
9																59	59		62	61	60									56	61		60	60				56																				55
10												58		51				60	62	63	62	58	58	57							56	61	57			60	58	58	56														53		58	60	62
11												53							57	60	60	53	52	53							53	54	54			58	57	57													76			53		61
12																				47	50				49	67		59	58	65												68	61	65	65						26	58					53
13																51	54																																							
14																																																									51					54
15																															48	49			54	54	54																63			59			
16																															42	46	60	60	52	53	53															61		54	60			
17																																												65	62	64	64							61		56	60			
18																			49	49	50	43	36			62	60	56	59	54	42	49	48		44	53	54	54		63			64	52	64	64						57	60		56	43		
19																					49	36			47	61	58	75	59	53	64	48	48			54	54	54		61			62	60	63	63						60	62	53	55	36	49	
20																										35	57	52	59	53	42	48	75			56	55	55					63	60	64	64						62	63	52	54		49	
21																										62	59	53	61	53													64	62	64	64						61	62	53	54		50	
22																									44			50	61	63													65	62	65	65						57	58	54			43	
23																									42			57																								57	58				36	
24																																																							55	57					
25																															51	50	54			57	53	53																	44			
26																															60	66	66																							66		62	
27																																		59	57																						60	
28																															54	52	51			60	58	58																	50	56	
29																															59	53	63	60	58																				60		61	59	
30																															60	62	64	58	52	65	63	63																	63		63	54	
31																																												62	59	62	62						56	56	50	51		42	
32																																												67	63	66	66						60	61	55	56		49	
33																																																				59	57	52			48	
34																																																							65	65	65			63		58	61			
35																																																							65	65	65			62		59	60		44	
36																																																											62	60	57			53	
37																																																											60	58	56			54	
38																																																											60	58	56			54	
39																																																											56	56	55	56			
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53																																																																53		58	60	62
54																																																																	54		59
55																																																																	56	61
56																																																																	43	
57																																																																	
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4.3 Traffic Assignments

Traffic assignments of Candidate Traffic has been done using diversion curve method, wherein a logit model computes expected diversion % based on the ratio of perceived cost on the existing alternate roads and proposed expressway. The perceived cost is the financial vehicle operating cost and the vehicle operating time saving cost including toll charges (if any).

The Consultants have estimated *"generalised"* costs for travel between each of the nodes on the proposed Project and between different origin & destinations while in two comparing circumstances:

(a) when using the presently available alternate through routes; and
(b) when using the proposed expressway (a six lane dual carriageway facility).

These *"generalised"* costs are:

(a) *for buses and trucks:* the **financial costs of travel (including passenger and other time costs)** plus any tolls;

(b) *for cars:* the **perceived costs of travel** (a term applied mainly to private users who are known to make route and modal choice decisions not on total, or even marginal costs, but on the costs of only a few specific items – normally fuel, tyres and time)

Vehicle Operating Costs (VOC) and Vehicle Operating Time (VOT) Costs have been estimated using the relationships presented in IRC Special Publication SP-30 2009, Manual on Economic Evaluation of Highway Projects in India, Indian Road Congress 2009. Perceived cost (VOC + VOT +Toll charges) in Rs/Km computed for different alternate routes (existing condition) vis a vis proposed Expressway (six lane dual carriageway) is shown on separate report on Economic Studies.

According to logit model a vehicle user will shift if the perceived cost on the proposed expressway is lower in comparison to existing road. The diversion equations for carrying out traffic assignment have been adopted from Study on Expressway System Planning, March 1991 done by Wilbur Smith Associates for Ministry of Surface Transport, Govt. of India. The relationships are shown on Table 4.29.

Table 4.29: Diversion Equations used for Analysis

Vehicle	Cost Ratio (CR)	Relationship
Car	CR < 0.634	% Div = 98.75 – ((CR/0.634)*8.125
	0.634 <= CR < 1.465	% Div = 90.625 – ((CR – 0.634)/0.831)*84.375
	1.465 <= CR <=2.00	% Div = 6.25 – ((CR – 1.465)/0.535))*5.25
Bus & Truck	CR < 0.75	% Div = 100 – ((CR/0.75)*5)
	0.75 <= CR < 1.25	% Div = 95 – ((CR-0.75)/0.5)*90
	1.25 <= CR <= 2.00	% Div = ((2-CR)/0.75)*5

Diversion percentages using Cost Ratio relationships as explained in Table 4.29, were estimated for each alternate route versus proposed expressway – results are shown on Annexure to Appendix. Diversion percentages were applied to the Candidate Traffic (All Trip Lengths) as shown in Table 4.12 to 4.17 to arrive at the Tollable Traffic (All Trip Lengths) on each section of the proposed expressway, i.e. sectional traffic (All Trip Lengths) between Node 'A' and Node 'L' is shown in Table 4.30.

Table 4.30: Tollable Traffic (All Trip Lengths) for Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A - B	4536	165	347	1187	920	631	1820	1132	10738	20838
B - C	3820	168	340	1072	903	618	1806	1120	9846	19828
C - D	3820	168	340	1072	903	618	1806	1120	9846	19828
D - E	3853	172	344	1080	907	618	1822	1128	9924	19980
E- F	2823	140	288	945	794	557	1471	890	7908	16120
F - G	2823	140	288	945	794	557	1471	890	7908	16120
G - H	1947	136	219	622	662	467	1155	727	5936	12564
H - I	1532	104	147	371	540	373	895	603	4565	9826
I - J	2049	119	184	467	632	395	1000	662	5509	11361
J – K	1559	98	121	321	513	244	733	542	4131	8529
K - L	1559	98	121	321	513	244	733	542	4131	8529

All the alternate routes are either toll operated Four Lane dual carriageway (NH28 (NH27): Lucknow – Barabanki – Faizabad – Basti; NH24B (NH-30): Lucknow - Raebareli – Allahabad - Varanasi) or under various stages of widening i.e. from existing two lane to four lane standards; for instance the four laning of National Highway 56 from Lucknow to Sultanpur and Varanasi. Similarly state highways which intersect with the proposed Expressway are under various stages of four laning by other State Agencies.

Thus the perceived cost (VOC + VOT +Toll charges) in Rs/Km for different alternate routes (a four lane dual carriageway with free access) vis a vis proposed Expressway (six lane dual carriageway) with restricted access will determine the route choice of the user; the link characteristics adopted here represents better level of service of roads under tolling scenario, as shown on Table 4.31 for calculation of Vehicle Operating Costs – results are shown on Table 4.34

Table 4.31: Link Characteristics for VOC Calculations

Description	Project Road (PR)	Alternate Road (AR)
Lane Configuration	6 lane Dual Carriageway	4 lane dual carriageway
Access Control	Restricted Access	Free Access
Speed (Km/hr)	85	70
Roughness	2500	2500
Rise & Fall (m)	10	10

Toll charges (Rs/km) that is likely to be charged on the proposed Expressway is per UPEIDA Toll Rules, Feb 2010 and subsequent notification dated August 2012, as shown on Table 4.32.

Table 4.32: Toll Charges (Rs/Km) for proposed Expressway

Toll Notifications	Year	Cars	LCV/ Mini Bus	Bus / Truck	HCM/ EME/ MAV (3 to 6 Axles)	Oversized Vehicles (7 or More Axles)
UPEIDA Toll Rules, Feb 2010	**(2009-10)**	0.80	1.30	2.75	4.30	5.25
	(2016-17)*	0.96	1.55	3.28	5.13	6.27
Revised Toll Notification, August 2012	**(2012-13)**	2.10	3.25	6.60	10.10	12.95
	(2016-17)**	**2.30**	**3.55**	**7.21**	**11.04**	**14.15**

Note: *revised rates with WPI as per Toll Rules, 2010; ** values considered for diversion analysis

The toll for the Alternate Road is assumed from the existing toll rates for Allahabad Bypass – shown on Table 4.33.

Table 4.33: Toll Rate (Rs/Km) on Alternate Four Lane Toll Road (Allahabad Bypass)

Toll Notifications	Year (2016-17)	Cars	LCV/ Mini Bus	Bus / Truck	4 to 6 Axle	HCM/EME	7 or More
NHAI Toll Notification, March 2016	Charge (Rs)	175	280	575	890	890	1110
	Length (kms)	84.67	84.67	84.67	84.67	84.67	84.67
	Toll Rate (Rs/Km)	2.067	3.307	6.791	10.511	10.511	13.110

Diversion percentage between Proposed Expressway and alternate four lane toll road as per Cost Ratios – results are shown in Table 4.34

Table 4.34: Diversion of Traffic (minimum 100 Km Trip Length)

Perceived Cost	Car		LCV/ MiniBus		2-Axle Truck	
Roads	PR	AR	PR	AR	PR	AR
VOC (Rs./km)	7.28	6.81	25.32	23.41	23.06	20.94
VOT (Rs./km)	5.04	6.11	3.78	4.59	28.48	34.59
Toll (Rs./km)	2.29	2.07	3.55	3.31	7.21	6.79
Total Cost (Rs./km)	14.62	14.99	32.65	31.30	58.75	62.33
Cost Ratio (PR/AR)	*0.975*		*1.043*		*0.943*	
% Diversion	***55.978***		***49.104***		***59.282***	

Diversion percentages were applied to the Candidate Traffic (minimum 100 Km Trip Lengths) as shown in Table 4.27 to arrive at the Tollable Traffic (minimum 100 Km trip lengths) on each section of the proposed expressway, i.e. sectional traffic (minimum 100 Km trip lengths) between Node 'A' and Node 'L' is shown in Table 4.35.

