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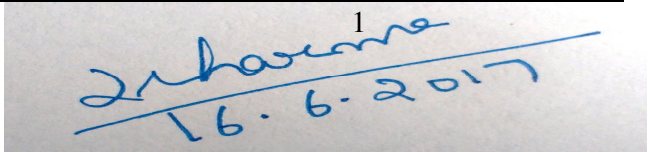
CHAPER – 0 Executive Summary



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EXECUTIVE SUMMARY

1. INTRODUCTION

The Governor of Rajasthan acting through the Chief Engineer (Roads), Public Works Department, Government of Rajasthan (the "Authority") is engaged in the development of state highways and as part of this endeavour, the Authority has decided to undertake two-laning of Tarnau to Mukundgarh (the "Project") through Public Private Partnership (the "PPP") on Design, Build, Finance, Operate and Transfer (the "DBFOT") basis.

Authority has decided to conduct feasibility studies for determining the technical feasibility and financial viability of all Highways comprising the Project. If found technically feasible and financially viable, the Highways under the Project may be awarded on DBFOT basis to a private entity (the "Concessionaire") selected through a competitive bidding process. The Project would be implemented in accordance with the terms and conditions stated in the concession agreement to be entered into between the Authority and the Concessionaire (the "Concession Agreement").

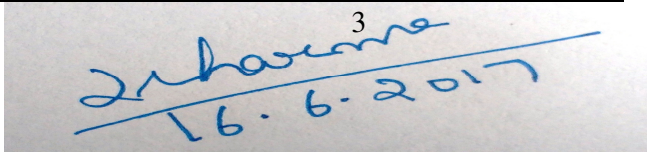
In pursuance of the above, the Authority has decided to carry out the process for selection of a Technical Consultant, a Financial Consultant and a Legal Adviser for preparing the Feasibility Report and bid documents. The Financial Consultant will develop the revenue model and assist the Authority in the bidding process. The Legal Adviser will review the draft concession agreement based on the Model Concession Agreement for State Highways through Public Private Partnership (the "MCA") read with the Manual of Standards and Specifications. The Technical Consultant shall prepare the Feasibility Report in accordance with the Terms of Reference specified ("TOR").

In developing the Work Plan for completing the assignment, the activities have been categorized under nine stages as follows:

1.	Stage I	-	Inception Report
2.	Stage II	-	Supplementary Inception Report
3.	Stage III	-	Report on Alignment and First Traffic Survey
4.	Stage IV	-	Report on Land Plan Schedules and Utility Relocation
5.	Stage V	-	Report on Indicative GAD of Structures
6.	Stage VI	-	Report on Environment and Social Impact Assessment
7.	Stage VII	-	Draft Feasibility Report
8.	Stage VIII	-	Final Feasibility Report
9.	Stage IX	-	Completion of Services including assistance during Bid Process

2. PROJECT DESCRIPTION

1. The corridor starts at Tarnau town from at chainage 39+668 of SH-60. Tarnau is a Village in Nagaur district in the Indian state of Rajasthan. Tarnau is a village Panchayat located in the Nagaur district of Rajasthan state, India. The latitude 27.1421517 and longitude 74.1166127 are the geocoordinate of the Tarnau. Jaipur is the state capital for Rajasthan. It is located



around 211 kilometer away from Tarnau. The other surrouning state capitals are Delhi 348.3 KM., Gandhinagar 452.6 KM. Tarnau is located around 72.7 kilometer away from its district head quarter nagaur. The other nearest district headquarters is Ajmer situated at 112 KM distance from Tarnau.

2. The corridor End at Mukundgarh (Y-junction) on Chainage 205.233 of SH-8. Mukundgarh is a city and municipality in Jhunjhunu district in the Indian state of Rajasthan. It is part of Shekhawati region. Mukundgarh is located at 27.95°N 75.2167°E. It has an average elevation of 349 meters (1148 feet). In routing of project corridor Laxmangarh is a town in Sikar district of Rajasthan state in India. It is the sub-divisional headquarters of the Laxmangarh sub-division in Sikar district. It is also the Tehsil headquarters of the Laxmangarh Tehsil. Laxmangarh is also Panchayat samiti headquarters of the Laxmangarh Panchayat samiti in the Sikar district. It is situated on National Highway-11 at a distance of 24 km from Sikar in north. The great fair is organized every year on the sixth of Bhadarpad (Hindi Month). Large numbers of people participate in the fair. The project road ends at Salasar-Sikar SH-83 at salasar. Salasar Balaji is in the religious circuit that includes the pilgrim centers of Rani Sati Temple of Jhunjhunu and Khatushyamji Sikar, which are both located close to it. Initially a small construction, the temple of Salasar Balaji is now considered to be a Shakti Sthal (a place of power) and Swayambhu (self-creation) by faith, belief, miracles and wish fulfillments of the devotee.

