

## Two-Laning with Paved Shoulders of Sikar-Bikaner Section of NH-11 in the State of Rajasthan on BOT (Toll Basis)



**Final Traffic Assessment Report**

**FEEDBACK INFRA**  
*Making Infrastructure Happen*

**November 2016**

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## Chapter 1

### *Traffic Surveys and Analysis*

#### 1.1 INTRODUCTION

IL&FS Transportation Networks Limited. has appointed M/s Feedback Infra Pvt. Ltd., a leading Integrated Infrastructure Consulting Company, based at New Delhi to prepare the traffic study 2-lane with paved shoulders from km 357.000 (Sikar) to km 557.775 (Bikaner) section of NH-11 in the state of Rajasthan on BOT (Toll Basis), under Government of India, Ministry of Road Transport and Highways (MORTH) through Public Works Department (PWD) and Government of Rajasthan.

As part of this study, a systematic methodology has been followed to assess the characteristics of the traffic on the project road. The details pertaining to the data collection, primary as well as secondary, and results from its analysis are presented in the following sections.

The present Traffic Report presents the existing traffic characteristics, methodology used to derive traffic growth rates, details on adopted traffic growth rates, forecasted Traffic, divertible traffic and generated traffic if any. Based on these, tollable traffic and toll revenue estimation at the toll plaza locations have been calculated and presented.

#### 1.2 OBJECTIVE AND SCOPE OF SERVICES

The objective of the study is to estimate the base year tollable traffic, projected tollable traffic and related revenues on the project road for the duration of the concession. The scope of services of this study is to:

- 1 day Origin Destination Surveys, 24 hours; at the Toll Plaza Locations
- 1 day Registration Plate Surveys, 24 hours; at the Toll Plaza Locations
- Review the past traffic data on the project stretch and other competing / alternative routes;
- Analyse the network conditions, traffic characteristics and level of toll charged for the competing/alternate routes if any;
- Establish seasonality factors using available past traffic data and /or from using fuel sales data or any other relevant data. Detailed justifications for SCF to be brought out in the report;
- A study of the Project Influence Area, alternate routes to the Project and assessing the possibility of diversion of traffic from / to the Project road under consideration due to existing or future developments;
- Various NHs/ SHs/ other roads linked to project road. Comment on condition of various adjoining/ feeder roads (if any) and their likely impact on future traffic movement on the Project road. Category I class of traffic coming from those roads. Comments on traffic potential viz. normal traffic, diverted traffic (from road and from rail), induced/generated traffic, Project influence areas- districts I' sectors;
- Network Analysis of the project stretch;
- Identify factors which may have a positive and / or negative impact on the Traffic;
- Estimation of the ADT & AADT based on the findings of the study done on the above points;
- Estimation of category wise traffic growth rates at all toll plazas; (please note that if the factors influencing the traffic at all toll plazas are different then the traffic growth rate needs to reflect the same);
- Forecast of category wise tollable traffic annually from current year till end of concession period;
- Forecast of year wise Toll revenue (both vehicle wise and usage wise) from current year till end of concession period (in line with the toll policy and relevant toll schedules in the Concession agreement).

- All traffic data collected shall be in line with relevant Schedule and read with the amendments thereto the Concession Agreement;
- The approach / methodology to be followed and assumptions made for arriving at future traffic projects should be scientific, to be carried out systematically taking into account all socio-economic demographic and traffic characteristics for the project corridor, as followed by leading traffic analysts.

### 1.3 THE PROJECT CORRIDOR

The project corridor from Sikar Bikaner section of NH-11 is located in the state of Rajasthan. The project corridor starts at km 357.000 at Sikar and ends at Bikaner at km 557.775. The total length of the project corridor is 237.578 km. The project road falls under 3 districts namely Sikar, Churu and Bikaner districts of Rajasthan.

The important towns and settlements along the project corridor are Sikar, Laxmangarh, Fatehpur, Ratangarh, Bikaner and Shri Dungargarh. NH 11 is a National Highway in India that links Jaisalmer and Fatehpur. This 495 km long highway passes through Bharatpur, Dausa, Jaipur, Sikar and Fatehpur.

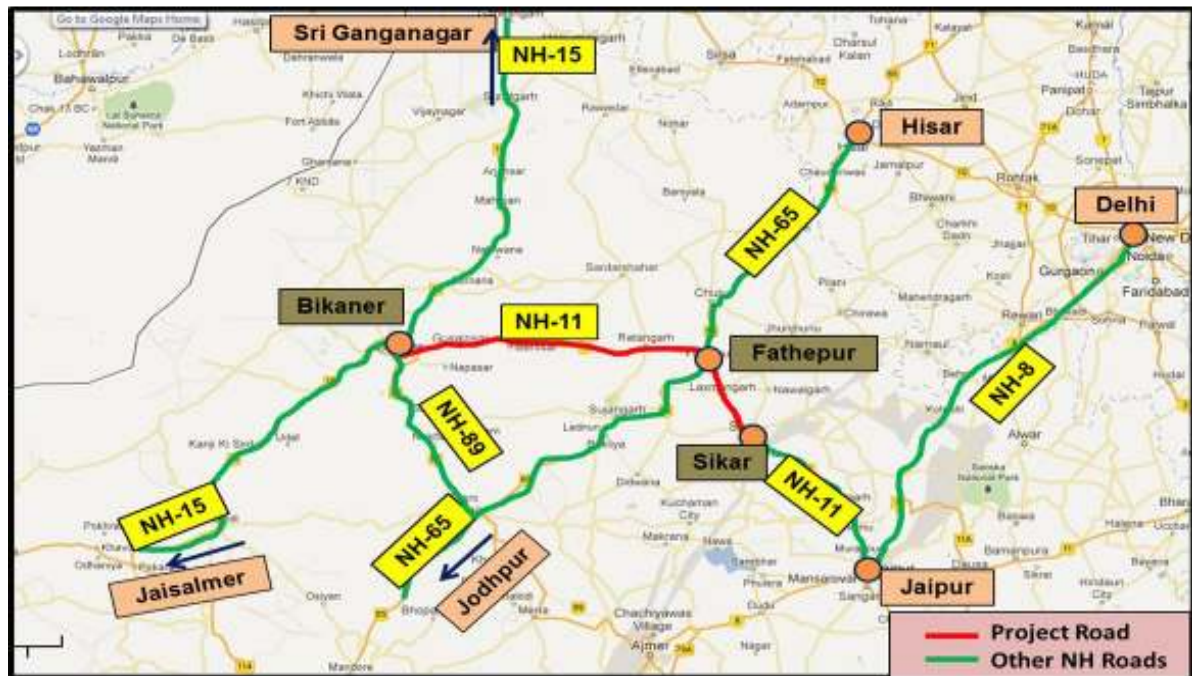


Figure 1-1: Project Stretch

#### Sikar District

The district is located in the north-eastern part of the state of Rajasthan. It is bounded on the north by Jhunjhunu district, in the north-west by Churu district, in the south-west by Nagaur district and in the south-east by Jaipur district. It also touches Mahendragarh district of Haryana on its north-east corner.

Sikar district is one of the semi desert districts of Rajasthan. Agriculture and animal husbandry is the main occupation of the people in this district. It was an industrial backward district but since last few years it appears to have bright future for industrial development due to favorable geographical situation regarding availability of raw material from mineral resources. Bajra, Wheat, Gram, Barley, Rape & Mustard Groundnut, Pulses and Guar are the major crops of the Sikar District.

Animal husbandry plays a vital role in the economy of the district. Sikar, district is very rich in livestock, both quantitatively and qualitatively since rearing of livestock forms an important spare time occupation



of the cultivators of the district. The main livestock of the district are cows, buffaloes, sheep, goats and camels.

### Churu District

Churu district is a district of the Indian state of Rajasthan in western India. The district has good connections within and outside the state. National Highway Nos. 11 (Agra-Bikaner), 65 (Ambala-Pali), and 709 Ext. (Rohtak-Rajgarh) pass through the district. The economy of the town and surrounding area is mainly based on agriculture and animal husbandry. The oilseeds, especially mustard seed, are the predominant crop in recently developed small, well-irrigated fields. Wheat, kharif pulses, bajra (pearl millet), and gwar are other produces. Churu is the main mandi (market) for agricultural produce of the area. There is no large or medium size industry in the industrial area. The main small-scale industries are granite slabs and tiles, cutting and polishing, and mustard seed crushing.

### Bikaner District

Bikaner is a district of the state of Rajasthan in western India. The district is bounded by Ganganagar District to the north, Hanumangarh District to the northeast, Churu District to the east, Nagaur District to the southeast, Jodhpur District to the south, Jaisalmer District to the southwest, and Punjab Province of Pakistan to the northwest. Bikaner is an agricultural district with cereals, pulses and oilseeds being the main agricultural products of the region. The district has few registered small-scale industries. Almost the entire district is devoid of rock exposures except near Kolayat and at a few places in the southern parts of Nokha and Dulmera. The district Bikaner is thus vast sandy racks except Kolayat are covered with sand of Rock locally known as “Magra” are found in parts of Kolayat tehsil.

## 1.4 TRAFFIC STUDIES

To capture traffic flow characteristics, travel pattern of traffic passing through the project road and other characteristics related to miscellaneous requirements on the project road, the consultant has collected the toll data for a period of 7 days (29-05-2016 to 5-06-2016) from client and following Table 1-1 primary traffic surveys were conducted.

Table 1-1: Traffic surveys schedule

| S. No. | Type of survey                          | No. of days | Locations (Chainage) | Period                  |
|--------|---|-------------|----------------------|-------------------------|
| 1      | Origin – Destination survey & VR Survey | 1           | km 362.000           | 1-06-2016 to 2-06-2016  |
|        |   | 1           | Km 420.000           | 3-06-2016 to 4-06-2016  |
|        |   | 1           | Km 507.000           | 2-06-2016 to 3-06-2016  |
|        |   | 1           | Bikaner Bypass       | 31-05-2016 to 1-06-2016 |

Traffic survey location for carrying out VR and OD surveys were carried out at the existing toll plaza locations as per the Concession Agreement. The traffic survey locations as per existing chainage are marked in **Figure 1-2**.



Figure 1-2: Traffic Survey Location Map

## 1.5 TRAFFIC INTENSITY

### 1.5.1 Classified Traffic Volume Counts

The Toll data was provided by the client for 7 days continuously. The vehicle classification used in the survey along with their PCU factors, as suggested in IRC: 64 – 1990, are presented in Table 1-2

Table 1-2: Vehicle Classification and PCU Factors Used in the Study

| Vehicle Type                                     | PCU Factor |
|--|------------|
| <b>Fast Moving Vehicles</b>                      |            |
| Car, jeep, van                                   | 1.0        |
| Taxi   | 1.0        |
| Mini bus   | 1.5        |
| Standard Bus (private and government classified) | 3.0        |
| Light Motor Vehicles (LMV)                       | 1.0        |
| Light commercial vehicle (passenger & goods)     | 1.5        |
| Truck 2-axle                                     | 3.0        |
| Truck 3-axle                                     | 3.0        |
| 4 to 6-axle truck                                | 4.5        |
| More than 6-axle truck                           | 4.5        |

The analysis of the classified traffic volume at the toll plaza locations was carried out to arrive at the following:

- Average Daily Traffic (ADT) and Annual Average Daily Traffic (AADT)
- Daily variation of traffic volume



- Average Composition of traffic

### 1.5.2 Average daily traffic (ADT)

Traffic volume data was averaged to determine Average Daily Traffic (ADT). ADT by vehicle type is presented in **Table 1-3**.

**Table 1-3: Average Daily Traffic**

| Mode of Vehicle              |                      | km<br>362.000 | km<br>420.200 | km<br>507.000 | Bikaner<br>Bypass |
|------------------------------|----------------------|---------------|---------------|---------------|-------------------|
| Tollable<br>vehicles         | Car/ Jeep/Van        | 2234          | 1838          | 2189          | 365               |
|                              | Minibus / LCV        | 425           | 213           | 128           | 127               |
|                              | Bus / Truck          | 872           | 473           | 529           | 161               |
|                              | 3 Axle Truck         | 433           | 233           | 396           | 574               |
|                              | MAV (4-6) Axle       | 429           | 193           | 405           | 601               |
|                              | OSV ( $\geq 7$ axle) | 0             | 0             | 0             | 0                 |
| Toll<br>Exempted<br>Vehicles | Car/ Jeep/Van        | 74            | 112           | 96            | 10                |
|                              | Minibus / LCV        | 62            | 25            | 57            | 11                |
|                              | Bus / Truck          | 1             | 3             | 1             | 1                 |
|                              | 3 Axle Truck         | 0             | 0             | 0             | 0                 |
|                              | MAV (4-6) Axle       | 0             | 0             | 0             | 0                 |
| Total                        | Grand Total (Nos.)   | 4529          | 3091          | 3802          | 1849              |
|                              | Grand Total (PCUs)   | 8886          | 5305          | 7165          | 5491              |

- The traffic at the first location is higher than that at the second location as some of the traffic goes off towards Churu using NH-65.
- The share of passenger vehicles is observed to be in the range of 75-80% of the total traffic at the three locations along the project road while at Bikaner bypass the share of passenger vehicles is low, in the range of 36%. The low share of passenger vehicles indicates that the bypass caters to mainly the through traffic.

### 1.5.3 Seasonal Correction Factor

The traffic plying on any road generally varies over different periods of the year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have a more realistic picture of the traffic on the project road, it is required to assess its seasonal variation to estimate the annual average daily traffic (AADT)

AADT is the base year (FY 2016-17) 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 corridor, arrival of vehicles at establishments like APMC, truck terminals, railway goods stations, etc. are the commonly used sets of data.

For the present study, fuel sales data for the last 2 years has been collected from various petrol pumps and analyzed and is as presented in **Table 1-4**.

**Table 1-4: Seasonal factors**

| Month | Fuel Outlets |       | SCF  |      |
|-------|--------------|-------|------|------|
|       | MS           | HSD   | MS   | HSD  |
| April | 22.83        | 98.75 | 1.03 | 1.02 |
| May   | 22.67        | 92.19 | 1.04 | 1.10 |

| Month     | Fuel Outlets |        | SCF  |      |
|-----------|--------------|--------|------|------|
| June      | 22.42        | 91.01  | 1.05 | 1.11 |
| July      | 23.83        | 103.26 | 0.99 | 0.98 |
| August    | 23.17        | 101.13 | 1.02 | 1.00 |
| September | 22.75        | 93.85  | 1.03 | 1.08 |
| October   | 24.08        | 106.98 | 0.98 | 0.95 |
| November  | 23.42        | 110.73 | 1.01 | 0.91 |
| December  | 24.75        | 107.49 | 0.95 | 0.94 |
| January   | 23.50        | 97.53  | 1.00 | 1.04 |
| February  | 23.42        | 106.28 | 1.01 | 0.95 |
| March     | 25.58        | 104.10 | 0.92 | 0.97 |

Since the daily toll for seven days was provided for the months of May and June, weighted average of the 2 months has been taken with 3 days of the month of May and 4 days of the month of June.

Thus, for cars the final SCF has been arrived at by taking an average of MS and HSD and for trucks / bus it has been considered 1.10, from the HSD data as listed above in **Table 1-4**.

