TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

Abbreviations

AADT	Annual Average Daily Traffic
ADB	Asian Development Bank
ADT	Average Daily Traffic
AI	All India
AL	Axle Load
ATCC	Automatic Traffic Counter and Classifier
CAGR	Cumulative Annual Growth Rate
CR	Cost Ratio
CTVC	Classified Traffic Volume Count
CVs	Commercial Vehicles
FY	Financial Year
GC	Generalized Cost
GDP	Gross Domestic Product
GR	Growth Rate
INR	Indian Rupee
IRC	Indian Roads Congress
IRC:SP	Indian Roads Congress: Special Publication
km	Kilometer
kmph	kilometer per hour
LCV	Light Commercial Vehicle
LMV	Light Motor Vehicle
LoS	Level of Service
MAV	Multi Axle Vehicle
MORT&H	Ministry of Road Transport & Highways
NH	National Highway
NSDP	Net State Domestic Product
OD	Origin – Destination
OSV	Oversized Vehicle
PCI	Per Capita Income
PCU	Passenger Car Unit
ROI	Rest of India
SCF	Seasonal Correction Factor
SH	State Highway
SIAM	Society of Indian Automobile Manufacturers
TL	Travel Length
TP	Toll Plaza
TR	Toll Rate
TT	Travel Time
VDF	Vehicle Damage Factor
VOC	Vehicle Operating Cost
VOT	Value of Time

4. TRAFFIC STUDIES & FORECAST

4.1. Traffic Surveys and Analysis

4.1.1 Introduction

This chapter presents the traffic studies and analysis carried out for Feasibility Study and Detailed Project Report for Construction of 2 lane/2 lane with paved shoulder from Kohima to Nagaland/Manipur border section of NH-29 (Old NH-150) starts near existing km 7.880 at Chedama Road in Kohima (Nagaland) and terminates near existing km 131.894 at its junction with NH-202 (old NH-155) near Jessami in Manipur state (Package-I).

4.1.2 Project Details

The Project Highway, section of NH-29 (Old NH-150) in the state of Nagaland, starts at km 7.880 at Chedama Road in Nagaland State and ends at km 131.894 at its junction with NH-202 (old NH-155) near Jessami village in Manipur State. The Project Highway passes through districts Kohima and Phek in the state of Nagaland and Ukhrul in the state of Manipur. It connects important Town / Villages namely Kohima, Chakabama, Kiruma, Fpsutsero, Misulumi, Enhulum, Chizami, Losami, Laniye and Jessami. The existing length of the Project Highway is about 124.014 kms while design length along the proposed alignment of Project Highway is 121.09 kms.

The Project Highway passes through mountainous and steep terrain. Based on physical characteristics and major junctions within the stretch and considering the above mentioned traffic generation/diversion points, the project highway is divided into three homogeneous sections for the purpose of analysis and presentation of traffic and travel characteristics. **Table 4.1** gives the details of the homogeneous sections defined for the study.

Table 4-1: Homogeneous traffic sections

Section No.	Starting		Ending		Length (in km)
	Existing km	Place	Existing km	Place	
I	km 7.880	End of Kohima Bypass	km 30.600	Chakhabama	22.720
II	km 30.600	Chakhabama	km 68.000	Pfutsero	37.400
III	km 68.000	Pfutsero	km 131.894	Jessami	63.894

4.1.3 Traffic Survey Schedule

The locations were finalized in consultation with client considering the requirements for traffic forecast. Manual classified traffic volume Counts (CVC's) were conducted at three locations to understand the traffic volume. Origin and Destination (OD) Surveys were conducted in these three locations to understand the travel characteristics. The details of surveys conducted are as follows:

- 7 days CVC survey at **three** locations.
- 24 hour OD survey at **three** locations
- 24 hour TMC at **four** locations
- 48 hours Axle Load Survey at **two** locations.

The schedule of survey is given in **Table 4.2** below. The details of survey locations map is depicted in **Figure 4.1**.

Table 4-2: Schedule of traffic volume count survey

Sl No	Type of Survey	Location	Chainage	Remark	Dates
1	Classified Traffic Volume Count Survey - 7 Days	Chidema	km 13.000	CVC-1	05.10.2015 – 11.10.2015
		Pfutsero	Km	CVC-	05.10.2015 –

Sl No	Type of Survey	Location	Chainage	Remark	Dates
			64.500	2	11.10.2015
		Losami	km 107.000	CVC-3	25.09.2015 – 01.10.2015
2	Origin Destination Survey - 1 Day	Chidema	km 13.000	OD-1	06.10.2015
		Pfutsero	Km 64.500	OD-2	07.10.2015
		Losami	km 107.000	OD-3	31.09.2015
3	Junction Turning Movement Count Survey - 1 Day	Chakabama	km 29.100	TMC-1	05.10.2015
		Phek Village	km 102.000	TMC-2	06.10.2015
		Phek Town Road	km 121.360	TMC-3	06.10.2015
		Jessami	Km 133.650	TMC-4	25.09.2015
4	Axle Load Survey - 2 Days	Chidema	km 13.000	AL-1	06.10.2015
		Losami	km 107.000	AL-2	01.10.2015
5	Pedestrian Survey	Pfutsero	Km 67.800	PS	08.11.2015
		Chizami	Km 89.900	PS	08.11.2015

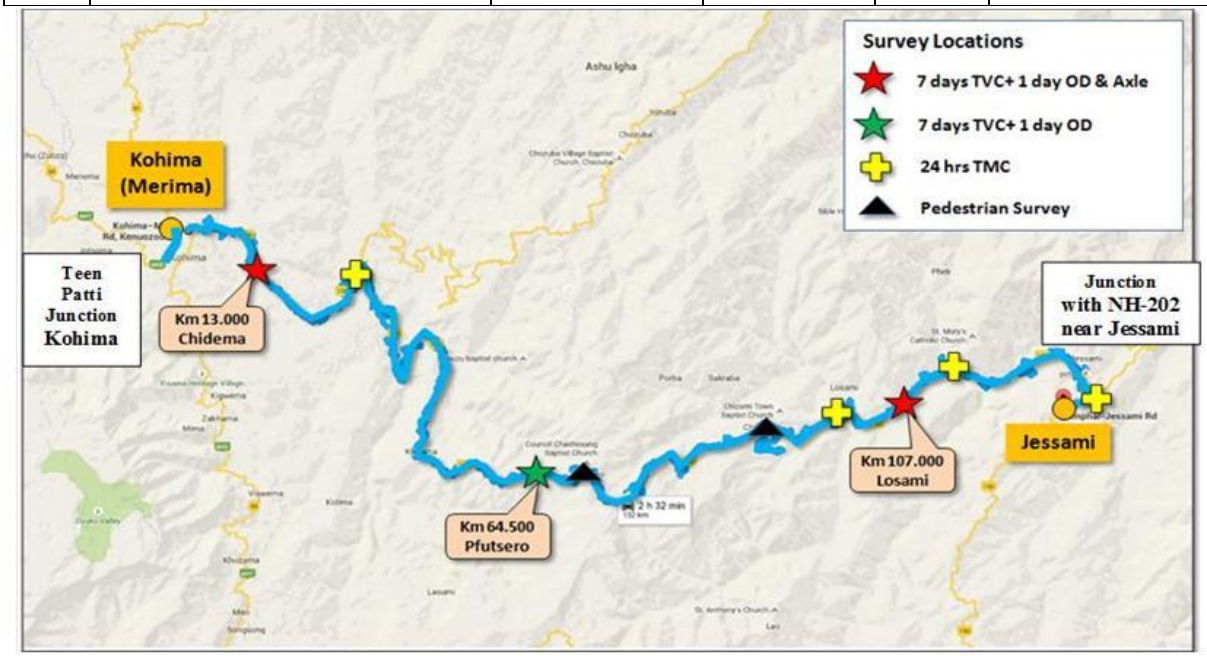

Figure 4-1: Traffic Survey Location Map

4.1.4 Traffic Survey Methodology

4.1.4.1 Primary surveys and considerations

To capture traffic flow characteristics, travel pattern and other characteristics related to miscellaneous requirements on the project road, following primary traffic surveys were conducted.

- Manual classified traffic volume count (CTVC)
- Origin – Destination survey (OD)
- Turning Movement Count Survey (TMC)

Traffic survey stations for carrying out CTVC, OD and TMC surveys were selected after a site reconnaissance considering the following parameters.