3. **Nagaur** is situated amidst 6 districts namely Bikaner, Churu, Jaipur, Ajmer, Pali, Jodhpur. Nagaur is the fifth largest district in Rajasthan with a vast terrain spreading over 17,718 sq.km. Its geographical spread is a good combine of plain, hills, sand mounds & as such it is a part of the great Indian Thar Desert.

4. **Sikar** is a city located in the Shekhawati region of Rajasthan state in India. It is the administrative headquarters of Sikar District. Sikar is a historical city and contains many old Havelis (big houses with Mughal-era architecture) which are a huge tourist attraction. It is 114 km away from Jaipur, 320 km from Jodhpur 215 km from Bikaner and 280 km from Delhi.

5. **Churu** is a city in the desert region of Rajasthan state of India. It is known as gateway to the Thar Desert of Rajasthan. It is the administrative headquarters of Churu District. It lies in the Thar Desert on the National Highway-65 connecting Pali to Ambala and is a junction station on the railway line to Bikaner. It is near the shifting sand dunes of the Thar Desert and has grand havelis with marvelous fresco paintings, namely Kanhaiya lal Bagla ki Haweli and Surana Haweli, with hundreds of small windows. It also has some fine Chhatris. Near the town is a religious seat of the Nath sect of Sadhus where there are life-size Marble statue of their deities and a place for prayers. There stands a Dharam Stup, a symbol of religious equality. At the centre of the town is a fort built about 400 years ago. Churu is a junction station on Delhi-Rewari-Bikaner broad Gauge railway line and also connected to JAIPUR via sikar. The railway tracks to Jaipur are meter gauge and are being converted to broad gauge. Churu lies on NH-65 and is connected to all major cities by all-weather roads.

6. **Jhunjhunu :-** Jhunjhunu is a town in the state of Rajasthan, India and the administrative headquarters of Jhunjhunu District. It is located a 180 km away from Jaipur, 220 km from

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Bikaner and 245 km from Delhi. The town is famous for the frescos on its grand Havelis; a special artistic feature of this region. As of 2001 India census, Jhunjhunu had a population of 100,476. Males constitute 53% of the population and females 47%. Jhunjhunu has an average literacy rate of 74%, higher than the national average of 59.5%: male literacy is 86.61%, and female literacy is 60%. In Jhunjhunu, 18% of the population is under 6 years of age. According to Haryana State Gazetteer languages like Ahirwati and Bagri is mainly spoken in Jhunjhunu The headquarters of the district is located in the town of Jhunjhunu. Jhunjhunu is a well-known trading hub and is home to plenty of industries.

7. The entire corridor has variable lane configuration which varies from intermediate lane to 2-lane with granular/earthen shoulder. While traversing it passes through 28 villages.

8. This corridor is comprises of various road sections, the sections are given in the table below.

Figure 0.1 Location Map of Project Road

Mostly the project corridor has a two lane carriageway. In general the terrain is plain. There are sections of roads having carriageway width of two lane and intermediate lane configuration. In some built-up sections, higher road widths were observed. The land use pattern is mainly agricultural, commercial and built-up area. Existing road has 0.55m to 2.16m earthen shoulder exists.

3. TRAFFIC SURVEY AND ANALYSIS

Estimation of traffic over the project corridor is an essential step in project preparation. This includes conducting field traffic surveys, data analysis estimation of traffic (ADT & AADT) and

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estimating commercial vehicles loading (CSA) for pavement design.

The traffic surveys have been planned in a way to obtain all the necessary information and data deemed necessary for the detailed project preparation. In order to identify traffic survey locations, the project road is divided into homogeneous sections based traffic flow pattern as given **Table 0.1**.