#### 1.5.4 Annual Average Daily Traffic (AADT)

The traffic volume survey along the project road has been carried out in month of May and June 2016 and seasonal factors for these months were considered for converting ADT to AADT. AADT vehicle type wise is shown in **Table 1-5**. The AADT values for base year (2016-17) have been used for the traffic volume projection up to horizon year and for projecting the toll revenue.

**Table 1-5: Annual Average Daily Traffic (PCU)**

| Mode of Vehicle                       |                    | km<br>362.000 | km<br>420.200 | km<br>507.000 | Bikaner<br>Bypass |
|---------------------------------------|--------------------|---------------|---------------|---------------|-------------------|
| <b>Tollable<br/>vehicles</b>          | Car/ Jeep/Van      | 2390          | 1967          | 2343          | 391               |
|                                       | Minibus / LCV      | 467           | 234           | 141           | 140               |
|                                       | Bus / Truck        | 959           | 521           | 582           | 177               |
|                                       | 3 Axle Truck       | 476           | 257           | 436           | 631               |
|                                       | MAV (4-6) Axle     | 472           | 212           | 446           | 661               |
|                                       | OSV (>=7 axle)     | 0             | 0             | 0             | 0                 |
| <b>Toll<br/>Exempted<br/>Vehicles</b> | Car/ Jeep/Van      | 79            | 120           | 102           | 11                |
|                                       | Minibus / LCV      | 68            | 28            | 63            | 12                |
|                                       | Bus / Truck        | 1             | 4             | 1             | 1                 |
|                                       | 3 Axle Truck       | 0             | 0             | 0             | 0                 |
|                                       | MAV (4-6) Axle     | 0             | 0             | 0             | 0                 |
| <b>Total</b>                          | Grand Total (Nos.) | <b>4912</b>   | <b>3343</b>   | <b>4114</b>   | <b>2024</b>       |
|                                       | Grand Total (PCUs) | <b>9704</b>   | <b>5780</b>   | <b>7815</b>   | <b>6032</b>       |

#### 1.5.5 Daily variation of traffic volume

Daily variation of traffic (mode wise) is shown in Figure1-3 below. Daily variation of traffic in terms of day factors is presented in Table 1-6.

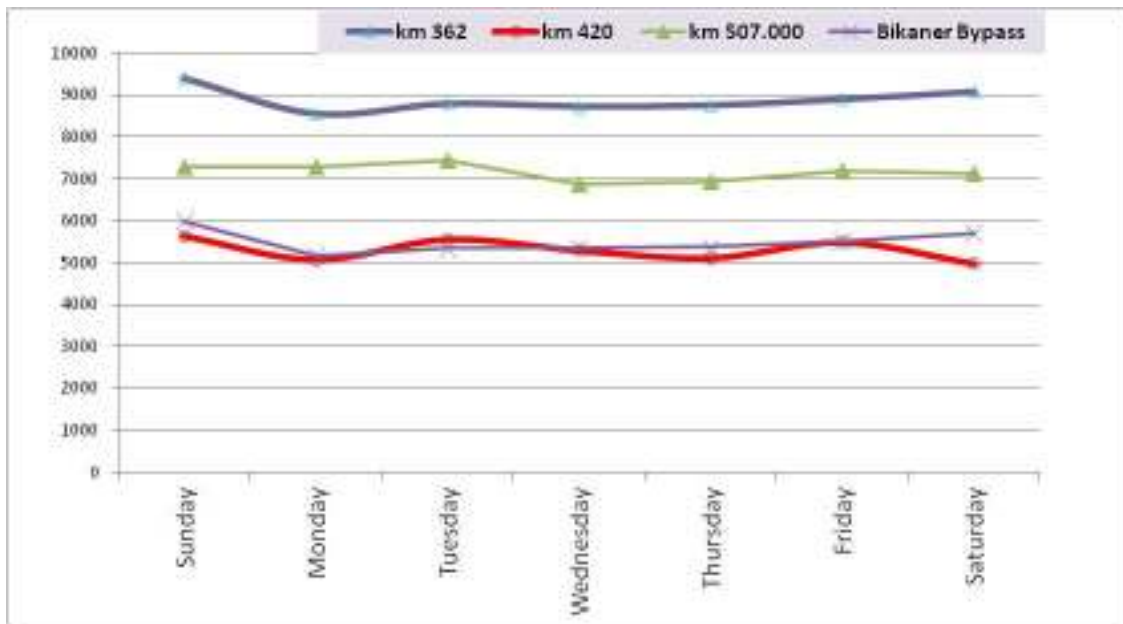


Figure 1-3: Daily variation of Traffic

Table 1-6: Day factors and maximum variations

| Location       | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Maximum variation |         |
|----------------|--------|--------|---------|-----------|----------|--------|----------|-------------------|---------|
|                |        |        |         |           |          |        |          | -ve (%)           | +ve (%) |
| km 362         | 5.9%   | -3.8%  | -1.1%   | -1.8%     | -1.5%    | 0.1%   | 2.2%     | -3.8%             | 5.9%    |
| km 420         | 6.3%   | -4.4%  | 4.8%    | -0.2%     | -3.7%    | 3.4%   | -6.2%    | -6.2%             | 6.3%    |
| km 507         | 1.8%   | 1.9%   | 3.9%    | -4.0%     | -3.3%    | 0.2%   | -0.4%    | -4.0%             | 3.9%    |
| Bikaner Bypass | 9.1%   | -5.9%  | -2.8%   | -2.7%     | -2.2%    | 0.3%   | 4.0%     | -5.9%             | 9.1%    |

Day factor is the variation of each day's traffic to the average daily traffic. Day wise variations are observed at all locations.

### Traffic Composition

The traffic composition of vehicles is given in Table 1-7.

Table 1-7: Traffic composition of All Vehicles

| Mode of vehicle | km 362.000 |         | km 420.000 |         | km 507.000 |         | Bikaner Bypass |         |
|-----------------|------------|---------|------------|---------|------------|---------|----------------|---------|
|                 | Nos.       | % share | Nos.       | % share | Nos.       | % share | Nos.           | % share |
| Car/ Jeep/Van   | 2390       | 48.66%  | 1967       | 58.84%  | 2343       | 56.95%  | 391            | 19.32%  |
| Minibus / LCV   | 467        | 9.51%   | 234        | 7.00%   | 141        | 3.43%   | 140            | 6.92%   |
| Bus / Truck     | 959        | 19.52%  | 521        | 15.58%  | 582        | 14.15%  | 177            | 8.75%   |
| 3 Axle Truck    | 476        | 9.69%   | 257        | 7.69%   | 436        | 10.60%  | 631            | 31.18%  |
| MAV (4-6) Axle  | 472        | 9.61%   | 212        | 6.34%   | 446        | 10.84%  | 661            | 32.66%  |
| OSV (>=7 axle)  | 0          | 0.00%   | 0          | 0.00%   | 0          | 0.00%   | 0              | 0.00%   |
| Toll Exempted   | 148        | 3.01%   | 152        | 4.55%   | 166        | 4.04%   | 24             | 1.19%   |
| Total Vehicles  | 0          | 0.00%   | 0          | 0.00%   | 0          | 0.00%   | 0              | 0.00%   |

## 1.6 TRAVEL PATTERN

### Origin Destination Survey

Origin - destination (O-D) surveys were conducted to elicit information related to the base year travel characteristics of goods and passenger trips using the project road and likely future traffic diversions to or from the project road. The travel characteristics obtained by O-D survey would facilitate the identification of (i) local and through traffic on the project road, and (ii) the tollable traffic at the existing toll plazas.

The O-D survey locations on the Project road are also shown in **Figure 1.2** along with other survey locations.

The origin-destination survey was carried out using the road side interview (RSI) technique. The survey was conducted for 1 day at the existing four toll plaza locations to understand the road user characteristics. Road users were interviewed by trained enumerators to obtain the required data under the guidance of traffic engineers and supervisors. For this purpose, cars (private and taxi cars) and buses were considered as passenger vehicles. Similarly, LMVs, LCVs, 2-axle trucks, 3- axle trucks, 4 to 6-axle trucks and more than 6-axle trucks were considered as goods vehicles.

The information collected contained trip origin and trip destination. In addition, type of commodity for goods vehicles and purpose and occupancy for passenger vehicles were also collected. Further, trip length and frequency also elicited during O-D surveys. The sample size of each vehicle type is given in **Table 1-8**.

The data collected from RSI 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.

**Table 1-8: Sample size of OD survey**

| Vehicle Type   | km 362.000 |          | km 420.000 |          | Km 507.000 |          | Bikaner Bypass |          |
|----------------|------------|----------|------------|----------|------------|----------|----------------|----------|
|                | AADT       | % Sample | AADT       | % Sample | AADT       | % Sample | AADT           | % Sample |
| Car/ Jeep/Van  | 2390       | 79.9     | 1968       | 66.4     | 2344       | 55.0     | 392            | 56.1     |
| Minibus / LCV  | 468        | 70.3     | 234        | 73.1     | 142        | 57.7     | 140            | 75.7     |
| Bus / Truck    | 960        | 51.1     | 522        | 84.1     | 582        | 65.1     | 178            | 66.3     |
| 3 Axle Truck   | 476        | 56.7     | 258        | 62.4     | 436        | 58.7     | 632            | 69.1     |
| MAV (4-6) Axle | 472        | 48.9     | 212        | 75.0     | 446        | 53.1     | 662            | 52.4     |

### 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 local traffic needed to be assessed precisely, at the same time through traffic and its geo-regional representation also should be assessed.

For the purpose of delineating the growth centres affecting the influence area, the entire country was broadly divided into two regions. They are, Immediate Influence Area (IIA) and Broad Influence Area (BIA) of the project.

While defining zone boundaries the following were considered:

- Important towns and industrial areas along or near the project road
- Important roads
- Administrative boundaries, e.g., district and state boundaries.

Eighteen zones were considered along and close to the project corridor, starting from Sikar to Bikaner. Certain areas / districts / states were considered separately and far off districts were clubbed together. These considerations helped in arriving at 84 zones for the project. The zones are listed in **Table 1-9** below.

**Table 1-9: Adopted zoning system**

| Zone No. | Zone Name                 | District               |
|----------|---------------------------|------------------------|
| 1        | Sikar                     | Along the Project Road |
| 2        | Pura ki Dhani, Bhadhadar  |                        |
| 3        | Rashidpura                |                        |
| 4        | Khuri Chhoti / Khuri bari |                        |
| 5        | Ghassu ki Bas             |                        |
| 6        | Laxmangarh                |                        |
| 7        | Fatehpur                  |                        |
| 8        | RolSabsar                 |                        |
| 9        | Biramsar / Bhojdesar      |                        |
| 10       | Ratangarh                 |                        |
| 11       | Bharpalsar                |                        |
| 12       | Rajaldesar                |                        |
| 13       | Kitasar                   |                        |
| 14       | Bigga                     |                        |
| 15       | Shri Dungagarh            |                        |
| 16       | Jodhasar                  |                        |
| 17       | Sheruna                   |                        |
| 18       | Bikaner                   |                        |
| 19       | Nokha Mandi               | Bikaner distt.         |
| 20       | Kolayat                   |                        |
| 21       | Poogal                    |                        |
| 22       | Chhatargarh               |                        |
| 23       | Jamsar,                   |                        |
| 24       | Lunkaransar               |                        |
| 25       | Sadarshahar               | Churu distt.           |
| 26       | Taranagar(Reni)           |                        |
| 27       | Raigarh                   |                        |
| 28       | Churu                     |                        |
| 29       | Sujangarh                 |                        |
| 30       | Nim ka Thana              | Sikar district         |
| 31       | Shri Madhopur             |                        |
| 32       | Danta Ramgarh             |                        |
| 33       | Jhunjhunun district       | Jhunjhunun district    |
| 34       | Ladnun                    | Nagaur district        |
| 35       | Didwana                   |                        |
| 36       | Jayal                     |                        |
| 37       | Nagaur                    |                        |
| 38       | Makrana                   |                        |
| 39       | Parvatsar                 |                        |



| Zone No. | Zone Name   | District                     |
|----------|---|------------------------------|
| 40       | Nawan, Marot  |                              |
| 41       | Merta City  |                              |
| 42       | Kheenvsar   |                              |
| 43       | Jodhpur   |                              |
| 44       | Phalodi, Bap, Shergarh  | Jodhpur                      |
| 45       | Osian, Bhopalgarh, Bilara   |                              |
| 46       | Suratgarh   | Ganganagar district          |
| 47       | Sadulshahr  |                              |
| 48       | Ganganagar distt  |                              |
| 49       | Hanumangarh, Tibi   | Hanumagarh district          |
| 50       | Rawatsar  |                              |
| 51       | Nohar, Bhadra   |                              |
| 52       | Sangariya   |                              |
| 53       | Kot Putli, Bairat, Shahpura Tehsils   | Jaipur                       |
| 54       | Jaipur distt  |                              |
| 55       | Tonk, Bundi, Kota, Baran, Jhalawar  | Other districts of Rajasthan |
| 56       | Alwar, Bharatpur  |                              |
| 57       | Sawai Madhopur, Dausa, Karauli, Dhaulpur  |                              |
| 58       | Kishangarh, Nasirabad   |                              |
| 59       | Ajmer   |                              |
| 60       | Bhilwara, Chittaurgarh, Banswara, Pratapgarh  |                              |
| 61       | Rajasmand, Udaipur, Dungarpur   |                              |
| 62       | Pali, Sirohi  |                              |
| 63       | Barmer, Jalor   |                              |
| 64       | Jaisalmer   |                              |
| 65       | Punjab  | Punjab                       |
| 66       | Hisar   | Haryana                      |
| 67       | Sirsa, Fatehabad  |                              |
| 68       | Bhiwani   |                              |
| 69       | Narnaul   |                              |
| 70       | Rewari, Gurgaon   |                              |
| 71       | Faridabad, Palwal   |                              |
| 72       | North Haryana   |                              |
| 73       | Chandigarh  |                              |
| 74       | New Delhi   | Other States of India        |
| 75       | Uttarakhand   |                              |
| 76       | Himachal Pradesh, J&K   |                              |
| 77       | Uttar Pradesh   |                              |
| 78       | Madhya Pradesh  |                              |
| 79       | Gujarat   |                              |
| 80       | Bihar, Jharkhand, West Bengal   |                              |
| 81       | Chhatisgarh, Orissa   |                              |
| 82       | Maharashtra, Goa  |                              |
| 83       | South India (Karnataka, Tamilnadu, Kerala, Andhra Pradesh)  |                              |
| 84       | Eastern States (Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Assam, Meghalaya) |                              |

#### 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  $x_c$  is number of cars interviewed and  $X_c$  is the total number of cars counted during the day, then  $X_c/x_c$  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. Accordingly eight matrices, for different modes were developed for each survey location.

O-D matrices for different vehicle type for project stretch at all survey locations are presented in **Annexure 1.1** to this report.

### Travel pattern and characteristics

The Influence various zones of particularly and areas along the project corridor are analysed. They are as given in **Table 1-10**.