- The station should represent homogeneous traffic section
- The station should be located in a reasonably level terrain with good visibility.

4.1.4.2 Classified Traffic Volume Counts

The CVC survey was conducted at 3 locations. Manual count was conducted continuously for 7 consecutive days for 24 hours at all locations. The surveys were as per guidelines illustrated in IRC: SP: 19 – 2001, 'Manual for Survey, Investigation and Preparation of Road Projects'. For carrying out the counts, the vehicles were grouped under the following categories as listed in Table 4.3.

Table 4-3: Vehicle group used in the study

Motorised traffic	
2 wheelers: Scooters, bikes, motor cycles and mopeds etc	
3 wheelers including auto rickshaw	
Passenger Car	Car, jeep, taxi & van
Bus	Mini bus
	Govt. Bus
	Private bus
Truck	Light commercial vehicles (LCV)
	2 Axle truck
	3 Axle truck
	4 to 6 Axle Truck
	Truck with more than 6 Axle
Other Vehicles	Agriculture Tractor, Tractor & Trailer
Non Motorised traffic	
Slow Moving Vehicles	Bicycle
	Cycle rickshaw
	Animal drawn
	Hand cart

For the purpose of counts, a day was divided into two shifts of 12 hours each and different groups of enumerators with a supervisor were assigned for each shift. The count data was recorded at 15-minute intervals for each vehicle group for each direction of travel separately. Trained enumerators were deployed for counting and recording by making tally marks in the five-dash system.

4.1.4.3 Origin-Destination Survey

The origin-destination survey was carried out with the primary objective of studying the travel pattern of goods and passenger traffic along the study corridor. The results have also been useful for identifying the influence area of the project road, estimating the growth rates of traffic and planning tolling strategies and locating toll plazas on the most viable sections of the project road.
The survey was conducted at three locations for a day (24 hours) as stated in Table 7.2. Roadside interview method was adopted for the survey, in accordance with guidelines given by **IRC: SP 19 – 2001**. The road users were interviewed by trained enumerators to obtain the required data under the guidance of traffic engineers and supervisors. During the surveys the information pertaining to trip length, trip purpose and occupancy as applicable for various vehicle types were recorded.

4.1.4.4 Axle Load Survey

Axle Load Survey was carried out at 2 locations along the project highway. The main purpose for carrying out the survey was to assess the loading pattern on the highway and to estimate Vehicle Damage Factor (VDF) based on the commercial (Heavy) vehicle volume which is using the road.
During the survey, Axle load of commercial vehicles, i.e. LCVs, 2-Axle, 3-Axle, Multi Axle Trucks and Buses, were weighed on random sampling basis. The vehicles were stopped with the help of police and the drivers were directed to stop their vehicles in such a way that wheel of each axle can be weighed using portable Axle Load Weighing Pad.

4.1.4.5 Turning Movement Count

The Turning Movement Survey was conducted at 4 intersections on the project highway to obtain information on directional movement of traffic at intersections along the highway. Classified traffic volume counts of all vehicle types were made separately for all turning movements from each approach as per guidelines given in IRC Code SP-41:1994.
The survey was conducted recording traffic for each successive 15-minute intervals, for peak hours on a working day with the help of trained enumerators. Each turning movement at the intersection was recorded by deploying enumerators in sufficient numbers at suitable locations. The data on peak hour volume with turning movement flows would be used to analyze and design the intersection.

4.1.4.6 Pedestrian Cross Survey

The survey was conducted at two major locations along the project highway by trained enumerators who noted down pedestrian movement across and along the road using hand tally marks. Analysis of this data will indicate the locations where exclusive pedestrian grade separators shall have to be provided across the highway.

4.1.5 Data Analysis

4.1.5.1 Traffic volume count

The classified traffic volume survey data for two count locations is analyzed in order to obtain the following traffic characteristics:

- Average hourly variation of traffic volume
- Daily variation of traffic volume
- Average Composition of traffic
- Directional distribution of traffic
- Average Daily Traffic (ADT) volume

Daily and hourly variation of classified traffic flow is recorded by conducting traffic count at two strategically selected traffic count stations. Recorded traffic data has been converted into Passenger Car Units using PCU factors as shown in **Table 4.4**. These equivalency factors are extracted from **IRC: 64 – 1990**, 'Guidelines for Capacity of Roads in Rural Areas' and **IRC: 106-1990**, 'Guidelines for Capacity of Urban Roads in Plain Area'

Table 4-4: Passenger car equivalency factors for rural and urban sections

Rural Section PCU	
Vehicle Type	**PCU Factors**
Two Wheeler	0.50
Auto–rickshaw	1.00
Car / Jeep / Van / Tempo	1.00
Mini Bus	1.50
Standard Bus	3.00
Light Commercial Vehicle (LCV), Agricultural Tractor	1.50
Two Axle Truck	3.00
Three Axle Truck	3.00
Truck Trailer	4.50
Agriculture Tractor-trailer	4.50
Animal Drawn	8.00
Cycle	0.50
Hand Cart	3.00
Cycle Rickshaw	2.00

4.1.5.2 Average daily traffic (ADT)

Traffic volume count data for 7 days at each location was averaged to determine Average Daily Traffic (ADT). The location wise ADT by vehicle type is presented in **Table 4.5** below. Mode-wise hourly traffic for all locations is presented in **Appendix G1.**

Table 4-5: Average Daily Traffic at count locations

Vehicle Type	Chidema	Pfutsero	Losami
	km 13.000	Km 64.500	km 107.000
Car / Jeep / Van (Private)	173	129	106
Car / Jeep (Taxi)	0	0	0
Shared Jeep	0	0	0
Mini Bus	0	0	0
School. Bus	0	0	0
Govt. Bus	9	9	7
Pvt. Bus	0	0	0
Maxx/Pick-Up	0	0	0
LCV (4 tyre)	0	0	0
LCV	25	30	27
2 Axle trucks	31	40	26
3 Axle trucks	0	0	0
MAV (4 to 6 Axles)	0	0	0
MAV (> 6 Axles)	0	0	0
Others	0	0	0
3 Wheeler	0	0	0
2 Wheeler	33	32	28
Agriculture Tractor	0	0	0
Agriculture Tractor with Trailer	0	0	0
Cycle	0	0	0
Cycle Rickshaw	0	0	0
Animal Drawn Cart	0	0	0
Grand Total (Nos.)	**271**	**240**	**194**
Grand Total (PCUs)	**347**	**337**	**260**

Entire project highway was divided into three homogenous sections. Each count location represents separate homogenous section. The first homogenous section carries maximum traffic in terms of numbers and PCUs respectively.

4.1.5.3 Annual average daily traffic (AADT)

AADT is the base year (2015) traffic. This is a product of ADT and seasonal variation factor. Seasonal variation factor can be derived using various methods. Vehicle data from toll booths check posts etc. or sale details of petrol and diesel fuels along the highway are the commonly used sets of data.

The traffic volume survey along the Project Highway has been carried out in month of September and October 2015 and through local enquires, it was understood that, except the Hornbill festive season of December month, when the traffic is on slightly higher side as compared to the other months of the year, a constant seasonal factor of 1.0 for this has been considered for converting ADT to AADT. AADT vehicle type wise at various locations along the project highway is shown in **Table 4.6** Summary of ADT & AADT.

Table 4-6: Annual Average Daily Traffic at Count Locations

Vehicle Type	Chidema	Pfutsero	Losami
	km 13.000	**Km 64.500**	**km 107.000**
Car / Jeep / Van (Private)	173	129	106
Car / Jeep (Taxi)	0	0	0
Shared Jeep	0	0	0
Mini Bus	0	0	0
School. Bus	0	0	0
Govt. Bus	9	9	7
Pvt. Bus	0	0	0
Maxx/Pick-Up	0	0	0
LCV (4 tyre)	0	0	0
LCV	25	30	27
2 Axle trucks	31	40	26
3 Axle trucks	0	0	0
MAV (4 to 6 Axles)	0	0	0
MAV (> 6 Axles)	0	0	0
Others	0	0	0
3 Wheeler	0	0	0
2 Wheeler	33	32	28
Agriculture Tractor	0	0	0
Agriculture Tractor with Trailer	0	0	0
Cycle	0	0	0
Cycle Rickshaw	0	0	0
Animal Drawn Cart	0	0	0
Grand Total (Nos.)	**271**	**240**	**194**
Grand Total (PCUs)	**347**	**337**	**260**

In the **Table 4.7** given above clearly suggests that traffic at Km 13.000 (Chidema) and Km 64.500 (Pfutsero), starting and second location on the highway is the maximum. This traffic is mainly due to the presence of settlements in close vicinity of

the three locations and is local in nature. It is observed that at three locations the traffic is more or less similar.