Table 4.35: Tollable Traffic (minimum 100 Km trip lengths) for Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A - B	3286	93	389	427	618	405	1430	1024	7674	16063
B - C	3569	94	403	473	635	423	1519	1051	8167	16901
C - D	3569	94	403	473	635	423	1519	1051	8167	16901
D - E	2802	78	344	436	568	364	1337	867	6797	14246
E- F	1669	64	296	174	458	314	1077	770	4823	11152
F - G	1254	54	217	152	442	298	945	757	4119	9936
G - H	1133	53	187	118	346	276	829	669	3611	8737
H - I	425	24	77	36	166	165	439	374	1706	4473
I - J	371	17	57	41	144	151	442	380	1602	4311
J – K	256	16	41	21	128	127	393	358	1338	3782
K - L	141	6	12	19	110	108	325	309	1030	3060

4.4 Diverted and Generated Traffic

4.4.1 Diverted Traffic

In this Study, the term "diverted" traffic refers to traffic which has diverted from other modes. Traffic diverting from other roads was, of course, considered above.

Although rail freight traffic is growing, the modal-share of surface transport that the railways enjoy has fallen, nationally, from about 78.45% in 1955 to 26% in 2001. The railways although reporting operating expenses in excess of operating expenditures are, also, not recovering sufficient revenue for needed capital investments and, when these items are taken into account, it is estimated that the users are being subsidised by the equivalent of about 20% of current tariffs. Also the growth of Rail Freight and Road Freight in terms of Billion Tonnes Kilo Meters (BTKM) is 4% and 9% respectively from 1950-51 to 2000-01 (five decades).

As the nascent Indian Expressway system grows and, as the quality-of-service offered by road transport companies grows in-line, it is likely that there will be further shifts away from rail and towards road. This has been the experience of other countries. Additional shifts towards road transport will also occur if the railways are required to recover their full capital expenditures from users. The share of road will also continue to increase given the highly competitive nature of road transport, convenience and flexibility in tariffs, and the capability of road to handle smaller loads.

The Consultants were, unfortunately, unable to obtain data from North/North Eastern Railways regarding the volumes of passengers and nature and volumes of freight on long distance East-West routes through Lucknow. While the general trend away from rail will undoubtedly continue, it can be seen that almost all rail freight movements along the project corridor are bulk and that, as such, these are not cargoes likely soon (or ever) to shift to the proposed expressway.

It is, moreover, noted that, except for occasional bulk raw material deliveries, agro processing, food processing, textiles, leather based industry, handloom and handicrafts, sports goods, bio-technology, mineral based industry, tourism and IT and ITeS industries, including software, captive business process outsourcing (BPO) and electronics industries now dominating the Uttar Pradesh economy, have high-value inputs and outputs, generally unsuited to rail transport.

The Consultants' interviews with hauliers operating near LDA Colony adjacent to Kanpur road, i.e. transport nagar of Lucknow, suggest that most of these industries are already relying mostly on road transport. Only road haulage can provide these industries, many of which are undertaking specific elements in wider global production processes, with the sufficiently fast, reliable, door-to-door services they need. (And in this regard, the Consultants have noted also that a high proportion of the road hauliers they interviewed stated that their customers would be prepared to pay additional tariffs for even faster and/or even more reliable delivery times.)

For the purposes of this Study, the Consultants have, therefore, assumed no immediate shift from rail to road. Any long term trend in the shift from rail to road will, of course, have been accounted for in the earlier described forecasts for natural growth.

The share of inland waterways and pipelines, which are both energy efficient modes of transport have relatively lower chances of being operative in the next few decades and hence not being projected and its impact in this report.

4.4.2 Generated Traffic

The project road, which will comprise various elements of an Expressway from Chand Sarai (District Lucknow) to Haidariya (District Ghazipur) and which will have restricted access, is of itself unlikely to cause the generation of much locally-based traffic. There are, however, four elements of generated traffic that should be considered:

(a) *some increase in traffic will occur from area development induced between Node G and Node H near Azamgarh* and the average proportion of total journey on the proposed Expressway, the percentage savings in perceived costs for cars and of financial costs for trucks, the presumed elasticity of demand with generalised costs (a value of 1.5 has been taken for calculation) and are shown on Table 4.36. The forecast opening year volumes of generated traffic are:

Table 4.36: Generated Traffic (2015) between Node G & Node H

Movements between Nodes	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
G – H	567	26	93	59	173	138	415	335

(b) *some increase in traffic will occur from reduced journey times on long-distance trips from, say, Delhi and Agra in the North West to Patna & Kolkata in the South East due to the proposed Four Lane of the Bridge across river Ganges; establishing Commercial Movement between Bharauli (NH19/NH31) and Buxar (NH84)* - The forecast volumes of such traffic are based on DPR report prepared by under the aegis of NHAI for four laning of Patna – Arrah – Buxar (NH30 & NH84/NH922) and the average proportion of total journey on the proposed Expressway will be between Haidariya (11 km from Bharauli) and Azamgarh, the percentage of savings in perceived costs for cars and financial costs for trucks, the presumed diversion shall be same as the diversion between four lane road with free access from either sides and six lane dual carriageway with restricted access like the proposed expressway. The Candidate Traffic (Arrah-Buxar) Traffic Projected for 2015 is shown on Table 4.37

Table 4.37: Generated Traffic (2015) for Azamgarh–Haidariya from Patna–Buxar Road

Movements between Nodes	Car	Mini Bus	Bus	Mini - LCV	LCV	2Axle Truck	3Axle Truck	MAV (4 to 6)
Arrah - Buxar (AADT-2015)	2671	240	190	565	357	2107	306	22
Diversion %	55.98%	49.10%	59.28%	49.10%	49.10%	59.28%	59.28%	59.28%
Generated Traffic between Node L and Node H	1495	118	113	277	175	1249	181	13

(c) *some increase in traffic will occur from secondary development at industrial estates purposely located close to interchanges* – such developments, while possibly substantial, are, however, notoriously difficult to predict – the Consultants' approach has therefore been to test the effect on Economic Internal Rate of Return (EIRRs) of the assumption that the growth in freight traffic to and from Lucknow during the first five years of the Project increases by an additional 1% per year (factored over the development period) as a direct result of the Project and that this additional traffic, on average, will use any quarter section of the proposed Expressway to access its destination.

(d) *Kushinagar International Airport* - One very important generator of traffic, that also needs special mention will be the new International Airport at Kushinagar on the Northern East Sections of the proposed highway. The timing of this project, although featuring prominently on the state's development plans, remains highly speculative. Consultant's were fortunate to have studies undertaken for economic, commercial or financial feasibility and there are, as yet, no financiers who have expressed willingness to invest funds in its construction. The Consultants, nonetheless, can state that:

(i) when constructed by the State, the airport will be a direct generator (and, from the tourism places induced to locate around the new site, also an indirect generator) of large volumes of road traffic – though the extent of such generation remains unknown; and

(ii) most of the traffic generated will be into and out of the Lucknow city and, thus, only the small volumes that have origins and destinations far outside the Lucknow might be induced to use the project road as it is presently conceived (in this regard, **a direct expressway from Azamgarh to the Kushinagar** would carry more tourism related traffic – such a expressway, more usefully, serving destinations on the outskirts of the State).

It should finally be noted that the investors in such capital intensive projects, are only ever prepared to take into account revenues about which they are absolutely certain – i.e. deriving from either existing traffic or developments that are: clearly committed; for which financing has already been arranged; and/or for which construction is about to commence. It has, therefore, not been deemed appropriate to include any benefit from the Kushinagar airport project in either the economic or financial analyses.

4.4.3 Base Estimates of Traffic (2015) Section-by-Section for Proposed Expressway

The Consultants' base year (2015) estimates of total traffic on each section of the expressway are shown on Table 4.38.

Table 4.38: Base Estimates of Traffic (2015) Section by Section of Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A - B	3286	93	389	427	618	405	1430	1024	7674	16063
B - C	3569	94	403	473	635	423	1519	1051	8167	16901
C - D	3569	94	403	473	635	423	1519	1051	8167	16901
D - E	2802	78	344	436	568	364	1337	867	6797	14246
E- F	1669	64	296	174	458	314	1077	770	4823	11152
F - G	1254	54	217	152	442	298	945	757	4119	9936
G - H	1700	79	280	177	519	414	1244	1004	5417	13105
H - I	1920	141	190	314	341	1414	621	387	5328	11373
I - J	1866	135	170	318	319	1400	623	393	5224	11211
J – K	1751	133	153	298	303	1376	574	371	4960	10682
K - L	1636	124	124	297	285	1357	506	322	4652	9960

4.4.4 Capacity Constraints

The Indian recommended design service volumes (DSV) of expressways for Level of Service B (LoS-B) and peak hour traffic in the range of 8% (actual peak hour traffic on the project highway is likely to be lower – no more than 7%) for plain / rolling terrain shall be 1300 PCU/hr/lane are shown below (source: IRC SP: 99-2013), viz Table 4.39:

Table 4.39: Design Service Volume (DSV) in PCUs per day for Level of Service (LOS) B

Peak Hour	4-Lane	6-Lane	8-Lane
6%	86,000	1,30,000	1,73,000
8%	65,000	98,000	1,30,000

It can be seen from Table 4.40 that the lane requirement for the Base Estimates of Traffic (2015) for all sections is two lane configurations.