**Table 1-10: Zones with maximum influence on each mode**

| km 362.000            |                                   |            | km 420.000 |                        |            | km 507.000 |                           |            | Bikaner Bypass |                              |            |
|-----------------------|-----------------------------------|------------|------------|------------------------|------------|------------|---------------------------|------------|----------------|------------------------------|------------|
| Rank                  | Zone                              | Percentage | Rank       | Zone                   | Percentage | Rank       | Zone                      | Percentage | Rank           | Zone                         | Percentage |
| <b>Car / Taxi</b>     |                                   |            |            |                        |            |            |                           |            |                |                              |            |
| 1                     | Sikar - Laxmangarh                | 29.90%     | 1          | Fatehpur - Ratangarh   | 13.80%     | 1          | Shri Dungagarh - Bikaner  | 26.32%     | 1              | Bikaner - Nokha Mandi        | 68.93%     |
| 2                     | Sikar - Fatehpur                  | 9.96%      | 2          | Bikaner - Jaipur distt | 12.62%     | 2          | Bikaner - Jaipur distt    | 11.57%     | 2              | Shri Dungagarh - Nokha Mandi | 8.51%      |
| 3                     | Sikar - Khuri Chhoti / Khuri bari | 8.50%      | 3          | Sikar - Ratangarh      | 11.32%     | 3          | Ratangarh - Bikaner       | 7.00%      | 3              | Nokha Mandi - Lunkaransar    | 3.74%      |
| <b>LCV / Mini Bus</b> |                                   |            |            |                        |            |            |                           |            |                |                              |            |
| 1                     | Sikar - Laxmangarh                | 25.72%     | 1          | Fatehpur - Ratangarh   | 20.42%     | 1          | Shri Dungagarh - Bikaner  | 24.19%     | 1              | Bikaner - Nokha Mandi        | 31.09%     |
| 2                     | Sikar - Fatehpur                  | 7.73%      | 2          | Sikar - Bikaner        | 13.92%     | 2          | Shri Dungagarh - Jodhasar | 15.32%     | 2              | Bikaner - Kolayat            | 5.70%      |
| 3                     | Sikar - Khuri Chhoti / Khuri bari | 6.90%      | 3          | Sikar - Ratangarh      | 7.57%      | 3          | Shri Dungagarh - Sheruna  | 12.13%     | 3              | Bikaner - Jayal              | 5.66%      |
| <b>Bus / Truck</b>    |                                   |            |            |                        |            |            |                           |            |                |                              |            |
| 1                     | Sikar - Fatehpur                  | 15.27%     | 1          | Bikaner - Jaipur distt | 14.59%     | 1          | Bikaner - Jaipur distt    | 20.46%     | 1              | Bikaner - Nokha Mandi        | 27.92%     |
| 2                     | Bikaner - Jaipur distt            | 13.28%     | 2          | Sikar - Bikaner        | 9.14%      | 2          | Shri Dungagarh -          | 8.45%      | 2              | Shri Dungagarh -             | 5.79%      |

| km 362.000          |                                    |            | km 420.000 |                             |            | km 507.000 |                                |            | Bikaner Bypass |                                       |            |
|---------------------|------------------------------------|------------|------------|-----------------------------|------------|------------|--------------------------------|------------|----------------|---------------------------------------|------------|
| Rank                | Zone                               | Percentage | Rank       | Zone                        | Percentage | Rank       | Zone                           | Percentage | Rank           | Zone                                  | Percentage |
|                     |                                    |            |            |                             |            |            | Bikaner                        |            |                | Nokha<br>Mandi                        |            |
| 3                   | Sikar -<br>Laxmangarh              | 10.70%     | 3          | Sikar -<br>Ratangarh        | 8.38%      | 3          | Bikaner -<br>Sujangarh         | 7.44%      | 3              | Bikaner -<br>Nagaur                   | 4.99%      |
| <b>3 Axle Truck</b> |                                    |            |            |                             |            |            |                                |            |                |                                       |            |
| 1                   | Bikaner - Jaipur<br>distt          | 19.06%     | 1          | Bikaner - Jaipur<br>distt   | 18.87%     | 1          | Shri<br>Dungagarh -<br>Bikaner | 11.44%     | 1              | Bikaner -<br>Nokha<br>Mandi           | 18.04%     |
| 2                   | Ganganagar distt<br>- Jaipur distt | 9.12%      | 2          | Sikar -<br>Ratangarh        | 7.67%      | 2          | Bikaner -<br>Jaipur distt      | 11.42%     | 2              | Bikaner -<br>Jodhpur                  | 7.12%      |
| 3                   | Jaipur distt -<br>Punjab           | 5.75%      | -          | Sikar - Bikaner             | 6.98%      | 3          | Bikaner -<br>New Delhi         | 5.01%      | 3              | Shri<br>Dungagarh -<br>Nokha<br>Mandi | 3.46%      |
| <b>MAV</b>          |                                    |            |            |                             |            |            |                                |            |                |                                       |            |
| 1                   | Bikaner - Jaipur<br>distt          | 11.90%     | 1          | Bikaner - Jaipur<br>distt   | 14.20%     | 1          | Shri<br>Dungagarh -<br>Bikaner | 7.33%      | 1              | Bikaner -<br>Nokha<br>Mandi           | 9.14%      |
| 2                   | Jaipur distt -<br>Punjab           | 7.72%      | 2          | Sikar - Bikaner             | 8.73%      | 2          | Bikaner -<br>Jaipur distt      | 7.33%      | 2              | Punjab -<br>Gujarat                   | 8.33%      |
| 3                   | Ganganagar distt<br>- Jaipur distt | 5.16%      | 3          | Ratangarh -<br>Jaipur distt | 6.52%      | 3          | Sikar -<br>Bikaner             | 4.78%      | 3              | Punjab -<br>Maharashtra,<br>Goa       | 7.37%      |

## State Share

The share of trips influencing states are as given in **Table 1-11** below, which will be used in the growth rate estimation.

**Table 1-11: Distribution of Trips (%)**

| Mode/State        | Car / Taxi     | Mini Bus / LCV | Bus / Truck    | 3 Axle         | MAV            |
|-------------------|----------------|----------------|----------------|----------------|----------------|
| <i>km 362.000</i> |                |                |                |                |                |
| <i>Rajasthan</i>  | 98.66%         | 96.23%         | 94.45%         | 76.09%         | 74.04%         |
| <i>Punjab</i>     | 0.37%          | 1.48%          | 2.13%          | 7.63%          | 10.17%         |
| <i>Haryana</i>    | 0.68%          | 0.88%          | 0.80%          | 5.31%          | 5.21%          |
| <i>Gujarat</i>    | 0.00%          | 0.32%          | 0.33%          | 1.29%          | 0.89%          |
| <i>ROI</i>        | 0.29%          | 1.09%          | 2.29%          | 9.68%          | 9.69%          |
| <i>Total</i>      | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> |
| <i>km 420.000</i> |                |                |                |                |                |
| <i>Rajasthan</i>  | 97.47%         | 95.30%         | 94.09%         | 83.95%         | 82.86%         |
| <i>Punjab</i>     | 0.73%          | 1.16%          | 1.26%          | 1.26%          | 0.92%          |
| <i>Haryana</i>    | 0.79%          | 1.49%          | 3.51%          | 9.78%          | 8.88%          |
| <i>Gujarat</i>    | 0.00%          | 0.00%          | 0.00%          | 0.00%          | 1.56%          |
| <i>ROI</i>        | 1.01%          | 2.05%          | 1.15%          | 5.01%          | 5.79%          |
| <i>Total</i>      | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> |
| <i>km 507.000</i> |                |                |                |                |                |
| <i>Rajasthan</i>  | 98.09%         | 98.75%         | 92.53%         | 82.27%         | 66.77%         |
| <i>Punjab</i>     | 0.00%          | 0.00%          | 0.00%          | 1.02%          | 1.23%          |
| <i>Haryana</i>    | 1.05%          | 0.53%          | 2.36%          | 6.58%          | 13.63%         |
| <i>Gujarat</i>    | 0.04%          | 0.00%          | 0.51%          | 1.81%          | 8.92%          |
| <i>ROI</i>        | 0.82%          | 0.71%          | 4.59%          | 8.32%          | 9.46%          |
| <i>Total</i>      | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> |
| <i>Bypass</i>     |                |                |                |                |                |
| <i>Rajasthan</i>  | 98.55%         | 91.93%         | 84.56%         | 79.74%         | 64.57%         |
| <i>Punjab</i>     | 0.95%          | 3.79%          | 6.41%          | 6.85%          | 14.12%         |
| <i>Haryana</i>    | 0.25%          | 1.91%          | 2.61%          | 1.03%          | 1.32%          |
| <i>Gujarat</i>    | 0.00%          | 0.94%          | 2.10%          | 4.89%          | 8.83%          |
| <i>ROI</i>        | 0.25%          | 1.42%          | 4.31%          | 7.49%          | 11.17%         |
| <i>Total</i>      | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> | <b>100.00%</b> |

- At all four locations, Rajasthan holds the major share of cars while for the commercial trucks the influencing states include Rajasthan, Haryana, Gujarat and Punjab.



## Lead distribution

Table 1-12 depicts the trip length distribution of each mode of vehicles at survey locations.

**Table 1-12: Trip Length Distribution of Commercial Vehicles in %**

| Vehicle Type      | 0-50 | 50-100 | 100-200 | 200-500 | 500-1000 | >1000 | Total |
|-------------------|------|--------|---------|---------|----------|-------|-------|
| <b>km 362.000</b> |      |        |         |         |          |       |       |
| Car/ Jeep/Van     | 45.5 | 20.7   | 8.4     | 23.8    | 1.6      | 0.0   | 100.0 |
| Minibus / LCV     | 38.6 | 15.5   | 7.8     | 32.0    | 4.5      | 1.6   | 100.0 |
| Bus / Truck       | 12.1 | 23.9   | 6.1     | 48.2    | 5.8      | 3.8   | 100.0 |
| 3 Axle Truck      | 3.5  | 6.0    | 3.9     | 54.8    | 17.2     | 14.6  | 100.0 |
| MAV (4-6) Axle    | 3.3  | 4.7    | 8.9     | 48.0    | 18.4     | 16.8  | 100.0 |
| <b>km 420.000</b> |      |        |         |         |          |       |       |
| Car/ Jeep/Van     | 14.1 | 16.5   | 10.9    | 54.4    | 4.0      | 0.1   | 100.0 |
| Minibus / LCV     | 21.3 | 15.2   | 17.1    | 40.3    | 5.7      | 0.5   | 100.0 |
| Bus / Truck       | 9.1  | 13.1   | 11.8    | 60.1    | 5.9      | 0.0   | 100.0 |
| 3 Axle Truck      | 4.3  | 11.5   | 14.5    | 53.8    | 8.1      | 7.7   | 100.0 |
| MAV (4-6) Axle    | 2.6  | 10.6   | 11.6    | 59.8    | 7.4      | 7.9   | 100.0 |
| <b>km 420.000</b> |      |        |         |         |          |       |       |
| Car/ Jeep/Van     | 9.0  | 29.7   | 32.5    | 26.7    | 2.1      | 0.0   | 100.0 |
| Minibus / LCV     | 28.9 | 28.1   | 20.3    | 20.3    | 2.3      | 0.0   | 100.0 |
| Bus / Truck       | 3.4  | 9.3    | 33.3    | 47.0    | 5.5      | 1.5   | 100.0 |
| 3 Axle Truck      | 1.8  | 12.6   | 25.0    | 43.7    | 9.6      | 7.3   | 100.0 |
| MAV (4-6) Axle    | 1.0  | 8.4    | 15.7    | 37.8    | 14.3     | 22.9  | 100.0 |
| <b>Bypass</b>     |      |        |         |         |          |       |       |
| Car/ Jeep/Van     | 69.0 | 12.9   | 4.7     | 12.6    | 0.8      | 0.0   | 100.0 |
| Minibus / LCV     | 31.3 | 16.4   | 10.2    | 28.1    | 12.5     | 1.6   | 100.0 |
| Bus / Truck       | 29.2 | 6.8    | 13.0    | 28.6    | 13.0     | 9.3   | 100.0 |
| 3 Axle Truck      | 19.3 | 7.5    | 10.3    | 31.9    | 14.8     | 16.2  | 100.0 |
| MAV (4-6) Axle    | 9.7  | 3.7    | 11.5    | 25.9    | 18.7     | 30.4  | 100.0 |

## Commodity Groups and Analysis

The different commodities recorded during the O-D survey have been classified in 19 categories as presented in Table 1-13. Due consideration has been given to include all possible commodities and to categorize them into homogeneous groups, accounting the pattern of movement along the corridor.

**Table 1-13: Classification of commodities**

| No. | Commodity Type                                  |
|-----|---|
| 1   | Empty   |
| 2   | Food Grains (Rice, Wheat, Gur, sugarcane etc.,) |
| 3   | Vegetables / Fruits                             |
| 4   | Milk/ Milk products / Fish/Meat                 |
| 5   | Consumer Item                                   |
| 6   | Iron / Steel                                    |
| 7   | Petroleum / Oil / Gas/ Lubricants               |
| 8   | Chemicals                                       |
| 9   | Timber / Wood                                   |
| 10  | Marble / Stone                                  |

| No. | Commodity Type   |
|-----|--|
| 11  | Aggregate, boulders, Bricks  |
| 12  | Sand, soil & Cement  |
| 13  | Manufactured Goods (Electronic items, Vehicles, Leather, Tobacco, Rubber/ Tyres, Plastics, etc.) |
| 14  | Minerals (chromium, Iron ore etc.)   |
| 15  | Paper  |
| 16  | Animal / Animal Fodder   |
| 17  | Parcels / Containers   |
| 18  | Textiles, fibre  |
| 19  | Scrap  |

The percentage of each commodity mode-wise is given in Table 1-14 and 1-15 below.