Table 4-7: Summary of ADT and AADT at count locations

Location	ADT		AADT	
	Nos.	PCUs	Nos.	PCUs
km 13.000	271	347	271	347
Km 64.500	240	337	240	337
km 107.000	194	260	194	260

4.1.5.4 Daily Variation of traffic

Daily variation of traffic in PCU for all locations is shown in **Figure 4.2**. Daily variation of traffic in terms of day factors at each of the count location is presented in **Table 4.8.**

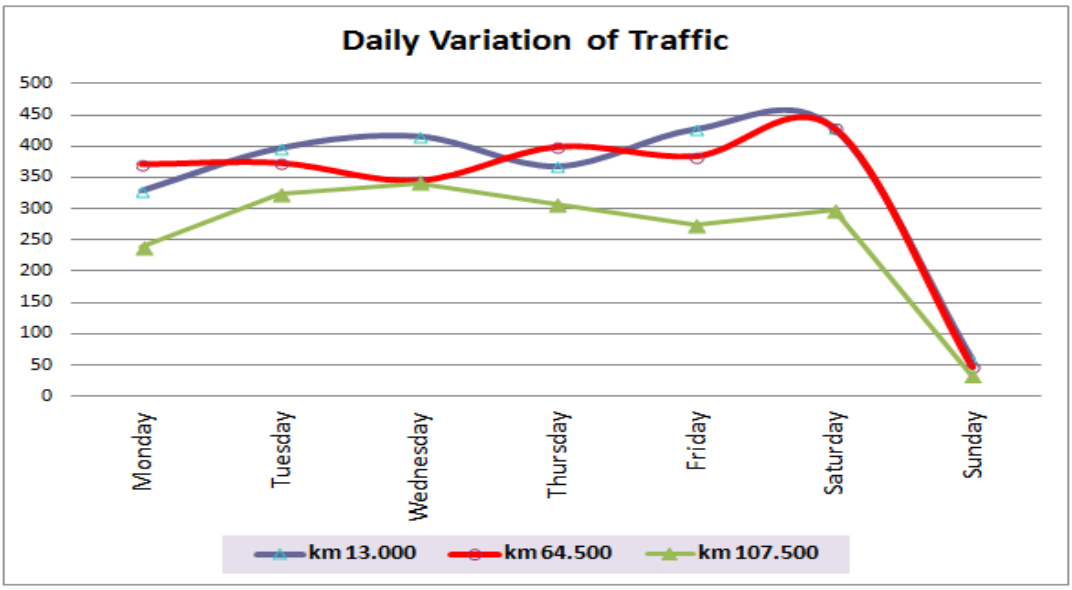

Figure 4-2: Daily Variation of Traffic

Figure 4.2 shows the daily variation of traffic flow at all three count locations, separately. The passenger and commercial vehicle flow at all locations had different trend in variation. It is observed that the traffic on weekdays is constant at all the three locations and on the Sunday the traffic falls significantly, due to holiday.

Table 4-8: Day Factors and Maximum Variations

Location	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Maximum Variation	
								-ve (%)	+ve (%)
km	-5.3%	14.4%	19.7%	5.9%	23.1%	23.5%	-	-	23.5%

Location	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Maximum Variation	
								-ve (%)	+ve (%)
13.000							83.4%	83.4%	
Km 64.500	10.1%	10.7%	2.4%	18.4%	13.9%	27.3%	-86.1%	-86.1%	27.3%
km 107.000	-7.7%	24.9%	31.6%	18.5%	6.0%	14.6%	-86.7%	-86.7%	31.6%

Daily variation factor is the variation of each day's traffic to the average daily traffic. Maximum traffic is seen at Chidema (Km 13.000) any day of the week followed by Pfutsero (Km 64.500).

4.1.5.5 Hourly variation of traffic

Average hourly variation of traffic for all three count locations is shown in **Figure 4.3**. The peak hour at various locations along the project road varies and is different for different locations.

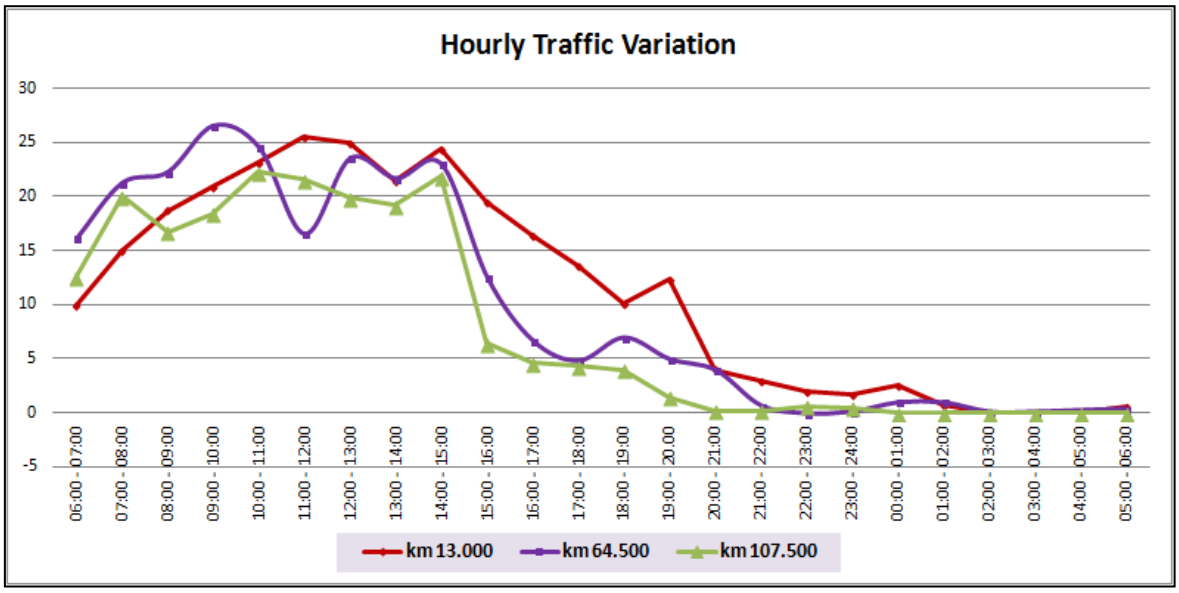

Figure 4-3: Hourly Traffic Variation

The graph indicates that the traffic falls and become equivalent to nil during the night hours at all 3 locations.

4.1.5.6 Peak hour traffic

The peak hour traffic at three locations is presented in **Table 4.9** below. The peak hour traffic ranges between 10.7% - 12.4% of the total daily traffic at three locations respectively.

Table 4-9: Peak Hour of Traffic

Location	Peak hour	PHF	Peak hour PCU
km 13.000	14:00-15:00	10.7%	37
Km 64.500	12:00-13:00	11.7%	39
km 107.000	14:00-15:00	12.4%	32

4.1.5.7 Directional Distribution of Traffic

Directional split at each of the location is shown in **Table 4.10**. This is a useful input for capacity analysis. As seen, the directional split for up and down traffic is nearly equal.

Table 4-10: Directional Split

Location	Kohima-Jessami	Jessami-Kohima
km 13.000	51.5%	48.5%
Km 64.500	50.8%	49.2%
km 107.000	50.3%	49.7%

4.1.5.8 Origin – Destination Survey

The O – D survey has been carried out on random sample basis and sample size obtained for each class of vehicle is shown in **Table 4.11** below.

Table 4-11: Sample Size for O&D Survey

Vehicle Type	Km 13.000		Km 64.500		Km 107.000	
	AADT	% Sample	AADT	% Sample	AADT	% Sample
Car / Jeep / Van	173	82.1	129	76.2	106	95.3
Govt. Bus	9	77.8	9	77.8	7	66.7
LCV	25	91.7	30	46.7	27	76.9
2 Axle trucks	31	90.3	40	74.4	26	100.0

The collected data were entered into the computer and checked manually. Incorrect entries were corrected by cross-checking it with original field data sheets. The data was also checked for inconsistencies. The checking included:

- Trips from zones to zones which cannot possibly ply through the survey location
- Vehicle type with their corresponding lead / load / occupancy for any inconsistencies

The checked and corrected data were used for final analysis.