Table 4.40: Lane Requirement at DSV for LOS B for Proposed Expressway (2015)

Sections	Base Traffic (PCUs)	Peak Hour (8%)	No. of Lanes Required
A - B	16063	1285	0.99
B - C	16901	1352	1.04
C - D	16901	1352	1.04
D - E	14246	1140	0.88
E- F	11152	892	0.69
F - G	9936	795	0.61
G - H	13105	1048	0.81
H - I	11373	910	0.70
I - J	11211	897	0.69
J – K	10682	855	0.66
K - L	9960	797	0.61

Note: DSV of 1300 PCU/h/lane has been considered

For the purposes of Development Proposal, the lane configuration shall be carried for a forecasted traffic for a 20 Year Horizon from year 2020 (year of traffic operations on the expressway)

4.5 Traffic Growth

4.5.1 Vehicular Registration

Data showing growth in numbers of registered vehicles throughout Uttar Pradesh is provided on Table 4.41. It can be seen that the decadal and recent annual growth in:

(a) the *"all-vehicle"* fleet has been:
- 11.61% per year from 2000 to 2015;
- 11.53% per year from 2005 to 2015; and
- 10.65% per year from 2010 to 2015

(b) the truck fleet (goods vehicles) has been:
- 12.93% per year from 2000 to 2015;
- 11.83% per year from 2005 to 2015; and
- 7.21% per year from 2010 to 2015

(c) the motor-car fleet (passenger vehicles) has been:
- 9.23% per year from 2000 to 2015;
- 11.88% per year from 2005 to 2015; and
- 6.62% per year from 2010 to 2015,

it may be noted that the annual growth last year of motor-car fleet has been about 13.5%;

(d) the two-wheeler fleet has been:
- 12.71% per year from 2000 to 2015;
- 11.54% per year from 2005 to 2015; and
- 12.10% per year from 2010 to 2015

Table 4.41: Vehicle Registration Data in Uttar Pradesh

Year	Motor Cycle	Motor Car	Bus	Mini Bus	Truck	Delivery Vehicle	Tractor	Tempo / Auto Rickshaw	Others	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1980-81	41401	3810	1242	-	5591	-	14146	-	5112	71302
1981-82	-	-	-	-	-	-	-	-	-	0
1982-83	57393	4019	1587	-	5222	-	12216	-	4311	84748
1983-84	71136	3625	1862	250	2776	529	13364	1714	3209	98465
1984-85	85004	4256	2194	117	3634	433	13835	2792	4095	116360
1985-86	92711	6111	1187	116	4396	370	15222	2601	4257	126971
1986-87	140014	8081	1747	157	4117	455	18644	2474	4657	180346
1987-88	160370	12123	1640	238	5324	532	19435	3295	2024	204981
1988-89	149013	9768	1611	208	5648	571	25586	5023	1858	199286
1989-90	179676	10358	1574	264	6994	974	27176	6692	6141	239849
1990-91	187436	11104	1209	633	8056	1314	35933	7337	2922	255944
1991-92	173703	10009	1198	367	6411	1472	36289	6847	2722	239018
1992-93	128816	6973	1521	1104	3706	709	27506	3974	4102	178411
1993-94	152398	11687	1213	889	3713	911	28175	4179	3848	207013
1994-95	167258	12200	1493	1092	5953	1156	30467	4811	3468	227898
1995-96	168676	13978	1400	763	7310	2093	28450	5083	6686	234439
1996-97	230933	27309	1146	588	10581	3659	34718	10796	11162	330892
1997-98	254225	28985	1813	730	9593	3112	39311	10145	8439	356353
1998-99	325793	33197	1244	814	9282	3837	52650	10698	12882	450397
1999-00	329633	42766	1575	1031	8312	3921	51286	10934	10897	460355
2000-01	406216	39840	1450	1439	7202	4817	84141	11933	7625	564663
2001-02	364839	64241	730	745	3619	2325	38750	6927	16550	498726
2002-03	552378	43827	1452	1005	7051	3531	40715	9546	9912	669417
2003-04	585013	47189	1182	910	13259	3766	39421	11302	8773	710815
2004-05	665589	52311	1223	942	16827	4260	42714	9691	9130	802687
2005-06	769183	60090	1570	1209	17825	5216	52705	12627	14364	934789
2006-07	773478	71213	1565	1206	22895	4909	45173	20235	16189	956863
2007-08	748731	81158	1402	1080	24590	5282	41338	14078	21894	939553
2008-09	831946	92423	1910	1471	23529	5789	46219	21404	24928	1049619
2009-10	1120748	116706	2628	2024	36353	6620	80123	34034	42809	1442045
2010-11	1269550	127116	3097	2385	43474	7112	83287	34480	42814	1613315
2011-12	1368524	134580	2753	2120	50178	7766	73513	38374	50068	1727876
2012-13	1455867	140549	3594	2768	61370	5712	77972	38254	68556	1854642
2013-14	1713375	141646	3709	2858	53105	6099	87315	32062	58829	2098998
2014-15	1653456	134004	2804	2161	42905	4306	78991	26359	47814	1992800
Total(Lakhs)	**173.75**	**16.07**	**.59**	**0.33**	**5.40**	**1.04**	**14.36**	**4.21**	**5.43**	**221.20**
Population	215609813									
Ownership%	**8.06**	**0.75**	**0.03**	**0.02**	**0.25**	**0.05**	**0.67**	**0.20**	**0.25**	**10.26**

Note: Annual Report of Transport Department, Govt. of Uttar Pradesh

4.5.2 Regional Influences on Traffic Growth

In Chapter 6, the Consultants have examined economic growth in the Study area. The findings from that Section and the data contained herein are highly relevant to the Consultants' forecasts for future traffic growth, viz:

(a) *freight:* the majority of *"candidate"* road freight is agricultural (often perishable) goods and goods destined for the secondary, manufacturing and construction sectors; and goods for the non-agricultural primary sector (mining and quarrying) etc. and bulk products for the secondary sector travel mainly by rail (see below) – and goods for the tertiary sector (mainly service industries) are light and while, no doubt most are travelling by road, these do not contribute significantly to total *"candidate"* road freight traffic (see Tables 2.8 (i) to 2.8 (vi) of Appendix for the commodity distribution by freight traffic)

(b) *passenger:* most *"candidate"* passenger travel is by persons with incomes much higher than the average (even when those persons are travelling by bus) – the average income of car passengers is half the national average and the average income of bus passengers about a quarter of the national average; in Uttar Pradesh total vehicle ownership is only 10.26 per 100 head of population; and car ownership is only 0.75 per 100 head of population (see Table 4.41) – which data implies that there is much scope for growth in this sector.

The Consultants, consequently, believe that future growth in:

(a) *candidate freight traffic:* might reasonably be linked to growth in the *"NSDP"* of those regional and State economies which are presently contributing candidate traffic; and

(b) *candidate passenger traffic*: might reasonably be linked to two factors in combination:

- growth in the *"populations"* (P) of those regional and State economies which are presently contributing *"candidate"* traffic; and

- growth in the *"average per capita incomes"* (I) of those regional and State economies which are presently contributing *"candidate"* traffic.

Recent growth in three indices for the above and for each of regions and States that contribute *"trip-ends"* for *"candidate"* traffic are shown on Tables 4.42.

Table 4.42: Zonal Influence Factors (%)

Zones	Passenger	Buses	Commercial Vehicles
Uttar Pradesh	100	100	69
Bihar	0	0	17
Rest of India	0	0	14
Total	100	100	100

From the zonal influence factors, it is clear that the growth rate of passenger car and bus (public transport) shall be regressed with growth of per capita income and growth of population of state of Uttar Pradesh respectively– results are shown on Table 4.43 and Table 4.44

On the Table 4.45, a "weighted" average for each of these indices has been derived and, in the case of freight, the *"growth in freight traffic"* correlated against the weighted average for *"NSDP"*. In the case of passenger traffic, the *"growth in car traffic"* was correlated against the *"growth in relevant per capita incomes"* and for bus traffic *multiplied by the growth in relevant populations*".