**Table 1-14: Commodity distribution (%)**

| Commodity Type  | LCV          | 2A         | 3A         | MAV        | LCV        | 2A         | 3A         | MAV<br>LCV |
|---|--------------|------------|------------|------------|------------|------------|------------|------------|
|   | km 362 .000  |            |            |            | km 420.000 |            |            |            |
| <i>Empty</i>  | 40.0         | 20.4       | 14.1       | 22.3       | 27.4       | 20.8       | 21.8       | 29.5       |
| <i>Food Grains (Rice, Wheat, Gur, sugarcane etc.)</i>   | 2.6          | 4.9        | 4.9        | 4.2        | 6.6        | 11.5       | 8.5        | 8.9        |
| <i>Vegetables / Fruits</i>  | 9.7          | 7.5        | 7.6        | 7.7        | 14.6       | 6.8        | 7.7        | 3.2        |
| <i>Milk/ Milk products / Fish/Meat</i>  | 10.2         | 2.8        | 0.7        | 0.0        | 4.2        | 0.8        | 1.3        | 1.1        |
| <i>Consumer Item</i>  | 6.4          | 14.9       | 16.7       | 10.7       | 4.7        | 1.7        | 4.3        | 7.4        |
| <i>Iron / Steel</i>   | 3.8          | 3.2        | 6.3        | 3.0        | 3.3        | 4.0        | 3.8        | 2.6        |
| <i>Petroleum / Oil / Gas/ Lubricants</i>  | 0.2          | 4.1        | 5.8        | 3.5        | 2.4        | 13.0       | 4.7        | 7.9        |
| <i>Chemicals</i>  | 0.9          | 1.7        | 3.0        | 3.7        | 0.0        | 0.0        | 0.0        | 0.0        |
| <i>Timber / Wood</i>  | 2.4          | 0.0        | 3.0        | 1.6        | 0.0        | 5.7        | 2.1        | 1.1        |
| <i>Marble / Stone</i>   | 0.9          | 4.7        | 2.8        | 3.7        | 1.9        | 1.3        | 1.7        | 3.7        |
| <i>Aggregate, boulders, Bricks</i>  | 0.9          | 6.3        | 7.2        | 15.8       | 11.3       | 9.8        | 11.1       | 13.2       |
| <i>Sand, soil &amp; Cement</i>  | 0.2          | 1.5        | 0.0        | 1.4        | 1.4        | 0.8        | 0.4        | 2.1        |
| <i>Manufactured Goods (Electronic items, Vehicles, Leather, Tobacco, Rubber/ Tyres, Plastics, etc.)</i> | 8.5          | 14.2       | 7.6        | 10.9       | 9.0        | 12.5       | 19.7       | 10.5       |
| <i>Minerals (chromium, Iron ore etc.)</i>   | 0.2          | 0.0        | 0.0        | 0.9        | 0.5        | 0.8        | 0.0        | 0.0        |
| <i>Paper</i>  | 0.2          | 1.0        | 0.0        | 0.5        | 0.0        | 0.8        | 0.0        | 0.0        |
| <i>Animal / Animal Fodder</i>   | 9.7          | 7.6        | 13.0       | 6.7        | 10.8       | 7.0        | 8.1        | 6.8        |
| <i>Parcels / Containers</i>   | 1.2          | 2.6        | 1.9        | 0.5        | 0.5        | 0.0        | 1.3        | 1.6        |
| <i>Textiles, fibre</i>  | 1.7          | 2.5        | 5.6        | 3.0        | 0.0        | 2.1        | 3.4        | 0.5        |
| <i>Scrap</i>  | 0.2          | 0.0        | 0.0        | 0.0        | 1.4        | 0.4        | 0.0        | 0.0        |
| <b>Total</b>  | <b>100.0</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

**Table 1-15: Commodity distribution (%)**

| Commodity Type  | LCV        | 2A   | 3A   | MAV  | LCV            | 2A   | 3A   | MAV<br>LCV |
|---|------------|------|------|------|----------------|------|------|------------|
|   | Km 507.000 |      |      |      | Bikaner Bypass |      |      |            |
| <i>Empty</i>  | 37.0       | 28.5 | 19.5 | 25.6 | 32.8           | 28.9 | 37.9 | 29.3       |
| <i>Food Grains (Rice, Wheat, Gur, sugarcane etc.)</i> | 11.8       | 4.3  | 12.4 | 6.2  | 7.0            | 12.6 | 9.6  | 9.9        |

| Commodity Type  | LCV          | 2A         | 3A         | MAV        | LCV            | 2A         | 3A         | MAV<br>LCV |
|---|--------------|------------|------------|------------|----------------|------------|------------|------------|
|   | Km 507.000   |            |            |            | Bikaner Bypass |            |            |            |
| Vegetables / Fruits   | 7.9          | 2.6        | 5.8        | 4.2        | 13.3           | 8.2        | 9.6        | 6.7        |
| Milk/ Milk products /<br>Fish/Meat  | 4.7          | 3.8        | 4.8        | 2.0        | 0.8            | 0.0        | 2.1        | 1.5        |
| Consumer Item   | 6.3          | 7.7        | 6.8        | 3.7        | 15.6           | 11.3       | 6.5        | 3.7        |
| Iron / Steel  | 0.0          | 0.8        | 0.5        | 1.5        | 0.8            | 0.0        | 0.9        | 5.4        |
| Petroleum / Oil / Gas/<br>Lubricants  | 3.9          | 13.0       | 5.8        | 11.3       | 0.8            | 7.5        | 4.9        | 3.8        |
| Chemicals   | 0.0          | 1.9        | 1.0        | 2.5        | 0.0            | 0.0        | 1.0        | 3.2        |
| Timber / Wood   | 3.1          | 0.9        | 0.0        | 0.5        | 0.0            | 0.6        | 0.0        | 0.5        |
| Marble / Stone  | 1.6          | 0.0        | 2.0        | 3.7        | 0.0            | 0.6        | 1.0        | 2.7        |
| Aggregate, boulders, Bricks   | 8.7          | 25.7       | 27.1       | 27.8       | 8.6            | 7.5        | 9.4        | 14.2       |
| Sand, soil & Cement   | 0.0          | 0.9        | 0.0        | 0.0        | 0.8            | 0.6        | 2.1        | 0.5        |
| Manufactured Goods<br>(Electronic items, Vehicles,<br>Leather, Tobacco, Rubber/<br>Tyres, Plastics, etc.) | 4.7          | 6.2        | 4.3        | 4.7        | 7.0            | 6.3        | 5.4        | 7.2        |
| Minerals (chromium, Iron ore<br>etc.)   | 0.0          | 0.0        | 0.0        | 0.0        | 3.9            | 2.5        | 2.3        | 4.7        |
| Paper   | 0.0          | 0.0        | 0.0        | 0.0        | 0.0            | 1.9        | 0.5        | 0.3        |
| Animal / Animal Fodder  | 5.5          | 1.7        | 5.6        | 3.4        | 7.8            | 5.0        | 4.5        | 4.5        |
| Parcels / Containers  | 4.7          | 0.0        | 0.0        | 0.2        | 0.0            | 0.0        | 0.2        | 0.0        |
| Textiles, fibre   | 0.0          | 0.9        | 3.0        | 2.7        | 0.0            | 2.5        | 1.4        | 0.5        |
| Scrap   | 0.0          | 0.9        | 1.3        | 0.0        | 0.8            | 3.8        | 0.7        | 1.5        |
| <b>Total</b>  | <b>100.0</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b>     | <b>100</b> | <b>100</b> | <b>100</b> |

Table 1-16: Average Commodity distribution

| Commodity group | 1    | 2   | 3   | 4   | 5    | 6   | 7   | 8   | 9   | 10  | 11   | 12  | 13   | 14  | 15  | 16  | 17  | 18  | 19  |
|-----------------|------|-----|-----|-----|------|-----|-----|-----|-----|-----|------|-----|------|-----|-----|-----|-----|-----|-----|
| Km 362.000      | 24.2 | 4.1 | 8.1 | 3.4 | 12.2 | 4.1 | 3.4 | 2.3 | 1.7 | 3.0 | 7.6  | 0.8 | 10.3 | 0.3 | 0.4 | 9.2 | 1.5 | 3.2 | 0.1 |
| Km 420.000      | 24.9 | 8.9 | 8.1 | 1.9 | 4.5  | 3.5 | 7.0 | 0.0 | 2.2 | 2.1 | 11.3 | 1.2 | 12.9 | 0.3 | 0.2 | 8.2 | 0.8 | 1.5 | 0.5 |
| Km 507.000      | 27.7 | 8.7 | 5.1 | 3.8 | 6.1  | 0.7 | 8.5 | 1.3 | 1.1 | 1.8 | 22.3 | 0.2 | 5.0  | 0.0 | 0.0 | 4.1 | 1.2 | 1.7 | 0.6 |
| Bikaner Bypass  | 32.2 | 9.8 | 9.4 | 1.1 | 9.3  | 1.8 | 4.3 | 1.1 | 0.3 | 1.1 | 9.9  | 1.0 | 6.5  | 3.3 | 0.7 | 5.5 | 0.0 | 1.1 | 1.7 |

The distribution spectrum shows that commodity type food grains, vegetables, milk products, consumer items, construction materials and manufactured goods are being transported maximum along the corridor.

#### Occupancy of Passenger Vehicles

The average occupancy of the passenger vehicles are provided in Table 1-17.

Table 1-17: Average Occupancy at different locations

| Vehicle    | Average Occupancy |            |            |        |
|------------|-------------------|------------|------------|--------|
|            | km 362.000        | km 420.000 | km 507.000 | Bypass |
| Car / Jeep | 4                 | 4          | 3          | 3      |
| Mini Bus   | 18                | 18         | 4          | 16     |
| Bus        | 43                | 37         | 13         | 23     |

## Chapter 2

### Traffic Growth Rates

#### 2.1. INTRODUCTION

Traffic growth on a road facility is generally estimated on the basis of historical trends, in the present case traffic growth rates are estimated using econometric methods. Demand changes are usually because of shifts in the pattern of economic activities in the surrounding regions.

#### 2.2. METHODOLOGY FOR TRAFFIC GROWTH RATE ESTIMATION

The exercise of traffic growth rate estimation has been carried out by us using the elasticity approach. The elasticity method relates traffic growth to changes in the related economic parameters. According to IRC: 108 – 2015, elasticity based econometric model for highway projects could be derived in the following form:

$$\text{Log}_e(P) = A_0 + A_1 \text{Log}_e(EI)$$

Where;

- P = Traffic volume (of any vehicle type)
- EI = Economic Indicator (GDP/ NSDP / Population / PCI)
- A<sub>0</sub> = Regression constant
- A<sub>1</sub> = Regression co-efficient (Elasticity Index)

The main steps followed are:

- Defining the project influence area from OD analysis of travel pattern.
- Estimating the past elasticity of traffic growth from time series of registered vehicles of influencing state(s).
- Assessment of future elasticity values for major vehicle groups, namely, car, bus and truck.
- Study of past performance and assessment of perspective growth rates of state economies of influence area.

The elasticity values will be obtained by fitting log-log regression between the registered vehicle types (car, bus and commercial vehicles) and NSDP, Population and Per-capita income of influencing states and GDP of India. The influencing states obtained from the Origin-Destination survey include Rajasthan, Haryana, Punjab, Gujarat and Rest of India. The regression analysis will be carried out using various combinations of economic indicators and population of registered vehicles and the elasticity values resulted from the best fit equations will be used in estimating growth rates.

#### 2.3. REGIONAL INFLUENCE

In order to analyse the vehicles growth the share of constituent regions/states are to be considered and are presented in **Table 2-1** below. The states of Rajasthan, Haryana, Punjab, and Gujarat are the major influencing states while the share of other states is marginal, and has hence not been considered separately.

**Table 2-1: Regional Influence (%)**

| Mode   | RJ   | HR  | PB  | GJ  | Rest of India | Total |
|--------|------|-----|-----|-----|---------------|-------|
| Trucks | 84.7 | 3.5 | 4.1 | 2.3 | 5.4           | 100   |

RJ: Rajasthan, HR-Haryana, PB-Punjab, GJ-Gujarat

## 2.4. PAST VEHICLE REGISTRATION DETAILS

In order to analyse the vehicle growth in the states, the vehicle registration data of Rajasthan, Haryana, Punjab and Gujarat been collected and presented in **Table 2-2** below.

**Table 2-2: Past vehicle registration data of influencing states**

| Year                | Car / Jeeps | Bus  | Commercial vehicles |
|---------------------|-------------|--|---------------------|
| Rajasthan           |             |  |                     |
| 2004-05             | 409442      | 58092  | 208881              |
| 2005-06             | 460380      | 60979  | 229347              |
| 2006-07             | 515376      | 63320  | 269084              |
| 2007-08             | 579044      | 65605  | 297423              |
| 2008-09             | 646102      | 69298  | 318118              |
| 2009-10             | 727158      | 73257  | 346981              |
| 2010-11             | 824612      | 77980  | 385796              |
| 2011-12             | 934962      | 83345  | 431537              |
| 2012-13             | 1051288     | 88616  | 478379              |
| CAGR                | 12.51%      | 5.42%  | 10.91%              |
| Haryana             |             |  |                     |
| 2004-05             | 419879      | 11297  | 166437              |
| 2005-06             | 485453      | 19986  | 176046              |
| 2006-07             | 568758      | 22101  | 200977              |
| 2007-08             | 664134      | 26906  | 220470              |
| 2008-09             | 745335      | 29516  | 230858              |
| 2009-10             | 851374      | 33520  | 249991              |
| 2010-11             | 988958      | 35646  | 275162              |
| 2011-12             | 1134514     | 39153  | 292735              |
| 2012-13             | 1293065     | 43456  | 307509              |
| CAGR                | 15.10%      | 18.34%   | 7.98%               |
| Commercial Vehicles |             |  |                     |
| Year                | Punjab      | Gujarat  |                     |
| 2004-05             | 118766      | 191159   |                     |
| 2005-06             | 127720      | 204362   |                     |
| 2006-07             | 139816      | 223022   |                     |
| 2007-08             | 149983      | 239404   |                     |
| 2008-09             | 159251      | 247772   |                     |
| 2009-10             | 169553      | 259231   |                     |
| 2010-11             | 169553      | 276290   |                     |
| 2011-12             | 201758      | 301533   |                     |
| 2012-13             |             | 319207   |                     |
| CAGR                | 7.86%       | 6.62%  |                     |
| Commercial Vehicles |             |  |                     |
| Year                | All India   | <div>Source:</div> <ul style="list-style-type: none"><li>Road Transport Year Data Book by MORTH Publication, New Delhi</li><li>Respective state govt. transport department publication</li></ul> |                     |
| 2001-02             | 2948300     |  |                     |
| 2002-03             | 2973740     |  |                     |
| 2003-04             | 3491637     |  |                     |
| 2004-05             | 3748484     |  |                     |
| 2005-06             | 3877622     |  |                     |
| 2006-07             | 4274984     |  |                     |
| 2007-08             | 5118880     |  |                     |
| 2008-09             | 5600938     |  |                     |
| 2009-10             | 6040924     |  |                     |
| 2010-11             | 6431926     |  |                     |
| 2011-12             | 7064495     |  |                     |
| 2012-13             | 7658391     |  |                     |
| CAGR                | 10.46%      |  |                     |



## 2.5. PAST GROWTH OF ECONOMY

Growth of traffic on the project road is influenced by existing development and future growth prospects of the connecting regions. The time series data of states income NSDP at constant (2004-05) prices, state population, per-capita Income of PIA states and GDP as published by Central Statistical Organisation have been collected and studied to assess the past performance of influencing state economies. **Table 2-3** depicts the growth of economic indicators (The datum for GDP and other income levels have been modified to 2004-05 prices).

The growth rate of population in Rajasthan for the period of 2001 to 2011 has been observed to be 1.95% per annum.