Table 0-1: Homogeneous Sections

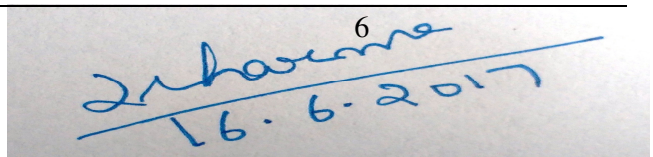
Sections	From	En-route	To	Design Length in km
1	Tarnau	Jayal, Kathoti, Bhantri, Ransisar Charna, Kairap, Nozlo ki Dhani, Koliya	Raghunathpura	47.502
2	Raghunathpura	Deedwana, Aas ki Dhani, Thanu, Ambapa, Indarpura, Meethri, Bochi, Ganeri	Salasar	52.930
3	Salasar	Juliyasar, Dhanani, Jajod, Choto Bhuma, Sanwali	Laxmangarh	35.285
4	Laxmangarh	Singroda, Aantroli, Balaran, Churimiyan, Ghoribara Khurd	Mukundgarh	29.848
Total =				**165.565**

The existing road passing through Deedwana, Mithari, Bochi & Laxmangarh built-up area is excluded and in-lieu of this bypasses have been proposed.

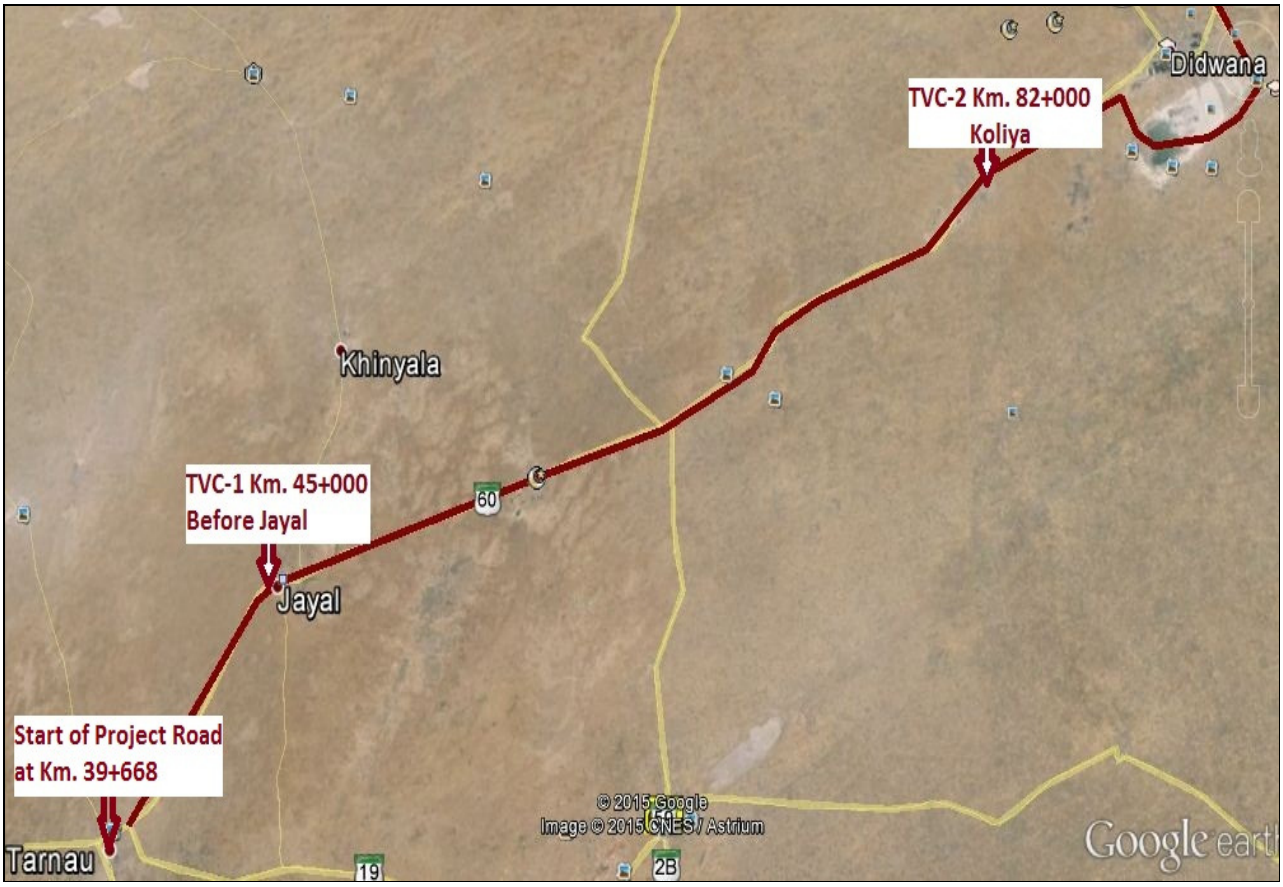
To establish the traffic flow characteristics and travel pattern on the corridor and to evaluate the viability of the project road on PPP mode, the following surveys were conducted on the identified locations along the project road sections.