4.1.5.9 Zoning System

For analysis of data collected from the field, it is required to code them for developing origin and destination matrices of trips. The project highway is in the state of Nagaland and Manipur in the Kohima, Phek and Ukhrul district. The zones were decided based on these facts. 36 zones were considered along the project highway and other zones. Neighboring districts and remaining districts of Nagaland and Manipur considered as IIA region and rest of India were grouped to form external influencing zones. The zones are listed in **Table 4.12**.

Table 4-12: Adopted Zoning System for the Study

Zone No.	Zone Name	State
1	Teen Patti Junction, Kohima	Along the project corridor
2	Kohima, Pfuchatsumia Khal	
3	Chakhabama	
4	Kikruma	
5	Pfutsero	
6	Chizami	
7	Losami	
8	Lozaphumu	
9	Jessami	
10	Kisama Naga, Kigwema	Kohima District
11	Dzukou Vally, Viswema, Mt Japfu	
12	Khonoma, Dzulekie	
13	Chiephobozou, Tseminyu, Tesophenyu, Kandinyu	
14	Phek	Phek District
15	Chetheba	
16	Chozuba Ruzazho	
17	Thevopisu, Zanibu Lake	
18	Meluri	
19	Wazeho, Shilloi, Phokhungri, Avang Khung	
20	Dimapur District	Rest of Nagaland State
21	Peren District	
22	Kiphire District	
23	Zunheboto District	
24	Wokha, Mokokchung Districts	
25	Tuensang, Longleng, Mon District	
26	Ukhral District	Manipur State
27	Rest of Manipur	
28	Guwahati	Assam State
29	Diphu, Nagaon, Marigaon Districts	
30	Haflong, Silchar, Karimganj, Haliakandi	

Zone No.	Zone Name	State
	Districts	
31	Rest of Assam	
32	Meghalay State	North East States
33	Tripura, Mizoram	
34	Arunachal Pradesh	
35	West Bengal	Rest of India
36	All States	

4.1.5.10 Expansion Factors and Development of O – D Matrices

The origin – destination details were collected from the trip makers during the survey on sample basis. Sampling varied with the changes in traffic flow across the day. Care has been taken to eliminate any element of bias in sampling. Since data was collected on sample basis, expansion factors are required to replicate the pattern as reflected in the sample to the total number of vehicular trips made during the day. These expansion factors are calculated separately for each class of vehicle. For example, if xc is number of cars interviewed and Xc is the total number of cars counted during the day, then Xc/xc would be the expansion factor for cars.

O – D matrices are developed to assess the traffic movement pattern. These matrices actually speak about distribution of trips for each zone as intra zonal and inter zonal movements. The vehicle wise O – D matrices are developed by multiplying the sample O – D matrix obtained from survey data with expansion factors.

O-D matrices for different vehicle type for project stretch at all survey locations are presented in **Appendix G2** to this report.

4.1.5.11 Lead Distribution

The distribution of vehicles as revealed from O – D survey is given in Table below. Mini bus is included in this, as its trips also impart important characteristics about distances. The lead distribution of vehicles as revealed from O – D survey is given in **Table 4.13** below.

Table 4-13: Trip Lead Distribution

Vehicle type	0-20	20-50	50-100	100-200	200-500	500-1000	> 1000	Total
km 13.000								
Car/Jeep/Van	1.7	3.4	16.7	44.3	33.9	0.0	0.0	100
Govt. Bus	0.0	0.0	30.0	40.0	30.0	0.0	0.0	100
LCV	8.7	21.7	56.5	13.0	0.0	0.0	0.0	100

Vehicle type	0-20	20-50	50-100	100-200	200-500	500-1000	> 1000	Total
Two Axle Trucks	3.2	29.0	32.3	35.5	0.0	0.0	0.0	100
Km 64.500								
Car/Jeep/Van	3.8	2.3	22.3	46.9	24.6	0.0	0.0	100
Govt. Bus	0.0	0.0	44.4	44.4	11.1	0.0	0.0	100
LCV	13.8	24.1	48.3	13.8	0.0	0.0	0.0	100
Two Axle Trucks	5.1	17.9	56.4	20.5	0.0	0.0	0.0	100
km 107.000								
Car/Jeep/Van	12.4	1.9	26.7	36.2	22.9	0.0	0.0	100
Govt. Bus	0.0	0.0	42.9	28.6	28.6	0.0	0.0	100
LCV	14.8	29.6	44.4	11.1	0.0	0.0	0.0	100
Two Axle Trucks	11.1	22.2	44.4	22.2	0.0	0.0	0.0	100

Major share of both passenger and goods vehicles is in the range 50-100 Km. At Km 13.000 we see maximum trips in 50-100 and 200-500 Km trip length range. Combine major share of goods vehicle trip range is in 50-100 Km range. This indicates that the traffic movement is mainly local in nature with few long distance trips.

4.1.5.12 Commodity groups and analysis

The different commodities recorded during the O – D survey have been classified in 10 categories as presented in **Table 4.14.** Due considerations has been given to include all possible commodities and to categorize them into homogeneous groups.

Table 4-14: Commodity Type

Code	Commodity
1	Agricultural Products
2	Milk, Poultry & Livestock
3	Construction Material
4	Industrial Products
5	Petroleum products
6	Household Material
7	Consumer Goods /Merchandise
8	Forest Product
9	Others
10	Empty

The commodity movement pattern along the corridor is analyzed and presented in **Table 4.15**.

Table 4-15: Commodity Distribution

Commodity Type	Km - 13.00		Km – 64.500		Km – 107.000	
	LCV	2Axle	LCV	2Axle	LCV	2Axle
Agricultural Products	4.2	6.7	12.9	4.9	3.8	14.8
Milk, Poultry & Livestock	4.2	16.7	12.9	12.2	3.8	18.5
Construction Material	16.7	20.0	16.1	14.6	11.5	11.1
Industrial Products	0.0	3.3	0.0	4.9	0.0	3.7
Petroleum products	8.3	0.0	9.7	4.9	0.0	7.4
Household Material	0.0	6.7	9.7	4.9	11.5	3.7
Consumer Goods /Merchandise	4.2	6.7	9.7	4.9	11.5	3.7
Forest Product	33.3	23.3	6.5	22.0	34.6	14.8
Others	4.2	6.7	6.5	4.9	3.8	3.7
Empty	25.0	10.0	16.1	22.0	19.2	18.5
Total	**100**	**100**	**100**	**100**	**100**	**100**

The commodity movement pattern indicates that the major share is that of the forest products followed by construction material and milk, poultry livestock.

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4.1.6 Turning movement count Survey

Data analysis of turning movements at two major junctions reveals that generally peak hours are staggered. Salient features of intersection counts are presented in **Table 4.16**.

Table 4-16: Intersection Traffic on Major and Minor Road

Name of Junction	Peak Hour	Peak Hour Traffic (PCU)	Daily Traffic (PCU)	Peak Hour Share
Km 29.100 Chakhabama	12:00-13:00	44	552	8%
km 102.000 Phek Village	08:00-09:00	46	357	13%
121.360 Phek Town Road	12:00-13:00	40	258	16%
133.650 Jessami	09:00-10:00	112	1116	10%

Peak hour share at all the junctions are around 8-16%.

All of the above junctions for which traffic survey had been conducted is well below the suggested traffic figures of 10,000 PCU s/hr within design period, as per IRC 92

Guideline or as per IRC 62-1976, hence none of the above demand grade separation. Neither these call for signal control as per the warrants stipulated as per guidelines of IRC-93-1985

All the intersections carry relatively lower traffic level, however with the two laning of existing single lane road, the geometry of the all the major intersection shall be improved with proper channelization and safety appurtenants in accordance with the IRC guideline.

4.1.7 Analysis of Pedestrian Count Survey

Pedestrian-vehicular conflict can be effectively studied through the indicator suggested in IRC 103-1988, 'Guidelines for Pedestrian Facilities'. The code suggests some form of control measure at mid blocks and intersections where the indicator PV2 is greater than or equal to 2 x 108. Where 'P' is the peak hour pedestrian volume and 'V' is the number of vehicles in that peak hour. The analysis was undertaken separately for each of the intersection where traffic surveys were conducted. A summary of the peak values for PV2 and the hour in which the same is observed is presented in **Table 4.17.**

Table 4-17: Intersection Traffic on Major and Minor Road

Sl. No.	Location	Chainage (km)	Hour	P	V	$PV^2/108$
1	Pfutsero	Km 67.80	16:00-17:00	42	10	0.00004
2	Chizami	Km 89.90	09:00-10:00	45	5	0.00001

It can be seen that the two locations, indicator PV^2 is less than 2; therefore no control measures are required at both locations for pedestrian safety.