**Table 2-3: Economic indices of states and India at constant prices (2004 - 05)**

| Year              | NSDP (Rs.)    | % growth        | Per capita NSDP (Rs) | % growth        |
|-------------------|---------------|-----------------|----------------------|-----------------|
| <b>Rajasthan</b>  |               |                 |                      |                 |
| 2004-05           | 11263572      |                 | 18565                |                 |
| 2005-06           | 12020228      | 7%              | 19445                | 5%              |
| 2006-07           | 13434991      | 12%             | 21342                | 10%             |
| 2007-08           | 14047148      | 5%              | 21922                | 3%              |
| 2008-09           | 15228354      | 8%              | 23356                | 7%              |
| 2009-10           | 16115948      | 6%              | 24304                | 4%              |
| 2010-11           | 18536565      | 15%             | 27502                | 13%             |
| 2011-12           | 20274905      | 9%              | 29612                | 8%              |
| 2012-13           | 21439120      | 6%              | 30839                | 4%              |
| 2013-14           | 22463210      | 5%              | 31836                | 3%              |
| 2014-15           | 23752978      | 6%              | 33186                | 4%              |
| <b>CAGR</b>       | <b>7.75%</b>  |                 | <b>5.98%</b>         |                 |
| <b>Haryana</b>    |               |                 | <b>Gujarat</b>       | <b>% growth</b> |
| 2004-05           | 8622228       |                 | 17226500             |                 |
| 2005-06           | 9401146       | 9%              | 19727000             | 15%             |
| 2006-07           | 10470049      | 11%             | 21395400             | 8%              |
| 2007-08           | 11289592      | 8%              | 23925300             | 12%             |
| 2008-09           | 12158839      | 8%              | 24948000             | 4%              |
| 2009-10           | 13677999      | 12%             | 28473200             | 14%             |
| 2010-11           | 14605347      | 7%              | 31589195             | 11%             |
| 2011-12           | 15852299      | 9%              | 33688617             | 7%              |
| 2012-13           | 16716882      | 5%              | 35647679             | 6%              |
| 2013-14           | 17830719      | 7%              | 38547194             | 8%              |
| 2014-15           | 19243700      | 8%              |                      |                 |
| <b>CAGR</b>       | <b>8.36%</b>  |                 | <b>8.39%</b>         |                 |
| <b>NSDP (Rs.)</b> |               |                 |                      |                 |
| <b>Year</b>       | <b>Punjab</b> | <b>% growth</b> | <b>All India</b>     | <b>% growth</b> |
| 2004-05           | 8610813       |                 | 2971464              |                 |
| 2005-06           | 9032981       | 5%              | 3253073              | 9%              |
| 2006-07           | 10007179      | 11%             | 3564364              | 10%             |
| 2007-08           | 10873818      | 9%              | 3896636              | 9%              |
| 2008-09           | 11476627      | 6%              | 4158676              | 7%              |
| 2009-10           | 12209725      | 6%              | 4516071              | 9%              |
| 2010-11           | 12998333      | 6%              | 4918533              | 9%              |
| 2011-12           | 13698738      | 5%              | 5247530              | 7%              |
| 2012-13           | 14258538      | 4%              | 5482111              | 4%              |
| 2013-14           | 15030456      | 5%              | 5741791              | 5%              |
| 2014-15           | 15887725      | 6%              | <b>7.59%</b>         |                 |
| <b>CAGR</b>       | <b>6.32%</b>  |                 |                      |                 |

Source : Central Statistical Organization (CSO), Govt. of India

## 2.6. TRANSPORT DEMAND ELASTICITY

The elasticity approach was 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 dependent variable.

Regression analysis was carried out on the database to arrive at the transport demand elasticity and growth rates using each category of vehicle with various combinations of economic parameter and population. The resultant elasticity values, growth rates,  $R^2$  values and t-statistic are presented in Table 2-4 based on best fit.

**Table 2-4: Observed transport demand elasticity values and traffic growth**

| <i>Vehicle Type</i><br>(a) | <i>Indicator</i><br>(b) | <i>Elasticity</i><br>(c) | <i>Growth of Indicator</i><br>(d) | <i>Growth Rate (%)</i><br>(e)=<br>(c)*(d) | <i>R-square</i><br>(f) | <i>t-stat</i><br>(g) |
|----------------------------|-------------------------|--------------------------|-----------------------------------|---|------------------------|----------------------|
| <b>Rajasthan</b>           |                         |                          |                                   |   |                        |                      |
| <b>Car</b>                 | Population              | 5.14                     | 1.67                              | 11.51                                     | 1.00                   | 2.57                 |
| <b>Bus</b>                 | PCI                     | 0.80                     | 6.32                              | 5.07                                      | 0.99                   | 24.50                |
| <b>Trucks</b>              | NSDP                    | 1.22                     | 8.10                              | 9.93                                      | 0.98                   | 24.33                |
| <b>Trucks</b>              |                         |                          |                                   |   |                        |                      |
| <b>Punjab</b>              | NSDP                    | 1.00                     | 6.33                              | 6.33                                      | 0.99                   | 12.27                |
| <b>Haryana</b>             | NSDP                    | 0.93                     | 8.37                              | 7.81                                      | 0.99                   | 33.86                |
| <b>Gujarat</b>             | NSDP                    | 0.68                     | 9.27                              | 6.26                                      | 0.99                   | 20.56                |
| <b>All India</b>           | NSDP                    | 1.22                     | 7.74                              | 9.44                                      | 0.99                   | 23.86                |

## 2.7. PROJECTED TRANSPORT DEMAND ELASTICITY

In order to arrive at realistic future elasticity values for the project road, various factors relating to vehicle technology changes besides character of traffic and travel pattern on the project road have been considered.

High elasticity of cars being witnessed now is because of large demand facilitated by financing schemes and loans. Factors like growth of household incomes (particularly in urban areas), reduction in the prices of entry-level cars, growth of the used car market, changes in life style, growing personal incomes, desire to own a vehicle facilitated by availability of loans/financing schemes on easy terms, etc. have all contributed to the rapid growth in ownership of cars. However, such trend would slow down and elasticity can be expected to decline.

Over the years there is a change in passenger movement with more and more people shifting towards personalised modes. Moreover, the buses are usually plying on fixed pre-decided routes and thus elasticity values for buses have been considered accordingly.

With the changing freight vehicle mix in favour of LCV for short distance traffic and 3-axle/MAV for long-distance traffic, higher elasticity values for these have been considered as compared to 2-axle trucks.

Presently, the trend of gradual replacement of three axle trucks by MAVs also observed in many areas, leading to reduction in numbers of 3 axle trucks. This shift has already been observed in various areas of the country.

The 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 nationally and internationally. The elasticity values have therefore been moderated for the future years as given in **Table 2-5**.

**Table 2-5: Projected transport demand elasticity values**

| <i>Vehicle Type</i>     | <i>Indicator</i> | <i>2017-2021</i> | <i>2022-2026</i> | <i>2027-2031</i> | <i>Beyond 2031</i> |
|-------------------------|------------------|------------------|------------------|------------------|--------------------|
| <b><i>Rajasthan</i></b> |                  |                  |                  |                  |                    |
| 2w                      | Population       | 5.23             | 4.70             | 4.23             | 3.81               |
| Cars                    | Population       | 5.52             | 4.69             | 3.99             | 3.39               |
| Buses                   | PCI              | 0.64             | 0.58             | 0.52             | 0.47               |
| Trucks(PIA)             | NSDP             | 0.82             | 0.78             | 0.74             | 0.70               |

## 2.8. PERSPECTIVE GROWTH: STATES' AND NATIONAL ECONOMIES

Against this 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 subject states 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.

Therefore, considering the present economic scenarios, a realistic growth slopping down from 7.0 to 5.0 % is assumed for the four period blocks for Rajasthan state. For Haryana, the NSDP growth for the six period blocks is considered varying from 7.5% to 5.0%, for Punjab it has been considered from 6.5% to 5.0% and for Gujarat it is 9.0% to 6.0%.

Similarly population growth rates also have been considered and therefore growth of PCI levels. The population projection is adopted from "*The population Projections for India and States, Report of the Technical Group on Population Projections Constituted by the National Commission on Population, May 2006, published by Office of the Registrar General & Census Commissioner, India.*"

Considering the present GDP growth and its future targets, a realistic growth rate of 7.8 % to 6.0 % has been assumed. The perspective economy growth rates considered are presented in **Table 2-6**.

**Table 2-6: Projected growth rates of indicators**

| <i>Indicator</i>        | <i>2017-2021</i> | <i>2022-2026</i> | <i>2027-2031</i> | <i>Beyond 2031</i> |
|-------------------------|------------------|------------------|------------------|--------------------|
| <b><i>Rajasthan</i></b> |                  |                  |                  |                    |
| <i>PCI</i>              | 6.20             | 6.07             | 5.95             | 5.83               |
| <i>NSDP</i>             | 7.00             | 6.50             | 6.00             | 5.00               |
| <i>Population</i>       | 1.45             | 1.38             | 1.31             | 1.24               |
| <b><i>NSDP'</i></b>     |                  |                  |                  |                    |
| <i>Haryana</i>          | 7.50             | 7.00             | 6.00             | 5.00               |
| <i>Punjab</i>           | 6.50             | 6.00             | 5.50             | 5.00               |
| <i>Gujarat</i>          | 9.00             | 8.00             | 7.00             | 6.00               |
| <i>GDP (India)</i>      | 7.80             | 7.50             | 7.00             | 6.00               |

## 2.9. PROJECTED TRAFFIC GROWTH RATES

Based on the present composition of goods vehicles, overall growth of goods vehicles and average load carried by each vehicle type, tonnage has been calculated for 5 year blocks for the present and future composition of traffic. The tonnage has been adjusted for future years for each mode of vehicle in such a way that the load share of 2A and 3A slashes and that of LCV and MAV increases. The difference in the present and future tonnage gives the additional traffic due to change in modal share which has been converted into vehicles. On this basis the growth rates of the commercial vehicles have been moderated keeping the overall growth of trucks constant.

Normally, the growth potential of passenger traffic depends on the population, per capita income and economic growth rates. As discussed above, the population is used to project these modes due to its good correlation with their respective growth.

Considering all the above discussed points, the growth rates were conceived using method discussed earlier and are modified accordingly.

**Table 2-7a: Estimated Traffic growth rates (%)**

| Year        | Car | Bus | LCV  | 2-Axle | 3-Axle | MAVs |
|-------------|-----|-----|------|--------|--------|------|
| 2017-2021   | 8.0 | 4.0 | 11.5 | -4.1   | -4.7   | 12.3 |
| 2022-2026   | 6.5 | 3.5 | 8.3  | -3.4   | -3.6   | 8.7  |
| 2027-2031   | 5.2 | 3.1 | 6.9  | -2.7   | -4.4   | 7.1  |
| Beyond 2031 | 4.2 | 2.7 | 5.4  | -1.5   | -0.8   | 4.4  |

In absence of segregated Toll data of Two Axle and Bus, it has been assumed that the ratio of 2 axle truck and bus is 50:50. Average growth rates of Bus & 2 axle truck has been adopted for Bus / 2 Axle Trucks. The final adopted growth rates are given in **Table 2-7b**.

**Table 2-7b: Adopted Traffic growth rates (%)**

| Year        | Car | LCV  | Bus / 2-Axle | 3-Axle | MAVs |
|-------------|-----|------|--------------|--------|------|
| 2017-2021   | 8.0 | 11.5 | -0.1         | -4.7   | 12.3 |
| 2022-2026   | 6.5 | 8.3  | 0.1          | -3.6   | 8.7  |
| 2027-2031   | 5.2 | 6.9  | 0.2          | -4.4   | 7.1  |
| Beyond 2031 | 4.2 | 5.4  | 0.6          | -0.8   | 4.4  |

## 2.10. COMPETING / ALTERNATE ROUTES

Any competing /alternate route or mode will have considerable impacts on the traffic and in turn on the toll expectancy.

A detailed reconnaissance study of the project road and the surrounding areas revealed that there exist alternate route through which the traffic may divert to the project road.

The Central and South India bound traffic (Indore and below) moving towards Hanumangarh and beyond are at present using the route from Indore – Chittorgarh-Bhilwara -Kishangarh via NH-79/79A and from Hanumangarh to Kishangarh via Mega Highway (State Highway). The project road also forms an alternate road for this traffic using Indore –Ujjain-Jhalawar (State Highway -27) from Jhalawar to Jaipur via NH-12 from Jaipur to Ratangarh via NH-11 and from Ratangarh to Hanumangarh via Mega Highway.

The alternate route and its details are as discussed below:

| Diverted Traffic | Project Road   |  | Alternative Road   |   |
|------------------|--|--|--|---|
|                  | Route  | NH/SH  | Route  | NH/SH   |
| Alternative-1    | Indore - Ujjain -<br>Jhalawar - Kota -<br>Jaipur - Sikar -<br>Ratangarh -<br>Hanumangarh | SH-27, NH-12,<br>NH-11, Mega<br>Highway (SH) | Indore-Ratlam-<br>Neemuch-<br>Chittorgarh -<br>Bhilwara-<br>Kishangarh -<br>Kishangarh-<br>Hanumanagrh | NH-59, SH-31,<br>NH-79, NH-79A,<br>Mega Highway<br>(SH) |



Figure 2-1: Project Route Vs Alternative Routes

#### Project Road Vs Alternative Route

The details of the project road and alternative road is presented in the **Table 2-8** below and pictorially shown in the **Figure 2-1**

Table 2-8: Details of Project Route and Alternative Route



| Alternative Route                 |            |                    |           |                              |
|-----------------------------------|------------|--------------------|-----------|------------------------------|
| Link                              | Length(km) | Lane Configuration | Condition | NH/SH/MDR                    |
| Total Length = 966 kms            |            |                    |           |                              |
| Indore-Ratlam-Neemuch-Chittorgarh | 339        | 4-Lane             | Good      | NH-59 / SH-31 / NH-79        |
| Chittorgarh-Bhilwara-Kishangarh   | 218        | 4/6 Lane           | Good      | NH-79/NH-79A                 |
| Kishangarh-Ratangarh-Hanumanagrh  | 409        | 2L+ PS             | Good      | Mega Highway (State Highway) |
| Project Road +Connecting Road     |            |                    |           |                              |
| Total Length = 976 kms            |            |                    |           |                              |
| Indore-Ujjain                     | 63         | 4L                 | Good      | SH-27                        |
| Ujjain-Jhalawar                   | 175        | 2L                 | Poor      | SH-27                        |
| Jhalwar - Kota                    | 84         | 2L/4L              | Poor      | NH-12                        |
| Kota - Jaipur                     | 248        | 4L                 | Good      | NH-12                        |
| Jaipur - Sikar                    | 111        | 4L                 | Good      | NH-11                        |
| Sikar - Ratangarh                 | 94         | 2L/4 L             | Good      | NH-11                        |
| Ratangarh-Hanumanagrh             | 201        | 2L+PS              | Good      | Mega Highway (State Highway) |

The detailed analysis is discussed below:

#### Procedure for Diversion Analysis Calculation

- VOC is calculated based on the observed speed, traffic, road characteristics, vehicle characteristics etc on the project road and alternative roads using HDM-4 models.
- Travel time is calculated for project and alternate roads.

$$\text{Travel time} = [\text{Length of road}/\text{observed speed of vehicle}]$$

Speed is based on vehicle type with present condition of road.

- VOT is calculated for vehicle category wise for project road and alternate route. VOT is product of speed and value of time in Rs/hr. (IRC: SP: 30 – 2009)
- Project road toll cost and the same on alternate route, if any.
- The generalised cost is calculated for project road and alternate route. Generalised cost consists of three components: vehicle operation cost (VOC), value of time (VOT) and toll cost.
- **Cost ratio:**

$$\text{Cost ratio} = [\text{Generalised cost of project road}/ \text{Generalised cost of alternate route}]$$

The rate of diversion is calculated using the diversion curve/equations, which is similar to Logit curve. These equations are presented in **Table 2-9** using which the percentage of diversion traffic to project road is calculated.

#### 2.11. DIVERTED TRAFFIC

Cost ratio diversion curves have been used for estimating the diverted traffic from/to the project road. In this approach, traffic likely to be diverted from alternate route to project road is estimated using diversion curves, which computes the ratio of perceived costs on the competitive/alternative facilities.

The rate of diversion is calculated using the diversion curve/equations, which is similar to Logit curve.