- *7-days Classified Traffic Volume Count (CTVC) Surveys*
- *1-day 24 hr. Axle Load Surveys*
- Location for carrying out traffic surveys were selected so as to coincide with the proposed toll plaza locations based on site reconnaissance and was finalized in-consultation with the client. The traffic survey locations on project road along with survey schedule are presented in ***Table 0.2*** and shown in ***Figure 0.2***.
- The surveys were undertaken Initially during the period for Tarnau to Salasar is 29th October 2014 to 04th November 2014 & Salasar to Mukundgarh is 26th December 2014 to 1st January 2015.
- Later on combined survey was carried out during 28/04/2015 to 04/05/2015 (Second Traffic Survey). The results obtained during this survey showed huge variations in Traffic due to a local Festival in Salasar and hence data thus obtained has not been used in analysis.

Table 0-2: Traffic Survey Location



S no	Traffic survey details	Section	Location details (As per Design Chainage)	Start date	End date
1	Tarnau to Jayal	Section-1	Km. 45.000 befor Jayal	15/09/2014	22/09/2014
2	Jatal to Didwana	Section-2	Km 82.000, before Koliya	15/09/2014	22/09/2014
3	Didwana to Ganeri	Section-3	Km 102.000, Near Aas ki Dhani	15/09/2014	22/09/2014
4	Ganeri to Salasar	Section-4	Km 132+000, After Ganeri	15/09/2014	22/09/2014
5	Salasar to Laxmangarh	Section-5	Km 161.500, Near existing Chhota Bhooma Toll Plaza	26 /12/ 2014	01 /01/ 2015
6	Laxmangarh to Mukundgarh	Section-6	Km 191.000, Near Balaran	26 /12/ 2014	01 /01/ 2015