4.1.8 Speed Delay Survey

The purpose of this survey was to identify the critical locations or bottlenecks and to assess the existing level of service of traffic operations. Information collected from this survey included journey time, journey speed, vehicular delay, Causes of Delay etc.

The survey data was analysed to assess the journey and running speeds on the Project Highway. The results are presented in **Table 4.18.**

Table 4-18: Observed Speed along the Project Highway

S. No.	Direction	Journey speed (Kmph)	Running Speed (Kmph)
1	Kohima-Jessami	41.03	41.14
2	Jessami-Kohima	39.06	39.37

The Journey speed and Running speed of the vehicles along the highway is in the range of 39-41 kmph.

4.2. Traffic Forecast and Toll Strategy

4.2.1 Introduction

Investment priorities are governed by the traffic demand, assessed benefits and cost of the project. Demand plays the important role, governing which type of facility / infrastructure needs to be created. This in turn determines likely benefits and costs to develop the same. A highway project of this nature calls for significant investment. Prediction of traffic demand becomes an important task and has to be carried out near accurately. Accurate estimation of traffic has direct bearing on the viability of the project. Recognizing this, efforts need to be made to carefully assess all the parameters that help in predicting the traffic demand in future, which necessitates realistic estimation of traffic growth rates. Traffic growth on a road facility is generally estimated on the basis of historical trends. In the present case, traffic growth rates have been estimated using elasticity method as per **IRC: 108 – 1996**. Demand changes are usually because of shifts in the pattern of economic activities in the surrounding regions. Hence, future traffic estimation necessitates a preview, however imprecise, of the probable pattern of future growth of the economy.

4.2.2 Past Vehicle Registration Details

It is revealed from OD survey that the project highway is mainly influenced by Nagaland and Manipur states. Thus, for establishing the growth rates, data of Nagaland and Manipur state have been considered. The vehicle registration data of two states have been collected and presented in **Table 4.19** below.

Table 4-19: Past vehicle registration data

Year	Car / Jeeps	Two Wheelers	Buses	Trucks
Nagaland				
2004-05	56865	39989	3863	48016
2005-06	59994	42851	4060	52076
2006-07	63946	45961	4262	56951
2007-08	67562	48976	4422	61926
2008-09	70760	52119	4694	67524
2009-10	73872	55208	5538	73730
2010-11	76562	61085	5395	84547
2011-12	80157	61,546	5542	93439
2012-13	84327	66150	5748	101727
CAGR	**5.05**	**6.49**	**5.09**	**9.84**
Manipur				
2004-05	18170	80557	2480	7804

Year	Car / Jeeps	Two Wheelers	Buses	Trucks
2005-06	20178	86931	2570	8600
2006-07	20819	93595	2634	9083
2007-08	21635	105465	2727	9461
2008-09	21635	105465	2727	9461
2009-10	28180	139650	2769	10510
2010-11	30816	145286	2776	11456
2011-12	32107	148942	2868	12653
CAGR	**8.47**	**9.18**	**2.10**	**7.15**
All India				
Year	***Commercial Vehicles***			
2001-02	2973740			
2002-03	3491637			
2003-04	3748484			
2004-05	3877622			
2005-06	4274984			
2006-07	5118880			
2007-08	5600938			
2008-09	6040924			
2009-10	6431926			
2010-11	7064495			
2011-12	7658391			
CAGR	**9.92%**			

Source:
- *Road Transport Year Data Book by MORTH Publication, New Delhi*
- *Respective state govt. transport department publication*

Source: India Stat Organization, Central Statistical Organization.

4.2.3 Past Growth of the Economy

Growth of traffic on the project highway is influenced by existing development and future growth prospects of the influencing regions. The time series data of state income NSDP at constant (1999-00) prices, state population, per-capita income of PIA states and GDP as published by Central Statistical Organization have been collected and studied to assess the past performance of the influencing state economies. **Table 4.20** depicts these economic indicators.

Table 4-20: Economic Indices of States and India at Constant Prices

(1999 - 00)

Year	NSDP (Rs.)	% growth	Per capita NSDP (Rs)	% growth
Nagaland				
2004-05	542146		30441	
2005-06	598609	10%	33072	8.6%
2006-07	645367	8%	35074	6.1%

Year	NSDP (Rs.)	% growth	Per capita NSDP (Rs)	% growth
2007-08	697836	8%	37317	6.4%
2008-09	742169	6%	39041	4.6%
2009-10	784196	6%	40590	4.0%
2010-11	858719	10%	43992	8.4%
2011-12	929119	8%	46340	5.3%
2012-13	988690	6%	48111	3.8%
2013-14	1052220	6%	49963	3.8%
CAGR	**7.65**		**5.66**	
Manipur				
2004-05	460330		18547	
2005-06	490705	7%	19341	4.3%
2006-07	499219	2%	19250	-0.5%
2007-08	526666	5%	19868	3.2%
2008-09	565217	7%	20861	5.0%
2009-10	603949	7%	21810	4.5%
2010-11	586166	-3%	20711	-5.0%
2011-12	641225	9%	22169	7.0%
2012-13	683740	7%	23130	4.3%
2013-14	726319	6%	24042	3.9%
CAGR	**5.20**		**2.93**	
All India				
Year	NSDP	% growth	Source : Central Statistical Organization (CSO), Govt. of India	
2004-05	2971464			
2005-06	3253073	9%		
2006-07	3564364	10%		
2007-08	3896636	9%		
2008-09	4158676	7%		
2009-10	4516071	9%		
2010-11	4918533	9%		
2011-12	5247530	7%		
2012-13	5482111	4%		
2013-14	5741791	5%		
CAGR	7.59%			

4.2.4 Transport Demand Elasticity

As discussed earlier, the elasticity approach has been used for determining growth rates of future traffic. Since time series traffic data on project road is not available, traffic growth rates and elasticity values are established by using registered vehicles as the dependent variable.

Description of Regression Analysis

The Regression Analysis tool performs linear regression analysis by using the "least squares" method to fit a line through a set of observations. We can analyze how a single dependent variable is affected by the values of one or more independent variables. In the present case, registered vehicles by type are the dependent variables whereas the economic parameters are independent variables. Once the relation is established by regression, the measures explained below are used to accept or reject the same.

t-statistic

The t-statistic is a measure of how strongly a particular independent variable explains variations in the dependent variable. The larger the t-statistic, the better is the independent variable's explanatory power.

R Square

R Square is another measure of the explanatory power of the model. In theory, R square compares the amount of error explained by the model as compared to the amount of error explained by averages. The higher the R-Square, the better it is. Regression analysis is carried out by creating econometric models which are suggested in IRC: 108 - 1996 using past vehicle registration data of and economic indicators, like, Population and PCI for passenger vehicles and NSDP for freight vehicles. All India registered trucks are also regressed with GDP (Gross Domestic Product) to estimate national level elasticity value for trucks and its growth rate. The elasticity values obtained for each class of vehicle are given in **Table 4.21**.

Table 4-21: Elasticity Values Derived based on Regression Analysis

Mode	Variable	Elasticity	R square	T-STAT	CAGR(GR)
Car	POP	0.77	0.994	3.505	5.51
	PCI	0.62		1.320	
	PCI	0.85	0.993	30.54	6.52
	POP	2.78	0.982	19.77	5.23
Two Wheelers	POP	0.00	0.992	0.00	2.10
	PCI	1.12		4.06	
	POP	3.62	0.970	14.96	6.80
	PCI	1.12	0.992	29.26	6.32
Buses	POP	1.06	0.922	0.44	10.74
	PCI	0.62		0.83	
	POP	3.07	0.913	8.59	5.76
	PCI	0.94	0.920	8.97	5.32
	NSDP	0.00	0.000	0.00	0.00
Trucks	NSDP	1.29	0.99	30.963	9.89
Trucks	NSDP	1.19	0.99	26.31	9.03

Mode	Variable	Elasticity	R square	T-STAT	CAGR(GR)
(All India) 10 Year data					

4.2.4.1 Projected transport demand elasticity

Considering the Project Influence Area (PIA) and economic indicators of Rajasthan and Madhya Pradesh, the projected elasticity values for various vehicle types are presented in **Table 4.22** which is used to estimate the growth rates of each vehicle type.