**Table 2-9: Diversion Curve Equations**

| Vehicle | Cost Ratio Interval | Relationship |
|---------|---------------------|--------------|
|---------|---------------------|--------------|

| Vehicle       | Cost Ratio Interval       | Relationship                                     |
|---------------|---------------------------|--|
| Car           | <0.634                    | % Div = $98.75 - ((CR/0.634) * 8.125)$           |
|               | $0.64 = CR < 1.465$       | % Div = $90.625 - ((CR - 0.634)/0.831) * 84.375$ |
|               | $1.465 \leq CR \leq 2.00$ | % Div = $6.25 - ((CR - 1.465)/0.535) * 5.25$     |
| Truck & Buses | $\leq 0.75$               | % Div = $100 - (CR/0.75) * 5$                    |
|               | $0.75 \leq CR \leq 1.25$  | % Div = $95 - ((CR - 0.75)/.5) * 90$             |
|               | $1.25 \leq CR \leq 2.00$  | % Div = $((2 - CR)/0.75) * 5$                    |

The generalised cost is calculated for project road and alternate route. Generalised cost consists of three components: vehicle operation cost (VOC), value of time (VOT) and toll cost. VOC is calculated based on the observed speed, traffic, road characteristics, vehicle characteristics etc. on the project road and alternative roads using HDM-4 models. Toll cost is calculated using prevailing toll policies. The generalised costs arrived at are presented in **Table 2-10**.

#### Alternate route

The various components of the project road and the *Alternate Route* are as given below:

#### Vehicle Operating Cost

Vehicle Costs include direct user expenses to own and use private vehicles. These indicate the savings that result from reduced vehicle ownership and use. VOC is calculated based on the observed speed, traffic, road characteristics, vehicle characteristics etc. on the project road and alternative road as described in IRC SP-30:2009.

**Table 2-10a: Vehicle Operating Cost (Rs.)**

| Vehicle Type | Alternate Route | Project Route |
|--------------|-----------------|---------------|
| Car          | 7100            | 7175          |
| Pvt Bus      | 17523           | 17814         |
| LCV          | 18612           | 18837         |
| 2Axle        | 20943           | 21339         |
| 3Axle        | 25131           | 25607         |
| MAV          | 36419           | 37021         |

#### Value of Time

VOT is calculated for vehicle category wise for project road and alternate route. VOT is product of speed and value of time in Rs/hr and is calculated based on IRC: SP: 30 – 2009. Travel time savings is often the principal benefit of a transportation project. Travel time savings can also lead to reductions in vehicle operating costs.

**Table 2-10b: Value of Time (Rs.)**

| Vehicle Type | Alternate Route | Project Route |
|--------------|-----------------|---------------|
| Car          | 2456            | 2552          |
| Pvt Bus      | 21107           | 22020         |
| LCV          | 441             | 455           |
| 2Axle        | 1001            | 1024          |
| 3Axle        | 1669            | 1707          |
| MAV          | 2598            | 2695          |

#### Toll Rates

The details of toll rates for the project road and the alternate route are as given below:

**Table 2-10c: Toll Rates (Rs.)**

| Vehicle Type | Alternative Road | Project Road |
|--------------|------------------|--------------|
| Car          | 753              | 670          |
| Pvt Bus      | 2578             | 2350         |
| LCV          | 1749             | 1395         |
| 2Axle        | 3318             | 2785         |
| 3Axle        | 5129             | 4395         |
| MAV          | 5668             | 4740         |

The total generalized cost for the project road has been worked out by adding tables 2.10 (a) to (c) and is as presented below:

**Table 2-10d: Generalized cost on Alternate route and project road (in Rs.)**

| Mode     | Alternate Route | Project Route |
|----------|-----------------|---------------|
| Car      | 10310           | 10397         |
| Bus      | 41208           | 42183         |
| LCV      | 20802           | 20687         |
| 2 axle   | 25262           | 25148         |
| 3 axle   | 31929           | 31709         |
| 4-6 axle | 44685           | 44456         |

From the OD data at NH-79 near Kishangarh provided by client, the traffic moving from Hanumangarh and north of Hanumangarh towards Indore & Central / South India has been worked out as potentially divertible traffic.

Based on cost ratio, the numbers of traffic getting diverted out of the potential divertible traffic in percentage of each mode is estimated and presented in Table 2-10e below.

**Table 2-10e: Potential and Actual traffic diversion to Project Road**

| Mode     | Potential Divertible Traffic | % of diversion | Actual Diverted Traffic<br>(2016-17) |
|----------|------------------------------|----------------|--------------------------------------|
| LCV      | 147                          | 50.99          | 75                                   |
| 2 axle   | 94                           | 50.81          | 48                                   |
| 3 axle   | 243                          | 51.24          | 124                                  |
| 4-6 axle | 296                          | 50.92          | 151                                  |

*It has been assumed that four laning of NH-12 shall be completed in year 2020-21. It is expected that 50% traffic will be diverted from alternate route to project road in year 2021-22 and remaining 50% in year 2026-27. This traffic has been included in the total traffic while doing the projections and revenue estimation.*

*Apart from the route discussed above, there are no other probable alternate routes to the project road.*

## Chapter 3

### Tolling Strategy and Traffic Projections

#### 3.1 TOLL PLAZAS

There are four toll plaza locations existing along project corridor including the one on the Bikaner bypass. Details of the toll plazas are given in **Table 3-1** below.

**Table 3-1: Toll plaza details as per existing chainage**

| Sl. No.     | Design Chainage | Existing Chainage | Length for which Fee is payable  |
|-------------|-----------------|-------------------|--|
| <b>TP1</b>  | Km 362.475      | Km 362.500        | 54.537 ( 4-Lane section 17.780 and 2-lane paved shoulders section 36.757kms) |
| <b>TP-2</b> | km 419.702      | Km 420.220        | 69.500   |
| <b>TP-3</b> | Km 506.878      | Km 507.000        | 73.338   |

In addition to the above, the fee levied and collected hereunder for structures or forming part of the Project Highway, as the case may be, costing more than 10 crores at the following toll plaza at one and a half times of the base rate as specified below shall be due and payable for following Plaza(s) are listed in the **Table 3-2**:

**Table 3-2: Structures / Bypass details**

| S. No.<br>(A) | Location of Toll Plaza<br>(chainage)<br>(B) | Nature of Structure<br>(C) | Length of bypass<br>for which<br>additional fee is<br>applicable<br>(D) | Cost (in Crore) |
|---------------|---|----------------------------|---|-----------------|
| <b>1</b>      | Km 362.475                                  | Sikar Bypass               | 19.463  | 25.34           |
| <b>2</b>      | km 419.702                                  | Realignment                | 3.500   | 20.07           |
| <b>3</b>      | Km 1.148 of Bikaner<br>Bypass               | Bikaner Bypass             | 17.240  | 50.12           |

#### Schedule of User Fee

As per Rule 3 of National Highways Fee (Determination of Rates and Collection) Rules, 2008, read with National Highways Fee (Determination of Rates and Collection) Amendment Rules, 2010 issue vide notification no. G.S.R. 950(E) dated 03.12.2010, National Highways Fee (Determination of Rates and Collection) Amendment Rules, 2011 issue vide notification No. G.S.R. 15(E) dated 12.01.2011, National Highways Fee (Determination of Rates and Collection) Second Amendment Rules, 2011 issue vide notification No. G.S.R. 756(E) dated 12.10.2011, the Central Government, hereby notified that there shall be collected fees on mechanical vehicles at per km base fee/toll rates as applicable from 2007-08 are given in **Table 3-3**. The escalated for 2016-17 rates are also given in **Table 3-3**.

**Table 3-3a: Toll Rates Adopted (in Rs) for four lane**

| 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-17 (in rupees per km)* |
|--------|--------------------------------------|--|---|
| 1      | Car, Jeep, Van                       | 0.65   | 1.02  |
| 2      | Light Commercial Vehicle or Mini Bus | 1.05   | 1.64  |
| 3      | Bus or Truck (2 Axle)                | 2.20   | 3.44  |
| 4      | 3 Axle Truck                         | 2.40   | 3.75  |
| 5      | HCM, EME, MAV (4-6 Axle )            | 3.45   | 5.39  |
| 6      | Oversized Vehicle (>7 Axle)          | 4.20   | 6.56  |

**Table 3-3b: Toll Rates Adopted (in Rs) for two lane**

| 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-17 (in rupees per km)* |
|--------|--------------------------------------|--|---|
| 1      | Car, Jeep, Van                       | 0.39   | 0.61  |
| 2      | Light Commercial Vehicle or Mini Bus | 0.63   | 0.99  |
| 3      | Bus or Truck (2 Axle)                | 1.32   | 2.07  |
| 4      | 3 Axle Truck                         | 1.44   | 2.26  |
| 5      | HCM, EME, MAV (4-6 Axle )            | 2.07   | 3.25  |
| 6      | Oversized Vehicle (>7 Axle)          | 2.52   | 3.95  |

**Table 3-4a: Toll Rates in Year 2016-17 (in Rs) \_Before COD**

| S. No. | Category of Vehicle                  | Km 362.500 | Km 420.220 | Km 507.000 | Bikaner Bypass |
|--------|--------------------------------------|------------|------------|------------|----------------|
| 1      | Car, Jeep, Van                       | 40         | 40         | 45         | 15             |
| 2      | Light Commercial Vehicle or Mini Bus | 65         | 70         | 70         | 25             |
| 3      | Bus or Truck (2 Axle)                | 135        | 140        | 150        | 45             |
| 4      | 3 Axle Truck                         | 145        | 155        | 165        | 50             |
| 5      | HCM, EME, MAV (4-6 Axle )            | 210        | 225        | 240        | 75             |
| 6      | Oversized Vehicle (>7 Axle)          | 255        | 270        | 290        | 90             |

**Table 3-4a: Toll Rates in Year 2016-17 (in Rs) \_After COD**

| S. No. | Category of Vehicle                  | Km 362.500 | Km 420.220 | Km 507.000 | Bikaner Bypass |
|--------|--------------------------------------|------------|------------|------------|----------------|
| 1      | Car, Jeep, Van                       | 50         | 45         | 45         | 15             |
| 2      | Light Commercial Vehicle or Mini Bus | 80         | 75         | 70         | 25             |
| 3      | Bus or Truck (2 Axle)                | 170        | 155        | 150        | 55             |

| S. No. | Category of Vehicle         | Km 362.500 | Km 420.220 | Km 507.000 | Bikaner Bypass |
|--------|-----------------------------|------------|------------|------------|----------------|
| 4      | 3 Axle Truck                | 180        | 170        | 165        | 60             |
| 5      | HCM, EME, MAV (4-6 Axle )   | 265        | 245        | 240        | 85             |
| 6      | Oversized Vehicle (>7 Axle) | 320        | 295        | 290        | 100            |

### Perception of the Inflation Rates

Inflation is generally defined as the increase of prices of goods and services over a certain period of time. Inflation is one of the macroeconomic parameter of the developing world which includes India as well. Since the last 2 years, with the newly formed government pursuing the monetary policy to contain inflation with strong macroeconomic fundamentals of our country, the inflation has come down. The WPI index and the inflation rate as per the calendar year and the financial year are as given below:

| Calendar Year          |  |         |         |         |         |         |         |         |         |         |         |        | Average |
|------------------------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|---------|
|                        |  | 2005    | 2006    | 2007    | 2008    | 2009    | 2010    | 2011    | 2012    | 2013    | 2014    | 2015   |         |
| WPI                    |  | 103.37  | 109.59  | 114.94  | 124.92  | 127.86  | 140.08  | 153.35  | 164.92  | 175.35  | 182.01  | 177.03 |         |
| Inflation Rate         |  |         | 6.02%   | 4.88%   | 8.68%   | 2.35%   | 9.56%   | 9.47%   | 7.54%   | 6.32%   | 3.80%   | -2.74% | 5.59%   |
| Financial Year         |  |         |         |         |         |         |         |         |         |         |         |        |         |
|                        |  | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 |        |         |
| WPI                    |  | 104.47  | 111.35  | 116.63  | 126.02  | 130.81  | 143.32  | 156.13  | 167.62  | 177.64  | 181.19  |        |         |
| Inflation Rate         |  |         | 6.59%   | 4.74%   | 8.05%   | 3.80%   | 9.56%   | 8.94%   | 7.36%   | 5.98%   | 2.00%   |        | 6.34%   |
| Monthly Inflation Rate |  |         |         |         |         |         |         |         |         |         |         |        |         |
|                        |  | Dec-05  | Dec-06  | Dec-07  | Dec-08  | Dec-09  | Dec-10  | Dec-11  | Dec-12  | Dec-13  | Dec-14  | Dec-15 |         |
| WPI                    |  | 104.9   | 112.2   | 116.7   | 124.5   | 133.4   | 146     | 157.3   | 168.8   | 179.6   | 178.7   | 176.8  |         |
| Inflation Rate         |  |         | 6.96%   | 4.01%   | 6.68%   | 7.15%   | 9.45%   | 7.74%   | 7.31%   | 6.40%   | -0.50%  | -1.06% | 5.24%   |

The average inflation rate based on the calendar year since 2005 indicates a growth of 5.59% while based on the financial year indicates a growth of 6.34%. India's inflation rate has been on the rise over the last decade. However, it has been decreasing slightly since 2010. Considering the upward and the down ward trend of inflation since last 10 years, the inflation factor adopted study for the entire concession period 5.0%, which is close to the average of the last 10 years.

### 3.2 TOTAL TRAFFIC PROJECTION

The summary of projected total traffic at four toll plaza locations is presented in **Table 3-5** below. This table gives the total traffic without considering diversions.