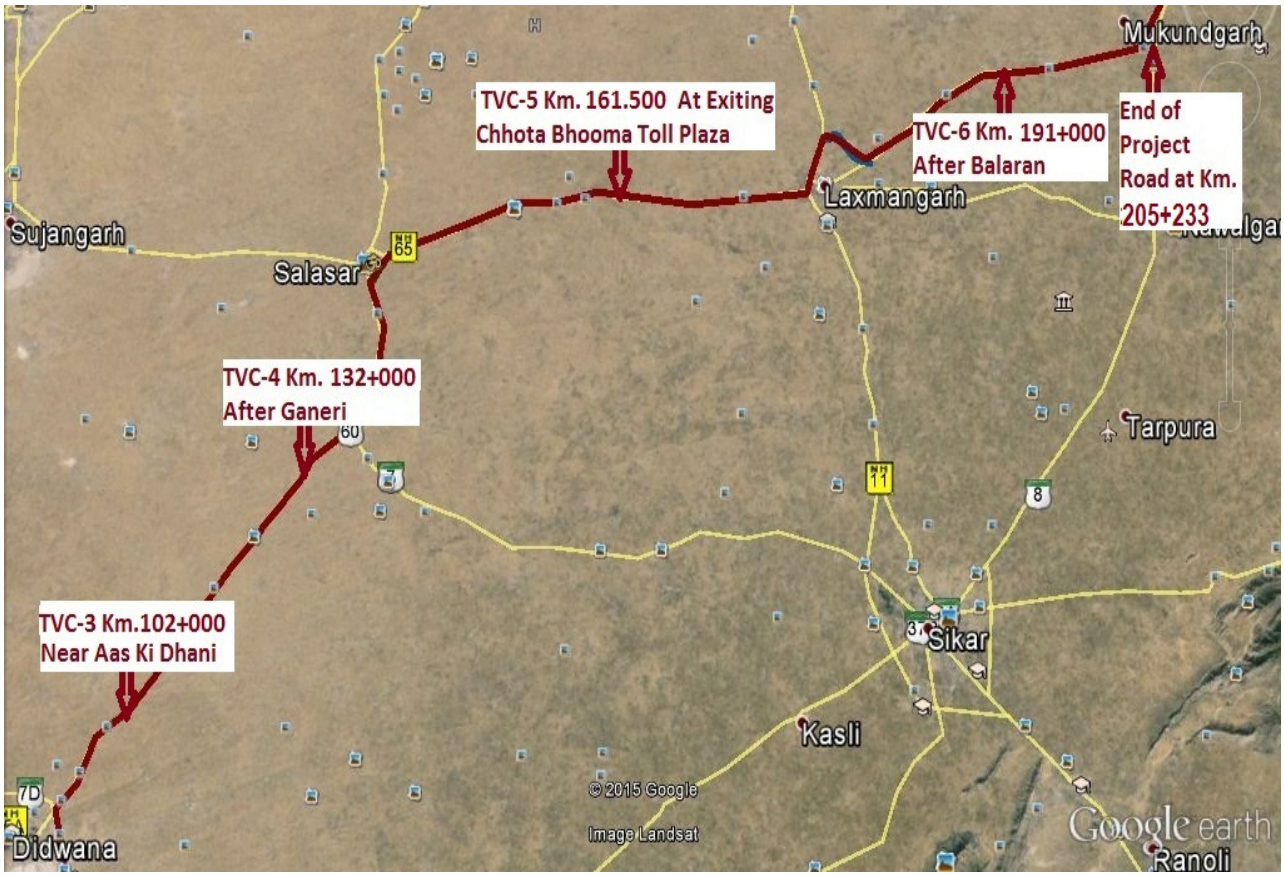


Figure 0.2: Traffic Survey Locations

Traffic demand plays the most important factor in deciding the type of facility (infrastructure) to be provided. This in turn determines likely benefits and costs to develop the same. A highway project of this nature calls for significant investment. Prediction of traffic demand becomes an important task and has to be nearly accurate. For the design of pavement and to plan for the future maintenance programmer as well as capacity augmentation and for economic evaluation, it is necessary to have realistic estimate of the size of traffic in the year 2014 to year 2040.

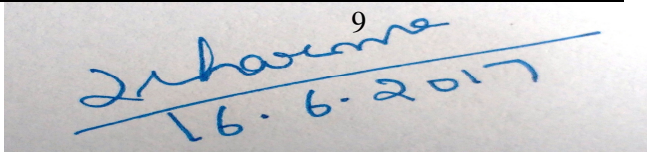
Traffic forecasting is made by determining the past trend of traffic flow along the corridor and by use of economic models developed to co-relate past vehicle registration data and economic indices such as per capita income (PCI), gross state domestic product (GSDP) and gross domestic product (GDP). By using the elasticity values obtained from the econometric models and the likely rate of growth of indices, population and zonal influences, the mode wise growth rates are established. Applying this growth rates, future traffic volume is estimated.
The traffic estimated for future years are given in the **Table 0.3** below.

Table: 0.3 Projected sectional traffic in PCUs
(As per Design)