Table 4.43: Regression Co-efficient of Car Growth with Per Capital Income (Uttar Pradesh)

Year	Car	Per Capita Income (Rs.)
2004-05	571768	12950
2005-06	621858	13445
2006-07	693071	14241
2007-08	774229	14875
2008-09	866652	15713
2009-10	983358	16390
2010-11	1110474	17388
2011-12	1245054	18014
2012-13	1385603	18635
2013-14	1527249	19233
2014-15	1661253	20057
CAGR % (2004-15)	**11.26**	**4.47**
Regression Co-efficient (Elasticity Value)	**2.47**	
R Square	**1.00**	
t-stat	**46.33**	

Table 4.44: Regression Co-efficient of Bus Growth with Population (Uttar Pradesh)

Year	Bus	Population
2004-05	27660	178405969
2005-06	29230	181868193
2006-07	30795	185329719
2007-08	32197	188812329
2008-09	34107	192325044
2009-10	36735	195841097
2010-11	39832	199347086
2011-12	42585	202830260
2012-13	46179	206311924
2013-14	49888	209802093
2014-15	52692	213273039
CAGR % (2004-15)	**6.66**	**1.80**
Regression Co-efficient (Elasticity Value)	**3.70**	
R Square	**0.99**	
t-stat	**28.90**	

Table 4.45: Regression Co-efficient of Truck Growth with NSDP (Uttar Pradesh. Bihar) & GDP-India

Year	Uttar Pradesh		Bihar		India	
	Trucks	**NSDP**	**Trucks**	**NSDP**	**Trucks**	**GDP**
2004-05	147055	231029	30516	70167	4031000	2971464
2005-06	164880	244514	49437	68419	4436000	3253073
2006-07	187775	263935	50016	80260	5119000	3564364
2007-08	212365	280851	52005	84415	5601000	3896636
2008-09	235894	302192	54414	97284	6041000	4158676
2009-10	272247	320989	58012	101938	6432000	4516071
2010-11	315721	346621	66485	117503	7064000	4918533
2011-12	365899	365375	73472	129521	7873499	5247530
2012-13	427269	384458	83191	143250	8666710	5482111
2013-14	480374	403509	104113	156671	9299561	5741791
2014-15	523279	427759	109935	171802	9914522	6001471
CAGR % (2004-15)	**13.53**	**6.36**	**13.67**	**9.37**	**9.42**	**7.28**
Regression Co-efficient (Elasticity Value)	**2.10**		**1.09**		**1.13**	
R Square	**0.99**		**0.89**		**0.99**	
t-stat	**35.69**		**8.359**		**27.46**	
Zonal Influence Factor	**69%**		**17%**		**14%**	

Note: NSDP (Rs. Crores) & GDP (Rs. Crores) are at 2004-05 Constant Prices

Elasticities were then derived. In the case of freight, the weighted average elasticity is 1.8 and, in the case of passengers the average elasticity is 2.47, in case of bus the average elasticity is 3.70 – implying that:

(a) growth in freight travel is growing faster than growth in the *"NDSP"* of the regional and State economies which presently contribute candidate traffic; and

(b) growth in passenger travel is growing faster than growth in the *"per capita incomes"* of the regional and State economies which presently contribute candidate traffic.

(c) growth in bus travel is growing faster than growth in the *"populations"* of the regional and State which presently contribute candidate traffic.

This is, as expected, and typical of developing economies that, like Uttar Pradesh and the rest of India, are experiencing a surge in economic growth. The elasticity can however be expected to fall with time. The Consultants' *"best estimate"* forecasts for traffic, which assume continued growth in the *"NSDP"* sectors and in *"per capita incomes"* at present rates and a small increase in average loads caused by the use of greater numbers of larger trucks, and an improvement in load factors, are consequently:

(a) *for freight vehicles*:
- for the period, 2015 to 2020 – about 10.17% (*6.36% NSDP growth * 1.60 elasticity*)
- for the period, 2021 to 2030 – about 9.51% (6.36*% NSDP growth * 1.36 elasticity /1.1 improvement in load factor etc.*)
- for the period, 2031 to 2040 – about 7.86% (*6.36% NSDP growth * 1.00 elasticity/1.25 improvement in load factor etc.*)

The growth in multi-axle vehicles (which are mainly articulated) is assumed to be 0.5% per annum higher than these figures. There are presently very few multi-axle vehicles amongst the

candidate vehicles. The experience of almost all other developing countries at a similar stage of development has been for a major growth in these vehicles types – particularly when nascent expressway systems are being developed.

(b) *for cars*:
- for the period, 2015 to 2020 – about 11.07% (4.47*% growth in I * 2.48 elasticity*)
- for the period, 2021 to 2030 – about 9.97% (5.25*% growth in I * 1.90 elasticity*)
- for the period, 2031 to 2040 – about 7.22% (6.00*% growth in I * 1.20 elasticity*)

(note: during the last few years growth in real incomes started raising above growth in per capita GDP – the Consultants expect that over the next decade that trend should continue)

(c) *for bus*:
- for the period, 2015 to 2020 – about 6.67% (1.80*% growth in P * 3.71 elasticity*)
- for the period, 2021 to 2030 – about 5.86% (1.70*% growth in P * 3.45 elasticity*)
- for the period, 2031 to 2040 – about 3.83% (1.60*% growth in P * 2.39 elasticity*)

(note: during the last few years growth in population is falling behind growth in national population – the Consultants expect that over the next decade that trend should reduce)

These growth rates may initially seem high (additional 1% per year factored over the development period as a direct result of the Project) and, over the next thirty years, are consistent with: a 8.5 fold increase in *"candidate"* freight traffic; a 9.6 fold increase in car traffic (but implying car ownership of still only about 0.75 per 100 head of population) and a 3.5 fold increase in bus passengers. These are not unreasonable expectations.

Summary of annual growth rate for vehicles during the development period of the expressway and further 20 year Horizon is shown in Table 4.46.

Table 4.46: Annual Growth Rates for Vehicles Development Period & further 20 Year Horizon

Period	Cars	All Buses	All LCVs	2-Axle Trucks	3-Axle Trucks	MAV (4-6axles)
2015-2020 Development Period	11.07	6.67	9.80	8.06	10.17	10.70
2021 -2030	9.97	5.86	9.14	7.34	9.51	10.03
2031 - 2040	7.22	3.83	7.50	5.55	7.86	8.35

Given the uncertain nature of traffic forecasting, the Consultants have, for financial analysis sensitivity purposes, assumed:
(a) low or pessimistic growth rates of 0.9 times these values; and
(b) high or optimistic growth rates of 1.1 times these values.
This is in line with normal practice in such situations.

4.5.3 Traffic Projections

Base Estimates of Traffic (2015) section by section of proposed expressway as shown in Table 4.38 have been projected by assigning the above annual growth rates for the corresponding periods – results are shown in Tables 4.47 to 4.49

Table 4.47: Traffic Forecast (2020) Section by Section of Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A – B	5555	129	537	682	987	597	2321	1703	12511	25939
B – C	6033	130	556	755	1014	623	2465	1748	13324	27302
C – D	6033	130	556	755	1014	623	2465	1748	13324	27302
D – E	4736	108	476	695	907	537	2170	1441	11070	22987
E- F	2821	89	409	278	731	462	1747	1280	7818	17946
F – G	2120	75	300	242	706	440	1533	1258	6674	16012
G – H	2873	109	387	283	829	610	2019	1668	8778	21118
H – I	3246	195	262	500	545	2084	1007	643	8483	17811
I – J	3154	187	234	508	509	2063	1012	653	8319	17569
J – K	2960	184	212	476	484	2027	932	616	7891	16723
K – L	2765	171	172	474	456	2000	821	536	7394	15569

Table 4.48: Traffic Forecast (2030) Section by Section of Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A – B	14369	227	949	1636	2366	1213	5758	4429	30946	63582
B – C	15606	229	983	1809	2432	1265	6115	4546	32985	66953
C – D	15606	229	983	1809	2432	1265	6115	4546	32985	66953
D - E	12252	191	841	1667	2175	1090	5382	3749	27346	56275
E- F	7297	157	724	668	1754	939	4334	3329	19200	43799
F – G	5485	132	530	581	1693	893	3804	3271	16387	39201
G – H	7432	192	684	678	1988	1238	5009	4339	21560	51699
H – I	8396	345	463	1200	1307	4232	2499	1673	20114	41181
I – J	8159	330	414	1217	1221	4188	2509	1698	19737	40678
J – K	7656	326	374	1142	1160	4116	2312	1602	18689	38644
K – L	7153	302	304	1136	1093	4061	2038	1393	17479	35857

Table 4.49: Traffic Forecast (2040) Section by Section of Proposed Expressway

Sections	Car	Minibus	Bus	Mini LCV	LCV	2 Axle Truck	3 Axle Truck	MAV (4 to 6)	Total Traffic (nos.)	Total PCUs
A - B	28853	331	1381	3371	4877	2081	12271	9876	63041	131677
B - C	31337	334	1432	3729	5012	2171	13032	10137	67183	138603
C - D	31337	334	1432	3729	5012	2171	13032	10137	67183	138603
D - E	24601	278	1224	3436	4482	1870	11469	8360	55721	116488
E- F	14653	228	1054	1376	3614	1612	9236	7422	39195	90898
F - G	11013	193	771	1197	3488	1532	8106	7295	33595	81786
G - H	14924	280	996	1397	4097	2125	10674	9676	44169	107813
H - I	16860	503	674	2473	2693	7263	5325	3730	39520	80696
I - J	16384	481	602	2508	2517	7188	5348	3786	38815	79842
J – K	15374	474	545	2353	2392	7064	4927	3573	36702	75712
K - L	14362	439	442	2342	2252	6969	4342	3107	34256	69986

The 20 year horizon traffic forecasts (year 2040) on all sections from Node A to L of the proposed expressway exceeds 65,000[1] PCUs per day, i.e. the requirement is 6-lane requirement and on 5 sections viz. A-B, B-C, C-D, D-E and G-H, the traffic forecasts (year 2040) exceeds 98,000[2] PCUs per day, i.e the requirement is 8-lane requirement.