Transport demand elasticity by vehicle type, over a period of time, tends to decline and approach unity or even less. As the economy and its various sectors grow, every region tends to become self-sufficient. Moreover, much of the past growth has been associated with the country's transition from a largely rural subsistence economy to cash-based urban economy, dominated by regional and national linkages. As the transition proceeds, its impact on transport pattern can be expected to become less dominant. Therefore, the demand for different type of vehicles falls over time, despite greater economic development. In other words the values of elasticity tend to decrease with economic development in future years due to changes in the structure of economy, with higher contribution from service sector and higher value of industrial outputs. The same is also clear from the relationships of the economy and transport demand elasticity over time, both nationally and internationally.

Table 4-22: Projected Transport Demand Elasticity Values

Vehicle Type	Indicator	2017-21	2022-26	2027-31	Beyond 2031
Cars	Population	3.44	3.27	3.11	2.95
Two wheeler	Population	3.97	3.77	3.58	3.40
Bus	Population	0.76	0.73	0.69	0.65
Trucks	NSDP	1.23	1.17	1.11	1.05
Truck (All India)	GDP	1.07	1.02	0.97	0.92

4.2.5 Future Economic Growth: State and National Economies

Against the discussed background, any agenda for future growth of the state economies has to take into account past trends, future prospects, and the emerging challenges. The growth prospects for the state have been developed taking into consideration the past performance of the state economies and the economic growth envisaged for the future. The pace with which the regional economies grow with the envisaged growth of the state is a major contributing factor in growth of traffic.

Based on the present NSDP growth of Nagaland and future policies of the government, the projected NSDP, Population and PCI growth rates estimated and presented in Table 7.23. The growth of NSDP of Nagaland has been 1.23 per cent (Analysis by Time Series Data). Therefore, considering the present economic

scenario, a realistic growth of 1.23% to 1.05% is assumed for the four periods for Nagaland state.

Considering the present GDP growth and its future targets, a realistic growth rate of 6.5% to 5.0% has been assumed. The perspective economy growth rates considered are presented in **Table 4.23**.

For traffic projection various methods and tools are there in practice. The methods suggested by IRC: 108 – 1996, "Guidelines for traffic prediction on rural highways" have been used as they account for economic performances and other social parameters.

From the above discussions the projected growth rates of GDP, NSDP, Population and Per-capita income are presented in **Table 4.23**. These growth rates are used in estimating future traffic growth rates.

Table 4-23: Projected growth rates of Economic indicators

Indicator	2017-21	2022-26	2027-31	Beyond 2031
NSDP	6.80	6.46	6.13	5.83
PCI	5.16	4.90	4.65	4.42
Population	1.64	1.56	1.48	1.41
GDP (All India)	6.5	6	5.5	5

4.2.6 Traffic Forecasting Methodology

The growth rates are found using the formulae Eqn (a) & (b).

For Passenger vehicles,

$$G = R_i \times E/100$$ ……Eqn. (a)

Where Ri = Growth in PCI and Population index
E=Elasticity Value

For commercial vehicles,

$$G = \sum[(R * E * I)State, (R * E * I)India]$$ ……Eqn. (b)

Where,

R = Economic index (NSDP/GDP)
E = Elasticity Value
I = Influence factor

Influence factor is estimated from OD survey analysis

The Estimated Growth rates arrived based on multiplying Elasticity values and growth in Economic factors is tabulated in the **Table 4.24**. The share of goods traffic (Influence factor) in Nagaland and from rest of India is applied in estimating growth rate of goods traffic.

Normally, the growth potential of passenger traffic in a zone depends on its population and economic growth rates. Therefore, both these parameters have been incorporated in forecasting of passenger traffic. Further, taking into account the fact that the different modes of passenger traffic grow at different rates, the elasticity (as discussed earlier) with respect to population and income growth rates is graded differently by different modes, incorporating the same for both the states.

Growth potential of goods traffic is different from passenger traffic. This is more directly related to zone's economic activity and production levels than its population and income growth, although the latter may strongly correlate with the former, especially the income growth.

Considering Most Likely scenario of the above discussed points, the growth rates were conceived using methods discussed earlier and have been modified accordingly. The basic growth factors are considered to be realistic rates. The final recommended growth rates are given in **Table 4.24**.

Table 4-24: Estimated and Recommended Traffic Growth Rates

Vehicle type	2017-21	2022-26	2027-31	Beyond 2031
Most likely Scenario				
Car	4.40	3.97	3.58	3.23
Two Wheelers	5.76	5.20	4.69	4.23
Bus	4.84	4.37	3.94	3.56
LCV	11.72	10.20	9.12	8.20
2AT	6.62	5.80	4.96	4.16
3Axle	5.0	5.0	5.0	5.0
MAV	5.0	5.0	5.0	5.0

The forecasted traffic for one scenario at homogenous sections is presented in **Appendix H** to this report.

4.2.7 Traffic Forecast for Non–Motorised Traffic

The slow moving vehicles essentially cater to short haul traffic, meeting localised demand for transportation of individual passenger and goods to market centres and urban centres. Non–motorised traffic, especially pedal cycles, will be gradually being replaced by motorised vehicles. Therefore, it is assumed that animal drawn vehicles' and pedal cycles' volume are expected to decline by a negative growth of 2 per

annum because of economic improvement. The growth rates of tractors have been however considered as 3 per annum.

4.2.8 Diverted, Induced and Generated Traffic

Normal Traffic: The normal traffic which is presently plying on the project highway.
Generated Traffic: Traffic which will come on project highway, due to its up gradation

Diverted Traffic: Traffic that may divert to the alternative route due to toll imposed on the project highway and due to resultant

Total Traffic: The total Traffic will include generated traffic- diverted traffic (from/to the project highway)

Generated/Induced Traffic: It is expected that once the Project Highway is upgraded to 2-lane standards, there will be an addition of generated traffic from tourists visiting Kohima and other regions in Nagaland state. Secondary data has been collected from the Statistical Handbook 2013, Nagaland for tourist arrivals, from 2001 to 2012 and it has been projected till 2018 to arrive at the additional tourist traffic. The tourist arrivals data is as presented in table below:

Table 4-25: Tourist Arrival Data

Year	International Tourist arrivals	Domestic Tourist arrivals	Total
2000	451	13268	13719
2001	920	29952	30872
2002	526	13543	14069
2003	870	14870	15740
2004	1084	10056	11140
2005	883	17470	18353
2006	576	15850	16426
2007	936	22085	23021
2008	1219	21129	22348
2009	1423	20953	22376
2010	1132	21094	22226
2011	2000	25000	23337
2012	2173	28945	24504

Source: Nagaland-Statistical Handbook 2013

It has been considered that the peak month would be catering to 30% of the total tourist arrivals. Following assumptions have been made to arrive at the passenger traffic due to tourist arrivals.

The percentage composition of cars has been taken as 90% while for buses it has been considered 10%. The occupancy of cars is considered as 4 while for buses it has been taken as 20. The total tourist details are given in **Table 4.26**.

Table 4-26: Generated Traffic

Particulars	Cars	Buses
Tourist per Day	328*	
Percentage share	90%	10%
Occupancy	4	20
Number of vehicles per day	74	2
PCU	1	3

**Source: Nagaland-Statistical Handbook 2013*

Diverted Traffic: There will be no diverted traffic as there is no alternate road exists.

4.2.9 Tentative Toll Plaza Location

The Project Highway is divided into two sections for toll revenue estimation purpose. First toll plaza is proposed near km 13.000 for first section from km 7.880 to km 75.000 and second toll plaza is proposed near km 85.000 for section from km 75.000 to km 128.970 after considering the guidelines for locating toll plazas and optimization of toll revenue. Table 4.27 below depicts the locations of toll plazas.

Table 4-27: Toll Plaza Locations

Toll plaza	Proposed Chainage	Village / location	Tollable section	Tollable length (km)	Tollable PCU in 2015-16
TP-1	km 13.000	Near Chidema	km 7.880 to km 75.000	**67.120**	331
TP-2	km 85.000	Near Pfutsero	km 75.000 to km 128.970	**53.970**	246

4.2.10 Schedule of User Fee

As per Rule 3 of National Highways Fee (Determination of Rates and Collection) Rules, 2008, of concession agreement for the Project, the per km base fee/toll rates as applicable from 2007-08 are given in Table 4.10. The escalated values for 2018-19 rates are given in Table 4.28.