Year		Km.45+000 Before Jayal	Km. 82+000 Near Koliya	Km.102+000 Near Aas Ki Dhani	Km.132 After Ganeri	Km. 161.500 At Existing Chhota Bhooma Toll Plaza	Km.191+000 After Balaran	Average
Base Year	2014	2590	4696	2122	5110	6416	4099	4172
1	2015	2720	4931	2228	5366	6737	4304	4381
2	2016	2855	5177	2340	5634	7074	4519	4600
3	2017	2998	5436	2456	5915	7427	4745	4830
4	2018	3148	5708	2579	6211	7799	4982	5071
5	2019	3306	5993	2708	6522	8189	5231	5325
6	2020	3471	6293	2844	6848	8598	5493	5591
7	2021	3644	6608	2986	7190	9028	5768	5871
8	2022	3827	6938	3135	7550	9479	6056	6164
9	2023	4018	7285	3292	7927	9953	6359	6472
10	2024	4219	7649	3457	8324	10451	6677	6796
11	2025	4430	8032	3629	8740	10974	7011	7136
12	2026	4651	8433	3811	9177	11522	7361	7493
13	2027	4884	8855	4001	9636	12098	7729	7867
14	2028	5128	9298	4201	10117	12703	8116	8261
15	2029	5384	9763	4411	10623	13338	8522	8674
16	2030	5654	10251	4632	11154	14005	8948	9107
17	2031	5936	10763	4864	11712	14706	9395	9563
18	2032	6233	11301	5107	12298	15441	9865	10041
19	2033	6545	11867	5362	12913	16213	10358	10543
20	2034	6872	12460	5630	13558	17024	10876	11070
21	2035	7216	13083	5912	14236	17875	11420	11624
22	2036	7576	13737	6207	14948	18768	11991	12205
23	2037	7955	14424	6518	15695	19707	12590	12815
24	2038	8353	15145	6844	16480	20692	13220	13456
25	2039	8771	15902	7186	17304	21727	13881	14128
26	2040	9209	16697	7545	18169	22813	14575	14835
27	2041	9670	17532	7922	19078	23954	15303	15577
28	2042	10153	18409	8319	20032	25152	16069	16355
29	2043	10661	19329	8734	21033	26409	16872	17173
30	2044	11194	20296	9171	22085	27730	17716	18032

Colour ID	DSV (PCU/day)	Lane Configuration	LOS
	6000	DSV of Intermediate Lane	**LOS - B**
	8400	DSV of Intermediate Lane	LOS - C
	15000	DSV of Two Lane	**LOS - B**
	21000	DSV of Two Lane	LOS - C
	17250	DSV of 2 Lane + P Shld	**LOS - B**
	24150	DSV of 2 Lane + P Shld	LOS - C

4. ENGINEERING SURVEYS AND INVESTIGATIONS



This activity includes the following tasks:

- Topographic, alignment and land use survey
- Road inventory survey
- Road condition survey
- Bridge condition survey
- Soil, geo-technical, material, hydrology and drainage surveys

Topographic, alignment and land use survey

The activities and Deliverables forming part of the topographic, alignment and land use survey are described below:

a) Divide the Project into various stretches as per terrain classification

b) Identify sections of Project which fall within urban limits and need four laning in accordance with the Manual.

c) Identify sections of Project which require raising. Such sections will be identified with attention being paid to the previous history of submergence and the extent to which the subgrade is likely to be affected by the capillary action if the section is not raised.

d) As far as possible, the existing alignment would be retained subject to the following requirements:

i. Identify stretches which do not meet the criterion of ruling design speed, i.e. where radii of horizontal curves are less than desirable minimum. Prepare realignment plans for improving geometrics in such stretches.

ii. Identify stretches out of (i) above, which meet the criterion of minimum design speed, i.e. where the radii of horizontal curves are more than the absolute minimum (This will enable the Authority to take a view on whether to include such stretches for improving geometrics in the initial stage or these can be postponed by a few years and in the meantime steps can be taken to acquire the necessary land for the ROW).

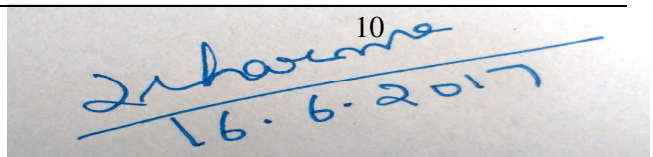
iii. Identify stretches where stopping sight distance is not available. Work out possible improvement plan to increase the sight distance to provide overtaking sight distance. Also work out option to increase the sight distance to provide at least the intermediate sight distance.

iv. Identify stretches, other than those in (iii) above, where intermediate sight distance is not available. Work out possible improvement plan to increase the sight distance to provide overtaking sight distance. Also work out possible improvement plan to increase the sight distance to provide at least the intermediate sight distance.