The projected traffic warrants the following the lane requirement for each section to maintain a design service volume for Level of Service B on the proposed expressway at the years mentioned in Table 4.50

Table 4.50: Lane Requirement to maintain Level of Service B on the Expressway

Sections	4-Lane requirement	6-Lane requirement	8-Lane requirement
A - B	2023	2031	2036
B – C	2022	2030	2036
C - D	2022	2030	2036
D - E	2024	2032	2038
E- F	2027	2036	2042
F – G	2028	2037	2044
G - H	2025	2034	2039
H - I	2028	2037	2044
I – J	2028	2037	2044
J – K	2028	2038	2046
K – L	2029	2039	2047

Note: DSV of 1300 PCU/h/lane has been considered

It can be seen that a 6-lane configuration can cater to the forecasted traffic till 2035, i.e. 15 years from start of operations of the Expressway; beyond which widening of few sections of the Expressway to 8-lane configuration becomes necessary.

Thus the development proposal for expressway shall be a 6-lane dual carriageway configuration with Structures of 8-lane configuration. Thus the life cycle cost of development of the Expressway is justified.

[1] the DSV for LOS B on 4-lane (refer Table 4.39)
[2] the DSV for LOS B on 6-lane configuration(refer Table 4.39)

4.6 Toll Studies

4.6.1 Introduction

The Consultants' analyses of tolling are based on:

(a) considerations of the most effective type of toll system to implement (Section 4.6.2);
(b) assessments of the volumes of traffic that would divert to the new expressway at a range prescribed toll levels (see previous Sections 4.3, 4.4 and 4.5);
(c) the impact tolls would have on the economic returns of the project (Section 4.6.3); and
(d) the consequent amounts of toll revenue that would be generated (Section 4.6.4); and

4.6.2 Toll Systems

"Closed" vs "Open" Systems

There are two toll systems that could be applied:

(a) a *"closed"* system whereby no traffic is permitted onto the expressway system without passing a control station (usually on the entry ramp) where either a fixed payment is made or a ticket stating the point of entry is obtained – closed systems enable all road users to be charged and, when the charge is collected on exit, the charges can be made to reflect distances travelled; and

(b) an *"open"* system, whereby all traffic is allowed onto the expressway system and charges are made only at control stations at various points along the main highway – such systems usually allow some traffic to escape payment and, unless large numbers of toll plazas are constructed, do not always permit the charges to accurately reflect distance travelled.

"Open" systems are most suited to systems where there are:

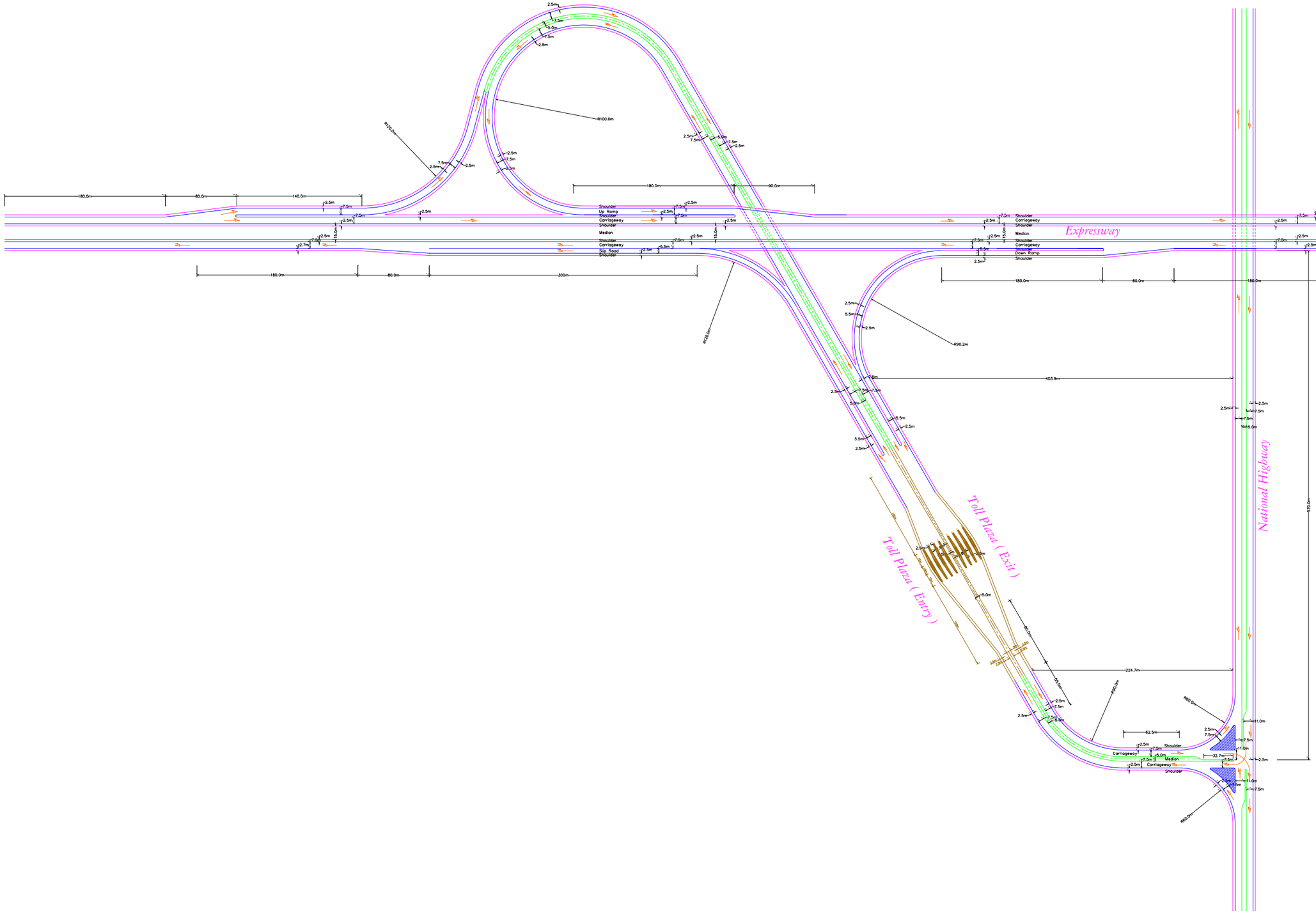
(a) few, or long distances between, exit/entry points; and/or
(b) there are points on the alignment (for example, major bridge sites) which are difficult to avoid and which lie between the points of origin and destination for most traffic.

"Open" systems are also prone to causing delays to traffic – particularly when the road has a number of entry and exit points and separate charges are required for each section. An *"open"* system on the Project Road, would for example require a vehicle travelling Node A to Node L to pass approximately 11 (eleven) toll booths.

"Closed" systems are most suited to highways where there are many, or only short distances between, exit/entry points and/or traffic volumes are high. The system can also be more expensive to operate. This is because booths for issuing tickets are required at all entry ramps - and, if as is most usual, the charges are distance-related, there must also be booths for collecting payment on exit ramps. Closed systems are unable to function if access is uncontrolled and work best when the traffic can be segregated by direction. Consequently, the Project Expressway has been designed to have grade separated junctions during all the years of operation, for a *"closed"* system to be possible.

Grade-separated junctions on toll-roads are usually "trumpet-shaped" (see Figure 4.3) - such configurations requiring only one site for the toll-booths/plazas and permitting easy adjustment to the numbers of entry and exit lanes to match daily variations in the dominant directional flows of the traffic.

Figure 4.3 "Trumpet" Interchange: Typical Configuration



Since the Project Expressway is a fully access controlled with grade-separated junctions, ahead of its time, they might otherwise be needed (but Net Present Values for early and late provision have shown that early provision results in life cycle cost benefits than late provisioning); "*closed"* systems are discussed in the Project Proposals and relevant cost are taken into account in the economic and financial analyses.

4.6.2.1 Toll Levels

A range of tolls for private vehicles (cars, vans, etc) and commercial vehicles (buses and trucks) have been tested. These were derived after consideration of the following:

(a) **Tolls being collected on Expressways elsewhere in India** - the Consultants investigated two facets of the present proposals for tolls on other expressways in India, viz:

- when green field (four lane) alignment (*Zirakpur – Parwanoo Expressway*), the per km toll charges for various vehicle categories, typically save about an hour of travel time are:
  1.05 Rs/km for cars;
  1.81 Rs/km for light commercial vehicles; and
  3.62 Rs/km for trucks and buses; and
  5.79 Rs/km for 3-axle trucks.