Table 4-28: Toll Rates Adopted (in Rs)

S. No.	Category of Vehicle	Capping Rate of base fee per vehicle per one way trip For 2007-08 (in rupees per km)	Capping Rate of base fee per vehicle per one way trip For FY-19 (in rupees per km)*
1	Car, Jeep, Van	0.39	0.66
2	Light Commercial Vehicle or Mini Bus	0.63	1.07
	Bus or Truck (2 Axle)	1.32	2.25
3	3 Axle Truck	1.44	2.45
4	HCM, EME, MAV (4-6 Axle)	2.07	3.53
5	Oversized Vehicle (>7 Axle)	2.52	4.30

4.2.11 Tollable Traffic

4.2.11.1 Discounts

There are certain discounts allowed for local traffic / frequent users as per the NHAI user fee policy. The executing authority or the concessionaire, as the case may be, shall upon request provide a pass for multiple journeys to cross a toll plaza within the specified period at the rates specified. Tollable traffic will have various components based on number of trips and trip distances. **Table 4.29** below gives percentages of various types of tickets they go for.

Certain vehicles who prefer monthly passes will also be returning on the same day. Similarly, some of through vehicles who take daily ticket will go for return ticket also. That means same vehicles will be crossing toll plaza more than once. But, in the volume count they will be counted separately, as many times as they pass the count locations. Buses will be crossing the count location / toll plaza many times in a day.

The O – D survey provides us with valuable information in this regard. The percentages of each type are derived from the number of appearance of vehicles in the data. The frequency of each type is calculated by considering the multiple entries. Subsequent reductions have been done to arrive at exact component of each type, so that they are not considered as tollable traffic repeatedly. The AADT figures can be directly multiplied by the respective component (%) values in the table to arrive at tollable traffic. The varying travel characteristics of vehicles such as more than 2 trips a day, 2 – 3 trips in a week etc are also depicted for quick reference.

Table 4-29: Tollable Component of each Mode of Vehicle

Mode of vehicle	Categories	TP-1	TP-2
Car/Jeep /Van	Travel < 20km	1.0	1.8
	Monthly pass	1.5	2.1
	Through daily (one entry)	61.3	55.4
	Through daily (re entry)	36.2	40.7
Taxi	Monthly pass	0.0	0.0
	Through daily (one entry)	100.0	100.0
	Through daily (re entry)	0.0	0.0
Mini bus	Monthly pass	0.0	0.0
	Through daily (one entry)	100.0	100.0
	Through daily (re entry)	0.0	0.0
Std. Bus	Monthly pass	0.0	0.0
	Through daily (one entry)	60.0	46.7
	Through daily (re entry)	40.0	53.3
Goods Pickup	Monthly pass	0.0	0.0
	Through daily (one entry)	100.0	100.0
	Through daily (re entry)	0.0	0.0
LCV	Monthly pass	2.6	4.1
	Through daily (one entry)	47.8	45.2
	Through daily (re entry)	49.6	50.7
2-Axle truck	Monthly pass	0.0	1.5
	Through daily (one entry)	63.5	54.1
	Through daily (re entry)	36.5	44.4
3-Axle truck	Monthly pass	0.0	0.0
	Through daily (one entry)	100.0	100.0
	Through daily (re entry)	0.0	0.0
MAV	Monthly pass	0.0	0.0
	Through daily (one entry)	100.0	100.0
	Through daily (re entry)	0.0	0.0

4.2.11.2 Tollable Traffic Projection

The Projected tollable traffic under different toll paying categories from FY 2015-16 to FY 2049-50 has been given in **Table 4.30** and **Table 4.31**.

Table 4-30: Projected Tollable Traffic at TP-1

Financial Year	Car / Jeep/ Va	Taxi	Mini bus	Std. Bus	Goods Pickup	LCV	2-Axles	Total	
								Nos	PCU

	n								
FY 2015-16	173	0	0	9	0	25	31	**238**	**331**
FY 2016-17	181	0	0	9	0	28	33	**251**	**349**
FY 2017-18	189	0	0	10	0	31	35	**265**	**371**
FY 2018-19	197	0	0	10	0	35	38	**280**	**394**
FY 2019-20	283	0	0	13	0	39	40	**375**	**501**
FY 2020-21	295	0	0	14	0	43	43	**395**	**531**
FY 2021-22	308	0	0	14	0	49	45	**416**	**559**
FY 2022-23	321	0	0	15	0	54	48	**438**	**591**
FY 2023-24	333	0	0	16	0	59	51	**459**	**623**
FY 2024-25	347	0	0	16	0	65	54	**482**	**655**
FY 2025-26	361	0	0	17	0	72	57	**507**	**691**
FY 2026-27	375	0	0	18	0	79	60	**532**	**728**
FY 2027-28	388	0	0	18	0	86	63	**555**	**760**
FY 2028-29	402	0	0	19	0	94	66	**581**	**798**
FY 2029-30	417	0	0	20	0	102	70	**609**	**840**
FY 2030-31	432	0	0	21	0	112	73	**638**	**882**
FY 2031-32	448	0	0	21	0	122	77	**668**	**925**
FY 2032-33	462	0	0	22	0	132	80	**696**	**966**
FY 2033-34	477	0	0	23	0	143	84	**727**	**1013**
FY 2034-35	492	0	0	24	0	155	87	**758**	**1058**
FY 2035-36	508	0	0	25	0	167	91	**791**	**1107**
FY 2036-37	524	0	0	25	0	181	95	**825**	**1156**
FY 2037-38	541	0	0	26	0	196	99	**862**	**1210**
FY 2038-39	558	0	0	27	0	212	103	**900**	**1266**
FY 2039-40	576	0	0	28	0	229	107	**940**	**1325**
FY 2040-41	594	0	0	29	0	248	111	**982**	**1386**
FY 2041-42	613	0	0	30	0	268	116	**1027**	**1453**
FY 2042-43	633	0	0	32	0	290	121	**1076**	**1527**
FY 2043-44	653	0	0	33	0	314	126	**1126**	**1601**
FY 2044-45	674	0	0	34	0	340	131	**1179**	**1679**
FY 2045-46	696	0	0	35	0	368	137	**1236**	**1764**
FY 2046-47	718	0	0	36	0	398	143	**1295**	**1852**
FY 2047-48	741	0	0	38	0	430	149	**1358**	**1947**
FY 2048-49	764	0	0	39	0	466	155	**1424**	**2045**
FY 2049-50	789	0	0	40	0	504	161	**1494**	**2148**

Table 4-31: Projected Tollable Traffic at TP-2

Financial Year	Car/ Jeep/Van	Taxi	Mini bus	Std. Bus	Goods Pickup	LCV	2-Axles	Total	
								Nos	PCU
FY 2015-16	106	0	0	7	0	27	26	**166**	**246**

Financial Year	Car/ Jeep/Van	Taxi	Mini bus	Std. Bus	Goods Pickup	LCV	2-Axles	Total	
								Nos	PCU
FY 2016-17	111	0	0	7	0	30	28	**176**	**261**
FY 2017-18	116	0	0	8	0	34	30	**188**	**281**
FY 2018-19	121	0	0	8	0	38	31	**198**	**295**
FY 2019-20	203	0	0	11	0	42	34	**290**	**401**
FY 2020-21	212	0	0	11	0	47	36	**306**	**424**
FY 2021-22	221	0	0	12	0	52	38	**323**	**449**
FY 2022-23	230	0	0	12	0	58	40	**340**	**473**
FY 2023-24	240	0	0	13	0	64	43	**360**	**504**
FY 2024-25	249	0	0	13	0	70	45	**377**	**528**
FY 2025-26	259	0	0	14	0	77	48	**398**	**561**
FY 2026-27	269	0	0	14	0	85	51	**419**	**592**
FY 2027-28	279	0	0	15	0	93	53	**440**	**623**
FY 2028-29	289	0	0	15	0	101	56	**461**	**654**
FY 2029-30	300	0	0	16	0	111	59	**486**	**692**
FY 2030-31	310	0	0	17	0	121	61	**509**	**726**
FY 2031-32	322	0	0	17	0	132	65	**536**	**766**
FY 2032-33	332	0	0	18	0	143	67	**560**	**802**
FY 2033-34	342	0	0	19	0	154	70	**585**	**840**
FY 2034-35	353	0	0	19	0	167	73	**612**	**880**
FY 2035-36	365	0	0	20	0	181	76	**642**	**925**
FY 2036-37	376	0	0	21	0	195	79	**671**	**969**