**Table 3-5: Projected total traffic for Most Likely Scenario**

| Year    | Km 362.000 |       | Km 420.200 |      | Km 507.000 |      | Bikaner Bypass |      | Average |      |
|---------|------------|-------|------------|------|------------|------|----------------|------|---------|------|
|         | Nos.       | PCUs  | Nos.       | PCUs | Nos.       | PCUs | Nos.           | PCUs | Nos.    | PCUs |
| 2016-17 | 4912       | 9704  | 3343       | 5780 | 4114       | 7815 | 2024           | 6032 | 3598    | 7333 |
| 2017-18 | 5206       | 10185 | 3554       | 6072 | 4367       | 8230 | 2124           | 6364 | 3813    | 7713 |
| 2018-19 | 5531       | 10728 | 3785       | 6399 | 4646       | 8697 | 2239           | 6752 | 4050    | 8144 |
| 2019-20 | 5890       | 11338 | 4039       | 6764 | 4953       | 9223 | 2372           | 7199 | 4314    | 8631 |

| Year    | Km 362.000 |       | Km 420.200 |       | Km 507.000 |       | Bikaner Bypass |       | Average |       |
|---------|------------|-------|------------|-------|------------|-------|----------------|-------|---------|-------|
|         | Nos.       | PCUs  | Nos.       | PCUs  | Nos.       | PCUs  | Nos.           | PCUs  | Nos.    | PCUs  |
| 2020-21 | 6286       | 12024 | 4317       | 7171  | 5292       | 9813  | 2525           | 7714  | 4605    | 9181  |
| 2021-22 | 6994       | 13715 | 4894       | 8545  | 5664       | 10474 | 2698           | 8303  | 5063    | 10259 |
| 2022-23 | 7383       | 14414 | 5173       | 8985  | 5984       | 11028 | 2841           | 8781  | 5345    | 10802 |
| 2023-24 | 7802       | 15173 | 5472       | 9461  | 6328       | 11629 | 2999           | 9306  | 5650    | 11392 |
| 2024-25 | 8253       | 15998 | 5793       | 9977  | 6698       | 12281 | 3171           | 9882  | 5979    | 12035 |
| 2025-26 | 8738       | 16892 | 6138       | 10536 | 7096       | 12988 | 3359           | 10512 | 6333    | 12732 |
| 2026-27 | 9626       | 19122 | 6875       | 12399 | 7523       | 13754 | 3564           | 11203 | 6897    | 14120 |
| 2027-28 | 10097      | 20036 | 7213       | 12993 | 7890       | 14416 | 3740           | 11801 | 7235    | 14812 |
| 2028-29 | 10599      | 21016 | 7572       | 13627 | 8279       | 15125 | 3930           | 12448 | 7595    | 15554 |
| 2029-30 | 11132      | 22065 | 7954       | 14306 | 8692       | 15882 | 4135           | 13145 | 7978    | 16350 |
| 2030-31 | 11699      | 23187 | 8359       | 15031 | 9130       | 16692 | 4355           | 13896 | 8386    | 17202 |
| 2031-32 | 12302      | 24389 | 8788       | 15806 | 9594       | 17556 | 4591           | 14705 | 8819    | 18114 |
| 2032-33 | 12798      | 25317 | 9144       | 16412 | 9977       | 18224 | 4772           | 15285 | 9173    | 18810 |
| 2033-34 | 13316      | 26287 | 9515       | 17045 | 10376      | 18922 | 4960           | 15890 | 9542    | 19536 |
| 2034-35 | 13857      | 27300 | 9903       | 17706 | 10792      | 19650 | 5158           | 16524 | 9928    | 20295 |
| 2035-36 | 14422      | 28359 | 10308      | 18396 | 11227      | 20410 | 5364           | 17185 | 10330   | 21088 |
| 2036-37 | 15013      | 29466 | 10732      | 19118 | 11681      | 21204 | 5580           | 17877 | 10752   | 21916 |
| 2037-38 | 15631      | 30623 | 11174      | 19871 | 12154      | 22032 | 5805           | 18599 | 11191   | 22781 |
| 2038-39 | 16277      | 31832 | 11635      | 20659 | 12648      | 22897 | 6041           | 19354 | 11650   | 23686 |
| 2039-40 | 16952      | 33096 | 12118      | 21481 | 13164      | 23800 | 6287           | 20143 | 12130   | 24630 |
| 2040-41 | 17657      | 34417 | 12621      | 22341 | 13702      | 24742 | 6545           | 20967 | 12631   | 25617 |
| 2041-42 | 18395      | 35797 | 13148      | 23239 | 14264      | 25726 | 6814           | 21829 | 13155   | 26648 |

With Reference to Article 29 Effect of variation of Traffic growth:

29.1.1 The Authority and the Concessionaire acknowledge that the traffic as on April 1, 2023 (the “Target Date”) is estimated to be 12357 PCUs per day (the “Target Traffic”), and hereby agree that for determining the modifications to the Concession Period under this Article 29, the actual traffic on the Target Date shall be derived by computing the average of the traffic as determined by traffic sampling to be undertaken, in accordance with Clause 22.3, on the date that falls one year prior to the Target Date, on the Target Date and on the first anniversary of the Target Date (the “Actual Average Traffic”). For the avoidance of doubt, it is agreed that traffic sampling shall be undertaken for a continuous period of 7 (seven) days during anytime within 15 (fifteen) days prior to the date specified herein and the average thereof shall be deemed to be the actual traffic. It is further agreed that if the Project Highway shall have two or more Toll Plazas, the average traffic thereof shall be computed for determining the Actual Average Traffic hereunder.

As per the definition of PCU given in the concession agreement, “PCU” shall have the meaning ascribed to a passenger car unit in the IRC-64:1990 or any modification thereof, and when used in this Agreement, shall include only motorized vehicles liable to make payments of user charges at the Toll Plazas in accordance with the Fee rules and the exempted vehicles specified therein, but does not include tractors, motor cycles and non-motorized vehicles.

**As per the Traffic Projection used for revenue estimation, an average Traffic of all four Toll Plazas on Target Date works out to be 11410 PCUs which is around 7.67% less than the Target Traffic (12357 PCU).**



29.2.1 Subject to the provisions of Clause 29.1.2, in the event Actual Average Traffic shall have fallen short of the Target Traffic, then for every 1% (one per cent) shortfall as compared to the Target Traffic, the Concession Period shall, subject to payment of Concession Fee in accordance with this Agreement, be increased by 1.5% (one point five per cent) thereof; provided that such increase in Concession Period shall not in any case exceed 20% (twenty per cent) of the Concession Period. For the avoidance of doubt, and by way of illustration, it is agreed that in the event of a shortfall of 10.6% (ten point six per cent) in Target Traffic, the Concession Period shall be increased by 15% (fifteen per cent) thereof.

As the Target Traffic is short by 7.67% then the extension in concession period will be  $1.5\% \times 7.67 = 11.5\%$  extension in concession period. With rounding off same works out to be 11% increase in the original concession period.

**Original Concession period is 25 Years**

**Addition concession period will be  $11\% \times 25 = 2.75$  Years**

**Revised Concession period will be  $25 + 2.75 = 27.75$  Years**

### 3.3 DISCOUNTS

The discounts allowed for local traffic/frequent users as per Schedule R of the Concession Agreement are given below.

- (1) 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 below
- (2) A driver, owner or person in charge of a mechanical vehicle who makes use of the section of national highway, permanent bridge, bypass or tunnel, may opt for such pass and he or she shall have to pay the fee in accordance with the following rates, namely:

| Amount Payable   | Maximum number of<br>one way journeys<br>allowed | Period of Validity                         |
|--|--|--|
| One and half times of the fee for one way journeys               | Two  | Twenty four hours from the time of payment |
| Two-third of amount of the fee payable for fifty single journeys | Fifty  | One month from date of payment             |

- (3) A person who owns a mechanical vehicle registered for non-commercial purposes and uses it as such for commuting on a section of national highway, permanent bridge, bypass or tunnel, may obtain a pass, on payment of fee at the base rate for the year 2007-2008 of rupees one hundred and fifty per calendar month and revised annually, authorizing it to cross the toll plaza specified in such pass:

Provided that such pass shall be issued only if such driver, owner or person in charge of such mechanical vehicle resides within a distance of twenty kilometers from the toll plaza specified by such person and the use of such section of national highway, permanent bridge, bypass or tunnel, as the case may be, does not extend beyond the toll plaza next to the specified toll plaza.

Provided further that no such pass shall be issued if a service road or alternative road is available for use by such driver, owner of person in charge of a mechanical vehicle.

- (4) No pass shall be issued of fee collected from a driver, owner or person in charge of a mechanical vehicle that uses part of the section of a national highway and does not cross a toll plaza

#### Tollable traffic components

The numbers and frequency of trips of vehicles of various categories needed to be estimated near accurately to arrive at the toll revenue estimates. The O – D survey data are used to arrive at these figures.

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 to be done to arrive at exact component of each type, so that they are not considered as tollable traffic repeatedly.

The frequency and share of each type as elucidated from O – D survey are provided in **Table 3-6**.

**Table 3-6: Tollable Component**

| Mode of Vehicle        | Categories       | km<br>362.000 | km<br>420.000 | km<br>507.000 | Bikaner<br>bypass | Frequency<br>Factor |
|------------------------|------------------|---------------|---------------|---------------|-------------------|---------------------|
|                        |                  | TP-1          | TP-2          | TP-3          | TP-4              |                     |
| Car/Jeep/Taxi          | Upto 20km Travel | 8.9           | 3.8           | 4.3           | 11.6              | 2.00                |
|                        | Monthly Pass     | 2.1           | 1.7           | 3.0           | 1.3               | 1.67                |
|                        | Single Entry     | 62.1          | 51.9          | 41.5          | 71.8              | 1.00                |
|                        | Return Pass      | 26.9          | 42.6          | 51.2          | 15.3              | 2.00                |
| Mini Bus /<br>LCV      | Monthly Pass     | 12.0          | 7.5           | 11.4          | 10.2              | 1.67                |
|                        | Single Entry     | 63.4          | 66.2          | 55.2          | 62.4              | 1.00                |
|                        | Return Pass      | 21.6          | 19.1          | 28.7          | 20.5              | 2.00                |
|                        | Local registered | 3.0           | 7.2           | 4.7           | 6.9               | 1.00                |
| Bus / 2 Axle<br>Trucks | Monthly Pass     | 3.6           | 2.7           | 1.0           | 8.9               | 1.67                |
|                        | Single Entry     | 62.2          | 66.6          | 71.4          | 60.3              | 1.00                |
|                        | Return Pass      | 27.7          | 23.2          | 25.3          | 26.8              | 2.00                |

| Mode of Vehicle   | Categories       | km<br>362.000 | km<br>420.000 | km<br>507.000 | Bikaner<br>bypass | Frequency<br>Factor |
|-------------------|------------------|---------------|---------------|---------------|-------------------|---------------------|
|                   |                  | TP-1          | TP-2          | TP-3          | TP-4              |                     |
| 3 Axle Trucks     | Local registered | 6.5           | 7.5           | 2.3           | 4.0               | 1.00                |
|                   | Monthly Pass     | 0.3           | 0.4           | 0.2           | 1.9               | 1.67                |
|                   | Single Entry     | 87.3          | 75.0          | 72.1          | 72.8              | 1.00                |
|                   | Return Pass      | 8.8           | 20.3          | 26.0          | 21.9              | 2.00                |
|                   | Local registered | 3.6           | 4.3           | 1.7           | 3.4               | 1.00                |
| 4 to 6Axle Trucks | Monthly Pass     | 0.3           | 0.2           | 0.1           | 1.0               | 1.67                |
|                   | Single Entry     | 86.9          | 83.1          | 83.6          | 83.6              | 1.00                |
|                   | Return Pass      | 9.9           | 15.5          | 15.0          | 13.5              | 2.00                |
|                   | Local registered | 2.9           | 1.2           | 1.3           | 1.9               | 1.00                |

The Projected tollable traffic under different toll paying categories from FY 2016-17 to FY 2041-42 has been given in **Table 3.7**.

**Table 3-7a: Projected Tollable Traffic at 362.000**

| Financial<br>Year | Car/<br>Jeep/Van | LCV  | 2AT  | 3-Axle T | 4- 6<br>Axles | Total |       |
|-------------------|------------------|------|------|----------|---------------|-------|-------|
|                   |                  |      |      |          |               | Nos   | PCU   |
| 2016-17           | 2390             | 467  | 959  | 476      | 472           | 4764  | 9520  |
| 2017-18           | 2581             | 521  | 958  | 454      | 530           | 5044  | 9984  |
| 2018-19           | 2788             | 581  | 957  | 432      | 595           | 5353  | 10504 |
| 2019-20           | 3011             | 647  | 956  | 412      | 668           | 5694  | 11092 |
| 2020-21           | 3252             | 722  | 955  | 393      | 751           | 6073  | 11759 |
| 2021-22           | 3512             | 869  | 978  | 423      | 978           | 6760  | 13420 |
| 2022-23           | 3740             | 942  | 979  | 408      | 1063          | 7132  | 14098 |
| 2023-24           | 3983             | 1020 | 980  | 393      | 1155          | 7531  | 14830 |
| 2024-25           | 4242             | 1104 | 981  | 379      | 1256          | 7962  | 15630 |
| 2025-26           | 4518             | 1196 | 982  | 365      | 1365          | 8426  | 16496 |
| 2026-27           | 4811             | 1392 | 1007 | 393      | 1689          | 9292  | 18700 |
| 2027-28           | 5062             | 1488 | 1009 | 375      | 1809          | 9743  | 19587 |
| 2028-29           | 5325             | 1590 | 1011 | 359      | 1937          | 10222 | 20537 |
| 2029-30           | 5602             | 1700 | 1013 | 343      | 2074          | 10732 | 21553 |
| 2030-31           | 5893             | 1817 | 1015 | 328      | 2222          | 11275 | 22647 |
| 2031-32           | 6199             | 1943 | 1017 | 314      | 2379          | 11852 | 23812 |
| 2032-33           | 6460             | 2048 | 1023 | 311      | 2484          | 12326 | 24712 |
| 2033-34           | 6731             | 2158 | 1029 | 309      | 2593          | 12820 | 25651 |
| 2034-35           | 7014             | 2275 | 1036 | 306      | 2708          | 13339 | 26639 |
| 2035-36           | 7308             | 2398 | 1042 | 304      | 2827          | 13879 | 27665 |
| 2036-37           | 7615             | 2527 | 1048 | 301      | 2951          | 14442 | 28732 |
| 2037-38           | 7935             | 2663 | 1054 | 299      | 3081          | 15032 | 29853 |
| 2038-39           | 8268             | 2807 | 1061 | 296      | 3217          | 15649 | 31026 |
| 2039-40           | 8616             | 2959 | 1067 | 294      | 3358          | 16294 | 32249 |
| 2040-41           | 8977             | 3119 | 1073 | 292      | 3506          | 16967 | 33528 |
| 2041-42           | 9355             | 3287 | 1080 | 289      | 3660          | 17671 | 34863 |
| 2042-43           | 9747             | 3465 | 1086 | 287      | 3821          | 18406 | 36258 |
| 2043-44           | 10157            | 3652 | 1093 | 285      | 3989          | 19176 | 37720 |

| Financial<br>Year | Car/<br>Jeep/Van | LCV  | 2AT  | 3-Axle T | 4- 6<br>Axles | Total |       |
|-------------------|------------------|------|------|----------|---------------|-------|-------|
|                   |                  |      |      |          |               | Nos   | PCU   |
| 2044-45           | 10583            | 3849 | 1099 | 282      | 4165          | 19978 | 39242 |
| 2045-46           | 11028            | 4057 | 1106 | 280      | 4348          | 20819 | 40838 |
| 2046-47           | 11491            | 4276 | 1113 | 278      | 4539          | 21697 | 42504 |
| 2047-48           | 11974            | 4507 | 1119 | 276      | 4739          | 22615 | 44245 |
| 2048-49           | 12477            | 4750 | 1126 | 274      | 4948          | 23575 | 46068 |