- and which are translated into approximate costs *"per hour of travel-time savings"* of:
  29.00 Rs/hour for cars;
  50.00 Rs/hour for light commercial vehicles;
  100.00 Rs/hour for trucks and buses; and
  160.00 Rs/hour for 3 to 6 axle trucks

- on the *Ahmedabad to Vadodara Expressway (National Expressway 1)*, the per toll km charges for various vehicle categories, typically save about 30 minutes of travel time are:
  0.97 Rs/km for cars;
  1.58 Rs/Km for light commercial vehicles;
  3.28 Rs/km for trucks/bus; and
  3.58 Rs/km for 4 to 6axle trucks.

- and which are translated into approximate costs *"per hour of travel-time savings"* of:
  190 Rs/hour for cars;
  310 Rs/hour for light commercial vehicles;
  640 Rs/hour for trucks/bus; and
  1010 Rs/hour for 4 to 6axle trucks.

Such values would normally be expected to represent the range of charges that users/operators might be prepared to pay.

(b) **Stated Preference Surveys** - the Consultants added some basic *"Stated Preference"* questions to their Origin and Destination surveys. These were designed to elicit information on *"willingness-to-pay"* and to relate that information to the economic status of the interviewees.

In the case of trucks, these road-side surveys were supplemented by interviews of the operators/owners of the trucks – this in order to ascertain any difference in the *"willingness-to-pay"* between drivers and management.

It was found that:

- *for cars:* the stated road-side interview stated *"willingness-to-pay"* values were very low – on average about Rs 100 per hour of time saved; and

- *for trucks:* the owners/operators' assessments of their *"willingness-to-pay"* varied widely – initial responses were usually very low and in the order of Rs 250 for every hour of time saving (of the drivers' own assessments of *"willingness-to-pay"* which was only about Rs 60-100 per hour of time saved).

  (In the case of trucks, a much larger figure was, however, usually obtained when the owners/operators could be encouraged to look at the situation in a wider context and more closely. When asked to consider a nationwide system of expressways that reduced trip times by, say, 50% and then: (i) what increases in charges customers might be prepared to pay for every hour saved; and (ii) what increases in their own truck utilisation rates/decreases in their own costs they might achieve, their conclusions were typically supportive of tolls of up to 20 to 25% of present journey costs – which when translated to an average 24-hour, 600 km, Rs 18,000 trip, by a 10-tonne truck between Lucknow and Patna, is the equivalent of Rs 6 per km or Rs 360 per hour of time saving.)

Because of the generally accepted unreliability of Stated Preference Surveys, (and the above illustration of the difficulties in obtaining sensible initial first responses, and the lengthy time required to elucidate more rational responses), the Consultants have given least weight to the results generated by this approach.

(c) **Revealed Preferences** - fortunately for the Study, there was also an opportunity to undertake a survey of *"Revealed Preferences"*. There are many toll roads radiating from Lucknow city, close to the proposed route for the Purvanchal Expressway is Lucknow – Rae Bareli – Allahabad Bypass - Varanasi route, where presently tolls are charged at three locations. The toll road can be avoided if longer-time journeys are acceptable; alternate route via Sultanpur and Jaunpur. Travellers were interviewed in order to discover both the time-penalties they were prepared to pay in order to avoid the toll and the time-savings that users perceived they obtained by paying the toll. It was discovered that:

- the average estimated time savings by those intending to/having paid the toll and who (via Rae bareli & Allahabad Bypass)believed having paid it would/had saved them time was **90** mins; and

- the average estimated time cost by those not intending to/not having paid the toll and who (via sultanpur & jaunpur)believed their journeys were longer because of their decision was **60** mins

As the average toll paid by private cars and trucks is about Rs 240 and Rs 810 respectively for a trip between Lucknow and Varanasi via Dakhina Sekhpur (NH-24B (NH-30), i.e. old NH-30) – Allahabad Bypass (Handiya on NH-19 (NH31), i.e. old NH-2) – Lalanagar (NH-2), the first data implies an average value-of-time/willingness-to-pay for car and truck operators of at least Rs 160 and Rs 540 per hour of time saved. Moreover, as less than 10% of vehicles chose to avoid paying the toll (rendering meaningless analyses of the associated time penalty data), the above values can, in fact, be treated as a realistic set of Study minimum *"values-of-time/willingness-to-pay"*.

4.6.2.2 Toll Levels as per The Uttar Pradesh Expressway (Levy of Tolls and fixing of Fees and realisation thereof) Rules, 2010 (Toll Rules 2010)

The consultants assessed the toll levels as per Toll Rules 2010 and compared it with toll rates on the existing alternate routes.

The toll charges for Car (Rs/Trip) for the year 2009-10 for different pairs of tolling sections on the expressway is a sum of Toll Charges for use of Road portion and Toll Charges for use of Structures are shown on Tables 4.51 to Table 4.53

Table 4.51: Toll Charges (Rs/Trip) for Car for use of Road Portion of Expressway (2009-10)

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0.00	28.62	45.21	63.47	95.00	107.52	142.11	183.24	198.07	229.81	257.84	265.76
B		0.00	16.59	34.85	66.39	78.90	113.49	154.63	169.45	201.20	229.22	237.15
C			0.00	18.26	49.80	62.31	96.90	138.04	152.86	184.60	212.63	220.56
D				0.00	31.53	44.05	78.64	119.77	134.60	166.34	194.36	202.29
E					0.00	12.52	47.11	88.24	103.06	134.81	162.83	170.76
F						0.00	34.59	75.72	90.55	122.29	150.32	158.24
G							0.00	41.13	55.96	87.70	115.72	123.65
H								0.00	14.82	46.57	74.59	82.52
I									0.00	31.74	59.77	67.70
J										0.00	28.02	35.95
K											0.00	7.93
L												0.00

Note: Toll Charges for reverse trips shall have same diagonal amounts

Table 4.52: Toll Charges (Rs/Trip) for Car for use of Structures on Expressway (2009-10)

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0.00	29.50	45.00	63.50	84.50	116.50	155.00	183.00	202.00	221.00	232.00	248.00
B		0.00	15.50	34.00	55.00	87.00	125.50	153.50	172.50	191.50	202.50	218.50
C			0.00	18.50	39.50	71.50	110.00	138.00	157.00	176.00	187.00	203.00
D				0.00	21.00	53.00	91.50	119.50	138.50	157.50	168.50	184.50
E					0.00	32.00	70.50	98.50	117.50	136.50	147.50	163.50
F						0.00	38.50	66.50	85.50	104.50	115.50	131.50
G							0.00	28.00	47.00	66.00	77.00	93.00
H								0.00	19.00	38.00	49.00	65.00
I									0.00	19.00	30.00	46.00
J										0.00	11.00	27.00
K											0.00	16.00
L												0.00

Note: Toll Charges for reverse trips shall have same diagonal amounts

Table 4.53: Toll Charges (Rs[3]/Trip) for Car (Road + Structures) of Expressway (2009-10)

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0	60	90	125	180	225	295	365	400	450	490	515
B		0	30	70	120	165	240	310	340	395	430	455
C			0	35	90	135	205	275	310	360	400	425
D				0	55	95	170	240	275	325	365	385
E					0	45	120	185	220	270	310	335
F						0	75	140	175	225	265	290
G							0	70	105	155	195	215
H								0	0	85	125	150
I									0	50	90	115
J										0	40	65
K											0	25
L												0

Note: Toll Charges for reverse trips shall have same diagonal values

From the above table and distance matrix shown on Table 4.3, the per Km Toll Rates for Car for different pairs of tolling sections on the expressway has been worked out and as shown on Table 4.54

Table 4.54: Toll Rate (Rs/Km) for Car (Year 2009-10)

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0.00	1.56	1.53	1.54	1.47	1.62	1.63	1.56	1.57	1.53	1.48	1.51
B		0.00	1.49	1.53	1.43	1.64	1.64	1.56	1.58	1.53	1.48	1.50
C			0.00	1.56	1.41	1.68	1.67	1.57	1.59	1.53	1.47	1.50
D				0.00	1.31	1.73	1.69	1.57	1.59	1.53	1.47	1.50
E					0.00	2.73	1.94	1.66	1.67	1.57	1.49	1.53
F						0.00	1.65	1.47	1.52	1.45	1.39	1.43
G							0.00	1.32	1.44	1.37	1.31	1.37
H								0.00	1.76	1.42	1.30	1.39
I									0.00	1.26	1.19	1.31
J										0.00	1.11	1.36
K											0.00	2.18
L												0.00

Note: Toll Rates for reverse trips shall have same diagonal values

As per Toll Rules 2010, the annual revision (generally upward) of Toll Rates is computed (Whole Sale Price (WPI) index published for 1st week ending of January 2016[4]) and the Toll Rates for year 2016 (FY 2017) are as shown on Table 4.55

[3] rounded of the nearest five rupees.
[4] Extrapolated values from monthly WPI indices published till year 2016, as weekly indices are no more published.