Financial Year	Car/ Jeep/Van	Taxi	Mini bus	Std. Bus	Goods Pickup	LCV	2-Axles	Total	
								Nos	PCU
FY 2037-38	388	0	0	21	0	211	83	**703**	**1017**
FY 2038-39	401	0	0	22	0	229	86	**738**	**1069**
FY 2039-40	414	0	0	23	0	247	90	**774**	**1124**
FY 2040-41	427	0	0	24	0	268	93	**812**	**1180**
FY 2041-42	441	0	0	25	0	290	97	**853**	**1242**
FY 2042-43	455	0	0	26	0	313	101	**895**	**1306**
FY 2043-44	469	0	0	27	0	339	106	**941**	**1377**
FY 2044-45	484	0	0	28	0	367	110	**989**	**1449**
FY 2045-46	500	0	0	29	0	397	115	**1041**	**1528**
FY 2046-47	516	0	0	30	0	430	120	**1096**	**1611**
FY 2047-48	532	0	0	31	0	465	125	**1153**	**1698**
FY 2048-49	549	0	0	32	0	503	130	**1214**	**1790**
FY 2049-50	567	0	0	33	0	544	135	**1279**	**1887**

4.2.12 Toll Revenue

The summary of toll revenue estimate for most likely scenario is presented in **Table 4.32** below:

Table 4-32: Revenue Summary (Crores)

Year		Revenue from Toll plaza @ km TP-1	Revenue from Toll plaza @ km TP-2	Total
Apr-18	**Mar-19**	0.61	0.36	0.97
Apr-19	**Mar-20**	0.80	0.51	1.31
Apr-20	**Mar-21**	0.91	0.56	1.47
Apr-21	**Mar-22**	0.98	0.61	1.59
Apr-22	**Mar-23**	1.11	0.70	1.81
Apr-23	**Mar-24**	1.20	0.77	1.97

Year		Revenue from Toll plaza @ km TP-1	Revenue from Toll plaza @ km TP-2	Total
Apr-24	**Mar-25**	1.34	0.86	2.20
Apr-25	**Mar-26**	1.50	0.95	2.45
Apr-26	**Mar-27**	1.66	1.07	2.73
Apr-27	**Mar-28**	1.81	1.18	2.99
Apr-28	**Mar-29**	2.02	1.31	3.33
Apr-29	**Mar-30**	2.20	1.44	3.64
Apr-30	**Mar-31**	2.44	1.60	4.05
Apr-31	**Mar-32**	2.69	1.77	4.46
Apr-32	**Mar-33**	2.98	1.95	4.93
Apr-33	**Mar-34**	3.28	2.16	5.43
Apr-34	**Mar-35**	3.61	2.37	5.98
Apr-35	**Mar-36**	3.98	2.63	6.61
Apr-36	**Mar-37**	4.36	2.92	7.27
Apr-37	**Mar-38**	4.82	3.21	8.03
Apr-38	**Mar-39**	5.28	3.56	8.84
Apr-39	**Mar-40**	5.88	3.95	9.83
Apr-40	**Mar-41**	6.45	4.36	10.81
Apr-41	**Mar-42**	7.10	4.83	11.93
Apr-42	**Mar-43**	7.92	5.33	13.26
Apr-43	**Mar-44**	8.79	5.91	14.70
Apr-44	**Mar-45**	9.63	6.56	16.19
Apr-45	**Mar-46**	10.69	7.35	18.04
Apr-46	**Mar-47**	11.86	8.16	20.03
Apr-47	**Mar-48**	13.18	9.08	22.26
Apr-48	**Mar-49**	14.54	10.11	24.65
Apr-49	**Mar-50**	16.23	11.22	27.46

4.2.13 Capacity Analysis

Capacity analysis for project highway has been carried out in order to define the Level of Service (LoS) offered by road sections under the prevailing roadway and traffic conditions.

4.2.13.1 Capacity and level of service guidelines

Capacity and design service volumes for various lane configurations specified by IRC: 64 – 1990: 'Capacity of Roads in Rural Areas' has been adopted for determining the Level of Service offered by the road sections during design period.

4.2.13.2 Projected Total (Normal + Generated) Traffic

The projected total traffic is presented in **Table 4.33** and to estimate the generated traffic for the Nagaland regions tourist data is available till 2010 and the mode wise projected traffic is presented in **Appendix H**.

Table 4-33: Projected Total Traffic AADT (Vehicles & PCU)

Year	Km 13.000_Chidema		Km 64.500_Pfutsero		Km 107.000_Losami	
	Vehicles	PCU	Vehicles	PCU	Vehicles	PCU
2015 - 16	271	347	240	337	194	260
2016 - 17	286	367	254	358	205	276
2017 - 18	302	389	269	381	218	293
2018 - 19	319	412	285	405	231	312
2019 - 20	416	521	382	514	324	416
2020 - 21	439	551	404	546	343	442
2021 - 22	463	583	427	580	363	469
2022 - 23	486	614	450	612	382	495
2023 - 24	510	647	473	646	402	523
2024 - 25	536	681	499	683	423	552
2025 - 26	563	718	525	722	446	584
2026 - 27	591	757	554	763	470	617
2027 - 28	619	794	581	802	493	649
2028 - 29	647	833	609	843	517	683
2029 - 30	677	874	639	887	543	719
2030 - 31	709	917	671	934	570	757
2031 - 32	743	963	705	983	599	797
2032 - 33	774	1006	736	1029	626	835
2033 - 34	807	1051	770	1077	655	875
2034 - 35	842	1099	805	1129	685	917
2035 - 36	879	1149	842	1183	716	961
2036 - 37	917	1201	881	1240	750	1009
2037 - 38	957	1257	922	1300	785	1059
2038 - 39	1000	1316	966	1364	823	1111
2039 - 40	1044	1378	1012	1431	862	1167
2040 - 41	1092	1443	1060	1503	904	1227
2041 - 42	1141	1512	1112	1578	949	1290
2042 - 43	1194	1585	1166	1659	995	1356
2043 - 44	1249	1662	1224	1743	1045	1427
2044 - 45	1307	1743	1285	1833	1098	1502
2045 - 46	1369	1830	1349	1929	1153	1582
2046 - 47	1434	1921	1418	2030	1213	1667
2047 - 48	1502	2018	1490	2137	1275	1757
2048 - 49	1575	2120	1567	2251	1342	1853
2049 - 50	1652	2229	1649	2372	1413	1955
2050 - 51	1733	2344	1736	2501	1488	2063
2051 - 52	1820	2466	1828	2638	1568	2179
2052 - 53	1911	2596	1926	2784	1653	2302

Capacity and design service volumes for various lane configurations are specified in IRC: 64 – 1990, 'Capacity of Roads in Rural Areas', IRC-SP: 73-2015 'Manual of Specifications and Standards for Two-laning of Highways with paved shoulders'. The project highway passes through hill terrain predominantly. The design service volume standards for LoS B and LoS C considered as per guidelines are given in Table 4.34 below.

Table 4-34: Design service volume standards

Road	Shoulder Type	Plain Terrain	Rolling Terrain	Hilly Terrain
Single Lane	Earthen shoulders	2000	1800	1600
Intermediate lane	Earthen shoulders	6000	5700	5200
2 Lane	Earthen shoulders	15000	11000	7000
	Paved shoulders	18000	13000	9000

The traffic projections on the project highway do not demand for the 2-laning in the near future. But Ministry vide Circular no NH-14019/6/2012-P&M dated 5th October, 2012 had decided that, henceforth, whenever new projects of widening/bypass/realignment are taken up, the width of the carriageway shall be at least two lane with paved shoulders irrespective of the traffic thereon.

Later vide circular no NH-15017 / 28 / 2018 - P&M dated 23rd March 2018, it was revised that the carriageway width shall be of intermediate lane configurations, i.e. of 5.5m width (18 ft), with two-lane structures (23 ft.) for traffic volumes ranging from 3,000 PCUs/ day to about 8,000/ day in Hilly and Mountainous terrains.

However, as per the Cl.4.2.3 as given in the Minutes of the Meeting vide letter no. NHIDCL/Nagaland/General/2018/6/9 dated 23rd October 2018, it was recommended that the project road should be designed for 2 lane with hard shoulder configuration for cost optimization.

Thus, the project highway is proposed to be made 2-lane with hard shoulders on EPC mode.