Table 3-7b: Projected Tollable Traffic @ km 420.000

| Financial<br>Year | Car/<br>Jeep/Van | LCV  | 2AT | 3-Axle T | 4- 6<br>Axles | Total |       |
|-------------------|------------------|------|-----|----------|---------------|-------|-------|
|                   |                  |      |     |          |               | Nos   | PCU   |
| 2016-17           | 1967             | 234  | 521 | 257      | 212           | 3191  | 5606  |
| 2017-18           | 2124             | 261  | 520 | 245      | 238           | 3388  | 5882  |
| 2018-19           | 2294             | 291  | 520 | 233      | 267           | 3605  | 6191  |
| 2019-20           | 2478             | 324  | 519 | 222      | 300           | 3843  | 6537  |
| 2020-21           | 2676             | 362  | 519 | 212      | 337           | 4106  | 6929  |
| 2021-22           | 2890             | 468  | 542 | 251      | 513           | 4664  | 8280  |
| 2022-23           | 3078             | 507  | 543 | 242      | 558           | 4928  | 8705  |
| 2023-24           | 3278             | 549  | 543 | 233      | 607           | 5210  | 9161  |
| 2024-25           | 3491             | 594  | 544 | 225      | 660           | 5514  | 9659  |
| 2025-26           | 3718             | 644  | 544 | 217      | 717           | 5840  | 10194 |
| 2026-27           | 3960             | 793  | 569 | 249      | 984           | 6555  | 12032 |
| 2027-28           | 4166             | 848  | 570 | 238      | 1054          | 6876  | 12605 |
| 2028-29           | 4382             | 907  | 571 | 228      | 1129          | 7217  | 13220 |
| 2029-30           | 4610             | 969  | 572 | 218      | 1209          | 7578  | 13874 |
| 2030-31           | 4850             | 1036 | 574 | 208      | 1295          | 7963  | 14578 |
| 2031-32           | 5102             | 1108 | 575 | 199      | 1386          | 8370  | 15323 |
| 2032-33           | 5316             | 1167 | 578 | 198      | 1447          | 8706  | 15906 |
| 2033-34           | 5540             | 1230 | 582 | 196      | 1511          | 9059  | 16519 |
| 2034-35           | 5772             | 1297 | 585 | 194      | 1578          | 9426  | 17156 |
| 2035-36           | 6015             | 1367 | 589 | 193      | 1647          | 9811  | 17823 |
| 2036-37           | 6267             | 1441 | 592 | 191      | 1720          | 10211 | 18518 |
| 2037-38           | 6531             | 1518 | 596 | 190      | 1795          | 10630 | 19244 |
| 2038-39           | 6805             | 1600 | 599 | 188      | 1874          | 11066 | 19999 |
| 2039-40           | 7091             | 1687 | 603 | 187      | 1957          | 11525 | 20798 |
| 2040-41           | 7389             | 1778 | 606 | 185      | 2043          | 12001 | 21623 |
| 2041-42           | 7699             | 1874 | 610 | 184      | 2133          | 12500 | 22491 |
| 2042-43           | 8022             | 1975 | 614 | 182      | 2226          | 13019 | 23390 |
| 2043-44           | 8359             | 2082 | 617 | 181      | 2324          | 13563 | 24334 |
| 2044-45           | 8710             | 2194 | 621 | 179      | 2427          | 14131 | 25323 |
| 2045-46           | 9076             | 2313 | 625 | 178      | 2533          | 14725 | 26353 |
| 2046-47           | 9457             | 2438 | 629 | 176      | 2645          | 15345 | 27432 |
| 2047-48           | 9854             | 2569 | 632 | 175      | 2761          | 15991 | 28553 |
| 2048-49           | 10268            | 2708 | 636 | 174      | 2883          | 16669 | 29734 |

**Table 3-7c: Projected Tollable Traffic @ km 507.000**

| Financial<br>Year | Car/<br>Jeep/Van | LCV  | 2AT | 3-Axle T | 4- 6<br>Axles | Total |       |
|-------------------|------------------|------|-----|----------|---------------|-------|-------|
|                   |                  |      |     |          |               | Nos   | PCU   |
| 2016-17           | 2343             | 141  | 582 | 436      | 446           | 3948  | 7616  |
| 2017-18           | 2530             | 157  | 581 | 416      | 501           | 4185  | 8011  |
| 2018-19           | 2733             | 175  | 581 | 396      | 562           | 4447  | 8456  |
| 2019-20           | 2952             | 195  | 580 | 377      | 632           | 4736  | 8960  |
| 2020-21           | 3188             | 218  | 580 | 360      | 709           | 5055  | 9526  |
| 2021-22           | 3443             | 243  | 579 | 343      | 797           | 5405  | 10160 |
| 2022-23           | 3666             | 263  | 580 | 330      | 866           | 5705  | 10688 |
| 2023-24           | 3905             | 285  | 580 | 318      | 941           | 6029  | 11261 |
| 2024-25           | 4159             | 309  | 581 | 307      | 1023          | 6379  | 11890 |
| 2025-26           | 4429             | 334  | 581 | 296      | 1112          | 6752  | 12565 |
| 2026-27           | 4717             | 362  | 582 | 285      | 1209          | 7155  | 13302 |
| 2027-28           | 4962             | 387  | 583 | 273      | 1295          | 7500  | 13938 |
| 2028-29           | 5220             | 414  | 584 | 261      | 1387          | 7866  | 14618 |
| 2029-30           | 5491             | 442  | 585 | 249      | 1485          | 8252  | 15339 |
| 2030-31           | 5777             | 473  | 587 | 238      | 1591          | 8666  | 16121 |
| 2031-32           | 6077             | 505  | 588 | 228      | 1703          | 9101  | 16946 |
| 2032-33           | 6333             | 533  | 591 | 226      | 1778          | 9461  | 17585 |
| 2033-34           | 6599             | 561  | 595 | 224      | 1857          | 9836  | 18254 |
| 2034-35           | 6876             | 592  | 598 | 222      | 1938          | 10226 | 18945 |
| 2035-36           | 7165             | 624  | 602 | 221      | 2024          | 10636 | 19678 |
| 2036-37           | 7465             | 657  | 606 | 219      | 2113          | 11060 | 20434 |
| 2037-38           | 7779             | 693  | 609 | 217      | 2206          | 11504 | 21224 |
| 2038-39           | 8106             | 730  | 613 | 215      | 2303          | 11967 | 22049 |
| 2039-40           | 8446             | 770  | 617 | 214      | 2404          | 12451 | 22912 |
| 2040-41           | 8801             | 811  | 620 | 212      | 2510          | 12954 | 23809 |
| 2041-42           | 9171             | 855  | 624 | 210      | 2620          | 13480 | 24746 |
| 2042-43           | 9556             | 901  | 628 | 209      | 2735          | 14029 | 25726 |
| 2043-44           | 9957             | 950  | 632 | 207      | 2856          | 14602 | 26751 |
| 2044-45           | 10375            | 1001 | 635 | 205      | 2982          | 15198 | 27816 |
| 2045-46           | 10811            | 1055 | 639 | 204      | 3113          | 15822 | 28931 |
| 2046-47           | 11265            | 1112 | 643 | 202      | 3250          | 16472 | 30093 |
| 2047-48           | 11738            | 1172 | 647 | 200      | 3393          | 17150 | 31306 |
| 2048-49           | 12231            | 1236 | 651 | 199      | 3542          | 17859 | 32574 |

**Table 3-7d: Projected Tollable Traffic @ Bikaner Bypass**

| Financial<br>Year | Car/<br>Jeep/Van | LCV | 2AT | 3-Axle T | 4- 6<br>Axles | Total |      |
|-------------------|------------------|-----|-----|----------|---------------|-------|------|
|                   |                  |     |     |          |               | Nos   | PCU  |
| 2016-17           | 391              | 140 | 177 | 631      | 661           | 2000  | 6000 |
| 2017-18           | 422              | 156 | 177 | 601      | 742           | 2098  | 6329 |

| Financial Year | Car/<br>Jeep/Van | LCV  | 2AT | 3-Axle T | 4- 6<br>Axles | Total |       |
|----------------|------------------|------|-----|----------|---------------|-------|-------|
|                |                  |      |     |          |               | Nos   | PCU   |
| 2018-19        | 456              | 174  | 177 | 573      | 834           | 2214  | 6720  |
| 2019-20        | 493              | 194  | 176 | 546      | 936           | 2345  | 7162  |
| 2020-21        | 532              | 216  | 176 | 520      | 1051          | 2495  | 7674  |
| 2021-22        | 575              | 241  | 176 | 496      | 1181          | 2669  | 8267  |
| 2022-23        | 612              | 261  | 176 | 478      | 1283          | 2810  | 8739  |
| 2023-24        | 652              | 283  | 176 | 461      | 1395          | 2967  | 9265  |
| 2024-25        | 694              | 306  | 177 | 444      | 1516          | 3137  | 9838  |
| 2025-26        | 739              | 332  | 177 | 428      | 1648          | 3324  | 10468 |
| 2026-27        | 787              | 359  | 177 | 413      | 1792          | 3528  | 11160 |
| 2027-28        | 828              | 384  | 177 | 395      | 1919          | 3703  | 11756 |
| 2028-29        | 871              | 411  | 178 | 377      | 2055          | 3892  | 12400 |
| 2029-30        | 916              | 439  | 178 | 361      | 2201          | 4095  | 13096 |
| 2030-31        | 964              | 469  | 178 | 345      | 2357          | 4313  | 13843 |
| 2031-32        | 1014             | 502  | 179 | 330      | 2525          | 4550  | 14657 |
| 2032-33        | 1057             | 529  | 180 | 327      | 2636          | 4729  | 15234 |
| 2033-34        | 1101             | 557  | 181 | 324      | 2752          | 4915  | 15836 |
| 2034-35        | 1147             | 588  | 182 | 322      | 2873          | 5112  | 16470 |
| 2035-36        | 1196             | 619  | 183 | 319      | 2999          | 5316  | 17126 |
| 2036-37        | 1246             | 653  | 184 | 317      | 3131          | 5531  | 17818 |
| 2037-38        | 1298             | 688  | 185 | 314      | 3269          | 5754  | 18538 |
| 2038-39        | 1353             | 725  | 186 | 312      | 3413          | 5989  | 19293 |
| 2039-40        | 1409             | 764  | 188 | 309      | 3563          | 6233  | 20080 |
| 2040-41        | 1469             | 806  | 189 | 307      | 3720          | 6491  | 20906 |
| 2041-42        | 1530             | 849  | 190 | 304      | 3883          | 6756  | 21759 |
| 2042-43        | 1595             | 895  | 191 | 302      | 4054          | 7037  | 22660 |
| 2043-44        | 1662             | 943  | 192 | 299      | 4233          | 7329  | 23598 |
| 2044-45        | 1731             | 994  | 193 | 297      | 4419          | 7634  | 24578 |
| 2045-46        | 1804             | 1048 | 194 | 295      | 4613          | 7954  | 25602 |
| 2046-47        | 1880             | 1104 | 196 | 292      | 4816          | 8288  | 26672 |
| 2047-48        | 1959             | 1164 | 197 | 290      | 5028          | 8638  | 27792 |
| 2048-49        | 2041             | 1227 | 198 | 288      | 5249          | 9003  | 28960 |

### 3.4 TOLL REVENUE ESTIMATES

The summary of toll revenue estimate is presented in Table 3-8 below:

Table 3-8: Annual Toll Revenue Estimation (Rs. in Crores)

| Period |        | km<br>362.000 | km<br>420.000 | km<br>507.000 | Bikaner<br>Bypass | Total |
|--------|--------|---------------|---------------|---------------|-------------------|-------|
| Apr-16 | Mar-17 | 16.0          | 8.9           | 12.5          | 3.3               | 40.8  |
| Apr-17 | Mar-18 | 22.4          | 10.2          | 13.8          | 4.2               | 50.6  |
| Apr-18 | Mar-19 | 25.0          | 11.2          | 15.3          | 4.7               | 56.2  |

| <i>Period</i> |               | <i>km<br/>362.000</i> | <i>km<br/>420.000</i> | <i>km<br/>507.000</i> | <i>Bikaner<br/>Bypass</i> | <i>Total</i> |
|---------------|---------------|-----------------------|-----------------------|-----------------------|---------------------------|--------------|
| <i>Apr-19</i> | <i>Mar-20</i> | 27.8                  | 12.5                  | 17.0                  | 5.2                       | <b>62.6</b>  |
| <i>Apr-20</i> | <i>Mar-21</i> | 30.5                  | 13.8                  | 19.0                  | 5.8                       | <b>69.2</b>  |
| <i>Apr-21</i> | <i>Mar-22</i> | 37.1                  | 17.7                  | 21.2                  | 6.6                       | <b>82.6</b>  |
| <i>Apr-22</i> | <i>Mar-23</i> | 41.1                  | 19.3                  | 23.5                  | 7.5                       | <b>91.4</b>  |
| <i>Apr-23</i> | <i>Mar-24</i> | 45.0                  | 21.4                  | 26.1                  | 8.2                       | <b>100.8</b> |
| <i>Apr-24</i> | <i>Mar-25</i> | 50.0                  | 23.9                  | 28.7                  | 9.2                       | <b>111.8</b> |
| <i>Apr-25</i> | <i>Mar-26</i> | 55.5                  | 26.2                  | 32.0                  | 10.2                      | <b>123.9</b> |
| <i>Apr-26</i> | <i>Mar-27</i> | 66.7                  | 32.9                  | 35.8                  | 11.4                      | <b>146.8</b> |
| <i>Apr-27</i> | <i>Mar-28</i> | 73.2                  | 36.4                  | 39.1                  | 12.7                      | <b>161.4</b> |
| <i>Apr-28</i> | <i>Mar-29</i> | 80.7                  | 40.3                  | 43.1                  | 14.1                      | <b>178.2</b> |
| <i>Apr-29</i> | <i>Mar-30</i> | 89.0                  | 44.0                  | 48.0                  | 15.8                      | <b>196.7</b> |
| <i>Apr-30</i> | <i>Mar-31</i> | 98.3                  | 48.7                  | 52.8                  | 17.5                      | <b>217.4</b> |
| <i>Apr-31</i> | <i>Mar-32</i> | 109.6                 | 53.9                  | 58.4                  | 19.4                      | <b>241.4</b> |
| <i>Apr-32</i> | <i>Mar-33</i> | 119.2                 | 59.0                  | 63.7                  | 21.2                      | <b>263.1</b> |
| <i>Apr-33</i> | <i>Mar-34</i> | 130.1                 | 64.3                  | 69.6                  | 23.2                      | <b>287.2</b> |
| <i>Apr-34</i> | <i>Mar-35</i> | 142.3                 | 70.3                  | 76.2                  | 25.5                      | <b>314.2</b> |
| <i>Apr-35</i> | <i>Mar-36</i> | 155.2                 | 77.1                  | 83.2                  | 27.7                      | <b>343.2</b> |
| <i>Apr-36</i> | <i>Mar-37</i> | 170.3                 | 84.3                  | 91.0                  | 30.9                      | <b>376.4</b> |
| <i>Apr-37</i> | <i>Mar-38</i> | 186.6                 | 92.1                  | 100.0                 | 33.5                      | <b>412.2</b> |
| <i>Apr-38</i> | <i>Mar-39</i> | 203.9                 | 101.4                 | 109.1                 | 36.9                      | <b>451.3</b> |
| <i>Apr-39</i> | <i>Mar-40</i> | 223.3                 | 111.0                 | 119.7                 | 40.1                      | <b>494.1</b> |
| <i>Apr-40</i> | <i>Mar-41</i> | 244.2                 | 121.8                 | 130.6                 | 44.2                      | <b>540.7</b> |
| <i>Apr-41</i> | <i>Mar-42</i> | 268.1                 | 133.1                 | 143.7                 | 48.3                      | <b>593.1</b> |
| <i>Apr-42</i> | <i>Mar-43</i> | 294.9                 | 145.9                 | 157.2                 | 53.6                      | <b>651.6</b> |
| <i>Apr-43</i> | <i>Mar-44</i> | 322.3                 | 160.2                 | 172.0                 | 58.4                      | <b>713.0</b> |
| <i>Apr-44</i> | <i>Mar-45</i> | 354.6                 | 176.0                 | 188.6                 | 64.6                      | <b>783.8</b> |