Table 4.55: Toll Rate (Rs/Km) for Car (Year 2016-17)

Nodes	A	B	C	D	E	F	G	H	I	J	K	L
A	0.00	1.74	1.78	1.76	1.68	1.84	1.86	1.79	1.81	1.75	1.70	1.73
B		0.00	1.63	1.78	1.65	1.88	1.89	1.79	1.80	1.75	1.69	1.71
C			0.00	1.70	1.58	1.94	1.90	1.79	1.82	1.76	1.70	1.72
D				0.00	1.50	1.96	1.94	1.80	1.83	1.74	1.68	1.72
E					0.00	**3.07**	2.23	1.91	1.93	1.80	1.71	1.76
F						0.00	1.92	1.71	1.73	1.67	1.59	1.63
G							0.00	1.53	1.68	1.56	1.50	1.58
H								0.00	2.08	1.60	1.48	1.61
I									0.00	1.49	1.39	1.50
J										0.00	1.27	1.51
K											0.00	2.27
L												0.00

Note: Toll Rates for reverse trips shall have same diagonal values

The toll rate for Cars between toll nodes G and H of Rs. 1.27 per Km which happens to lower among the toll rates between different toll nodes of the proposed Expressway, although a little higher on unit basis than the toll rates on existing alternate 4-lane national highway routes presently under toll operation, are relatively easier on Level of Service basis that the proposed 6-lane Expressway shall provide.

When compared with an 6-lane Expressway facility like that of Yamuna Expressway, the Toll Rate of Rs. 2.10 per km of Cars on Yamuna Expressway (Noida – Agra), the computed toll rates for cars as shown on Table 4.55 is comparatively lesser for most pairs of different toll nodes of the proposed Expressway.

The estimated toll rate ranges between Rs. 1.27 per Km and Rs. 3.07 per Km with an average of Rs.1.75 per km (FY 2016-17) are much lower than base rate of fees (Rs. 2.29 per km for Car estimated for year 2016-17, refer Table 4.32) from toll notification (excerpts of the revised toll rates are shown on Table 4.56) dated August 8, 2012 with upward revision under Toll Rules 2010.

Table 4.56 Toll Rates for Year 2012-13 published notification by GoUP

Sl. No.	Type of Vehicle	Base rate of Fee per Km (in Rupees) based on the Wholesale Price Index (WPI) of December 2011 (WPI 294.62) for the year 2012-13
1	Car, Jeep, Van or Light Motor Vehicle	2.10
2	Light Commercial Vehicle, Light Goods Vehicle or Mini Bus	3.25
3	Bus or Truck	6.60
4	Heavy Construction Machinery (HCM) or Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV)	10.10
5	Oversized Vehicles (Seven or more Axles)	12.95

4.6.3 Impact of Tolls on Economic Returns

The Consultants' *"maximum tested toll"* levels (corresponds to Rs. 2.29 per Km for Car), although a little higher than the above, are of the same order-of-magnitude, yielding economic return of 15.12%. They correspond to an assumption that journey times from Chand Sarai to Haidariya (~ 340.824 Kms) would reduce - from about 8 hours if travelling by truck and 6 hours if travelling by car; to 6 hours and 3 hours respectively.

Whilst application of the highest tolls (corresponding to Rs. 3.07 per Km for Car, refer Table 4.55) to the full length construction of Expressway would reduce the economic returns to below 15% (the deemed cut-off point for viability).

The Consultants' "*minimum tested toll*" i.e. a simple tariff system corresponding to toll rate (2016-17) of Rs. 1.75 per Km for Car is recommended, yielding comparatively higher economic return of 18.22% due to increase in tollable traffic (*20% increase in diversion of initial traffic from alternate routes and trend to increase 10% in traffic growth rate*). There will thus be: easy collection, supervision and enforcement. With simple systems, it is also easier to convert, sometime in the future, to fully automated collection.

These "financially optimum/publicly expedient" tolls are therefore acceptable from all perspectives and recommended by the Consultants

4.6.4 Annual Toll Revenue Predictions

Forecasts of likely revenues in each of the thirty years during the (toll collection) recovery period and for all toll regimes described earlier have been derived for: completion of the six lane road portion and eight lane structures standards; and with the recommended tolls for Car at the rates computed in Table 4.55 and corresponding for MiniBus/MiniLCV/LCVs (Rs. 2.625/Km), Bus/2-Axle trucks (Rs. 5.25/Km) and 3-Axle Truck/MAV (Rs. 7.875/Km) - the toll revenues computed under the following structures:

(a) 300 toll revenue days each year;
(b) Single Trip Validity – 75% of AADT;
(c) 24 Hour Return Trip Validity - 20% of AADT;
(d) Monthly Pass Validity – 5% of AADT

Total annual revenues over the period to year 2050 likely with the Consultants':

(a) *"high"* (optimistic) estimates of traffic with *"minimum tested toll"* (*+10% than estimated growth rate; +20% increase in initial traffic volume*) are as shown on Table 4.57; and

(b) *"best"* estimate of traffic with *"maximum tested toll" (no change than estimated growth rate and no change in initial traffic volume)* are as shown on Table 4.58;

(c) *"low"* (pessimistic) estimates of traffic with "*maximum tested toll*" (*-10% than estimated growth rate; -20% reduction in initial traffic volume*) are as shown on Table 4.59.

Table 4.57: Annual Toll Revenue Predictions - *"high"* (optimistic) estimates of traffic with *"minimum tested toll"*

Financial Year	Calendar Year	Car	Mini Bus	Bus	Mini LCV	LCV	2-Axle Truck	3-Axle Truck	HCM/ MAV	Annual Toll
2015-16	2015	43.86	2.84	16.11	9.23	14.06	40.95	94.44	67.38	**288.87**
2016-17	2016	50.24	3.11	17.63	10.42	15.87	45.47	107.05	76.77	**326.55**
2017-18	2017	57.71	3.41	19.32	11.78	17.97	50.49	121.55	87.63	**369.85**
2018-19	2018	65.56	3.74	21.16	13.35	20.33	56.06	137.95	99.97	**418.12**
2019-20	2019	75.33	4.09	23.24	15.09	23.01	62.61	156.67	114.15	**474.19**
2020-21	2020	85.59	4.45	25.27	16.92	25.86	69.03	177.00	129.62	**533.74**
2021-22	2021	97.31	4.83	27.48	19.06	29.07	76.07	199.90	147.13	**600.85**
2022-23	2022	110.57	5.29	29.96	21.50	32.78	84.31	225.98	167.18	**677.58**
2023-24	2023	125.65	5.75	32.65	24.23	36.95	93.39	255.36	189.92	**763.90**
2024-25	2024	142.72	6.24	35.59	27.15	41.50	103.42	288.69	215.84	**861.16**
2025-26	2025	161.50	6.83	38.76	30.73	46.85	114.02	326.57	245.43	**970.70**
2026-27	2026	183.64	7.43	42.28	34.60	52.82	126.25	369.43	279.02	**1095.47**
2027-28	2027	209.64	8.12	46.19	39.13	59.61	140.41	418.35	317.65	**1239.10**
2028-29	2028	238.62	8.85	50.41	44.08	67.24	155.47	474.12	361.89	**1400.68**
2029-30	2029	271.09	9.67	55.00	49.63	75.80	172.07	536.92	411.92	**1582.11**
2030-31	2030	300.96	10.36	58.90	55.39	84.35	187.76	599.16	461.86	**1758.74**
2031-32	2031	332.82	11.09	62.97	61.58	93.77	204.03	668.19	517.70	**1952.13**
2032-33	2032	368.94	11.89	67.43	68.50	104.43	222.54	745.21	580.14	**2169.08**
2033-34	2033	409.66	12.74	72.18	76.12	116.10	242.65	832.30	651.15	**2412.92**
2034-35	2034	453.74	13.64	77.33	84.56	129.14	264.56	929.60	730.96	**2683.53**
2035-36	2035	505.08	14.59	82.98	94.15	143.57	289.49	1038.64	820.77	**2989.27**
2036-37	2036	560.07	15.63	88.90	104.94	159.92	315.45	1161.23	922.09	**3328.24**
2037-38	2037	622.25	16.72	95.34	116.47	177.87	344.78	1297.36	1035.23	**3706.02**
2038-39	2038	691.59	18.01	102.32	130.18	198.41	375.78	1450.88	1163.61	**4130.77**
2039-40	2039	769.49	19.29	109.82	144.98	221.35	410.59	1624.54	1309.31	**4609.38**
2040-41	2040	832.04	20.31	115.45	159.18	242.75	441.62	1787.86	1447.69	**5046.88**
2041-42	2041	897.43	21.35	121.22	174.62	266.25	473.11	1968.00	1601.06	**5523.05**
2042-43	2042	971.10	22.39	127.54	191.13	292.05	508.64	2167.32	1771.65	**6051.84**
2043-44	2043	1050.87	23.57	134.18	210.19	320.69	546.36	2388.90	1962.02	**6636.77**
2044-45	2044	1135.59	24.80	141.15	230.51	352.18	586.76	2632.64	2172.38	**7276.01**
2045-46	2045	1230.82	26.19	148.52	253.99	387.21	630.00	2901.91	2405.65	**7984.28**
2046-47	2046	1335.37	27.53	156.43	278.86	425.18	677.89	3200.55	2665.91	**8767.72**
2047-48	2047	1444.33	28.96	164.77	306.17	467.04	729.31	3531.03	2954.95	**9626.56**
2048-49	2048	1563.96	30.56	173.61	336.99	513.82	784.21	3896.78	3276.50	**10576.44**
2049-50	2049	1700.75	32.23	182.95	370.65	565.14	843.01	4301.44	3634.08	**11630.24**
2050-51	2050	1842.81	33.87	192.90	407.31	621.42	907.99	4750.51	4032.60	**12789.42**

Table 4.58: Annual Toll Revenue Predictions - *"best"* estimate of traffic with *"maximum tested toll"*

Financial Year	Calendar Year	Car	Mini Bus	Bus	Mini LCV	LCV	2-Axle Truck	3-Axle Truck	HCM/ MAV	Annual Toll
2015-16	2015	48.09	3.11	17.61	10.10	15.38	44.77	103.26	73.68	**315.99**
2016-17	2016	54.48	3.37	19.12	11.26	17.18	49.31	115.71	82.97	**353.40**
2017-18	2017	61.24	3.66	20.77	12.60	19.23	54.13	129.92	93.59	**395.14**
2018-19	2018	69.35	3.98	22.60	14.10	21.51	59.68	145.97	105.67	**442.88**
2019-20	2019	78.50	4.32	24.58	15.76	24.04	65.77	163.92	119.23	**496.12**
2020-21	2020	88.52	4.68	26.56	17.60	26.83	72.01	183.23	133.91	**553.34**
2021-22	2021	99.45	5.04	28.70	19.56	29.86	79.08	204.69	150.31	**616.69**
2022-23	2022	111.60	5.46	31.02	21.84	33.31	86.57	228.93	168.89	**687.62**
2023-24	2023	125.33	5.90	33.54	24.34	37.11	95.07	255.99	189.75	**767.04**
2024-25	2024	140.68	6.40	36.28	27.17	41.41	104.05	286.60	213.45	**856.03**
2025-26	2025	157.80	6.89	39.24	30.19	46.11	114.21	320.79	240.06	**955.28**
2026-27	2026	177.69	7.46	42.47	33.69	51.47	125.37	359.19	270.09	**1067.42**
2027-28	2027	199.46	8.11	45.98	37.77	57.53	137.57	402.49	304.07	**1192.98**
2028-29	2028	225.13	8.78	49.84	42.13	64.26	151.08	451.15	342.43	**1334.80**
2029-30	2029	253.87	9.51	54.05	47.10	71.81	166.33	505.62	385.57	**1493.86**
2030-31	2030	277.99	10.09	57.43	51.68	78.93	179.42	558.42	427.74	**1641.69**
2031-32	2031	305.32	10.77	61.07	57.06	87.06	194.09	617.16	474.94	**1807.46**
2032-33	2032	335.77	11.43	65.01	62.81	95.86	209.99	682.20	527.45	**1990.53**
2033-34	2033	368.41	12.19	69.16	69.29	105.66	227.06	754.35	585.86	**2191.97**
2034-35	2034	405.30	12.95	73.69	76.25	116.47	246.20	834.52	651.04	**2416.42**
2035-36	2035	447.34	13.81	78.48	84.09	128.44	266.21	923.44	723.64	**2665.44**
2036-37	2036	491.58	14.70	83.66	92.86	141.64	288.52	1021.91	804.49	**2939.37**
2037-38	2037	540.64	15.67	89.16	102.37	156.26	312.57	1131.78	895.11	**3243.56**
2038-39	2038	595.33	16.71	95.08	113.10	172.63	339.32	1253.81	996.03	**3582.02**
2039-40	2039	655.17	17.87	101.42	125.15	190.80	367.48	1389.03	1108.35	**3955.27**
2040-41	2040	705.22	18.67	106.11	136.03	207.44	391.94	1515.65	1214.66	**4295.72**
2041-42	2041	756.64	19.57	111.02	148.20	226.06	417.92	1656.08	1333.00	**4668.50**
2042-43	2042	813.30	20.43	116.26	160.86	245.54	446.47	1808.01	1461.71	**5072.56**
2043-44	2043	873.33	21.41	121.71	175.43	267.59	475.79	1975.69	1604.09	**5515.04**
2044-45	2044	938.64	22.43	127.43	190.89	291.35	507.84	2158.92	1760.60	**5998.09**
2045-46	2045	1011.17	23.49	133.65	207.96	317.39	543.17	2360.52	1933.12	**6530.46**
2046-47	2046	1084.59	24.65	139.98	226.88	345.98	579.40	2580.91	2122.77	**7105.16**
2047-48	2047	1165.77	25.84	146.74	247.20	377.40	619.05	2823.33	2332.42	**7737.75**
2048-49	2048	1259.04	27.10	153.98	269.81	411.43	662.48	3089.00	2562.86	**8435.69**
2049-50	2049	1354.05	28.43	161.48	294.04	448.49	707.42	3380.28	2816.43	**9190.62**
2050-51	2050	1456.96	29.83	169.41	320.86	489.57	756.28	3700.94	3097.20	**10021.05**

Table 4.59: Annual Toll Revenue Predictions *"low"* (pessimistic) estimates of traffic with "*maximum tested toll*"

Financial Year	Calender Year	Car	Mini Bus	Bus	Mini LCV	LCV	2-Axle Truck	3-Axle Truck	HCM/ MAV	Annual Toll
2015-16	2015	38.47	2.49	14.09	8.08	12.31	35.81	82.61	58.94	**252.80**
2016-17	2016	43.07	2.67	15.18	8.92	13.60	39.09	91.57	65.63	**279.73**
2017-18	2017	47.88	2.88	16.35	9.87	15.06	42.53	101.69	73.19	**309.46**
2018-19	2018	53.59	3.11	17.65	10.93	16.67	46.45	113.00	81.70	**343.10**
2019-20	2019	59.95	3.35	19.05	12.09	18.43	50.71	125.51	91.13	**380.21**
2020-21	2020	66.84	3.60	20.42	13.35	20.36	55.04	138.81	101.23	**419.66**
2021-22	2021	74.27	3.85	21.90	14.70	22.43	59.91	153.45	112.39	**462.88**
2022-23	2022	82.43	4.14	23.50	16.23	24.76	65.01	169.80	124.89	**510.76**
2023-24	2023	91.56	4.44	25.22	17.91	27.30	70.76	187.86	138.78	**563.82**
2024-25	2024	101.65	4.77	27.07	19.78	30.15	76.77	208.08	154.38	**622.65**
2025-26	2025	112.79	5.10	29.06	21.76	33.23	83.52	230.42	171.69	**687.57**
2026-27	2026	125.58	5.49	31.21	24.03	36.70	90.86	255.24	191.02	**760.14**
2027-28	2027	139.43	5.91	33.53	26.65	40.59	98.83	282.93	212.66	**840.53**
2028-29	2028	155.58	6.36	36.06	29.42	44.87	107.56	313.72	236.80	**930.36**
2029-30	2029	173.45	6.83	38.81	32.54	49.61	117.33	347.81	263.65	**1030.03**
2030-31	2030	188.29	7.21	40.99	35.39	54.04	125.64	380.50	289.60	**1121.64**
2031-32	2031	204.95	7.64	43.33	38.71	59.05	134.88	416.52	318.36	**1223.43**
2032-33	2032	223.34	8.07	45.84	42.22	64.42	144.83	456.03	350.04	**1334.79**
2033-34	2033	242.89	8.54	48.48	46.14	70.35	155.43	499.43	384.92	**1456.17**
2034-35	2034	264.77	9.03	51.34	50.31	76.82	167.21	547.21	423.46	**1590.16**
2035-36	2035	289.49	9.56	54.34	54.96	83.93	179.45	599.69	465.97	**1737.38**
2036-37	2036	315.26	10.12	57.57	60.12	91.69	192.98	657.23	512.82	**1897.80**
2037-38	2037	343.57	10.72	60.97	65.67	100.21	207.46	720.83	564.81	**2074.24**
2038-39	2038	374.85	11.36	64.62	71.86	109.66	223.44	790.78	622.12	**2268.70**
2039-40	2039	408.76	12.07	68.49	78.75	120.05	240.13	867.53	685.26	**2481.05**
2040-41	2040	436.87	12.56	71.34	84.91	129.47	254.52	938.71	744.42	**2672.79**
2041-42	2041	465.53	13.10	74.32	91.75	139.93	269.70	1016.99	809.69	**2881.01**
2042-43	2042	496.91	13.62	77.48	98.80	150.78	286.28	1100.95	880.05	**3104.86**
2043-44	2043	529.92	14.21	80.74	106.86	162.97	303.20	1192.85	957.20	**3347.95**
2044-45	2044	565.59	14.82	84.16	115.33	175.99	321.58	1292.41	1041.26	**3611.13**
2045-46	2045	604.91	15.45	87.86	124.61	190.15	341.72	1401.03	1133.08	**3898.81**
2046-47	2046	644.44	16.14	91.60	134.82	205.56	362.23	1518.75	1233.13	**4206.68**
2047-48	2047	687.86	16.83	95.58	145.68	222.36	384.54	1647.15	1342.74	**4542.75**
2048-49	2048	737.39	17.57	99.82	157.67	240.41	408.82	1786.64	1462.14	**4910.47**
2049-50	2049	787.47	18.35	104.20	170.42	259.90	433.78	1938.26	1592.34	**5304.72**
2050-51	2050	841.33	19.17	108.81	184.41	281.32	460.74	2103.75	1735.20	**5734.73**