v. Identify stretches where the gradients are steeper than the ruling gradient for the relevant terrain condition. Work out and prepare an improvement plan for the vertical alignment in such stretches. Divide improvement plans of such stretches into the following two parts:-

   a. Stretches where gradient is more than the ruling gradient but less than the limiting gradient. (The Authority can take a view on whether improvements of stretches in this category shall be taken up or not.)

vi. Identify stretches where extra width of roadway and carriageway at curves is required.



e) Identify stretches involving construction of new bridges and other grade separated structures including those requiring reconstruction and their approaches. Work out proposal for location of such structures and alignment of approaches.

f) Based on the improvement plans of horizontal and vertical alignment worked out as a result of tasks in (d), (e) and (f), prepare alignment plans, L-Sections and cross-sections of the entire Project. Scale of drawings shall be as per IRC: SP: 19. Proposed improvements shall be marked on the plans. Such improvements will include raising of road, widening of roadway, widening of existing carriageway, provision of shoulders – both paved and granular, new structures, underpasses, grade separators, service roads, additional road signs, road furniture, safety devices, relocation of utilities, removal of trees, etc.

g) Also prepare a separate Land Plan of the Project showing the existing ROW (along with all the existing assets within the ROW e.g. structures, drains, service roads, trees, utilities and safety devices) and proposed additional land required in various stretches for improvement of geometrics, construction of new structures, provision of intersections, interchanges, service roads, toll plazas, project facilities, etc. The Land Plan should also show encroachments, if any. A list of such encroachments along with their brief description shall also be prepared and included in the Feasibility Report.

h) For additional land proposed to be acquired as per final alignment plan of the Project, the Land Plans shall be marked on duly certified village maps showing khasara numbers and shall be furnished along with a report which will include detailed schedules in respect of the proposed acquisition of land holdings as per revenue records in a format that would enable the Authority to initiate land acquisition proceedings.

i) A set of cross-sections of the existing road including urban sections at one interval for each homogeneous section in plain/rolling terrain and at 100 m intervals in mountainous/steep terrain shall be provided by the Consultant. In plain/ rolling terrain, additional cross-sections shall be provided for curves at the start, at the middle and at the end. These cross-sections along with proposed improvement plan and preliminary design shall form the basis of preparation of indicative BOQ for the Project.

Road inventory survey

Deliverables under this component shall include:

a) An inventory of road, culverts, bridges and other structures like railway over/under bridges, flyovers (grade separated structures), underpasses and overpasses.

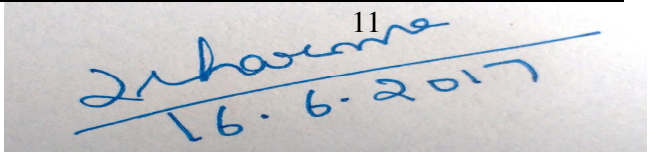
b) Identification of stretches of the Project which -

i. are affected by frequent flooding;
ii. are subjected to water logging;
iii. pass through black cotton soil area;
iv. pass through marshy area; or
v. pass through weak soil stratum

c) Typical cross-sections of the existing road showing the crust composition of pavement, shoulders and drains (one cross-section for every five of the road).

d) Identification of sections in cutting.

e) Identification of culverts requiring:



i. Reconstruction (all culverts which are structurally distressed shall be reconstructed as new structures).
ii. Widening (all existing culverts which are not to be reconstructed shall be widened equal to the roadway width).
iii. Repairs and/or rehabilitation along with preliminary proposals.
iv. New construction.

Road condition survey

The Consultant has undertaken a survey of the visual condition of the pavement and shoulders of the Project and provides its report as per Proforma-4 and also report if distresses are observed in the pavement and shoulders. Identify sections requiring reconstruction.

Bridge condition survey

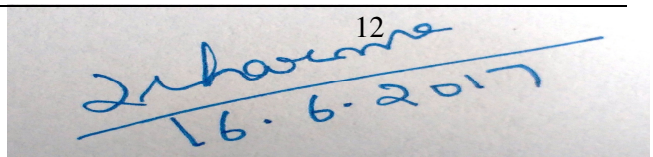
The activities and Deliverables forming part of bridge condition survey are specified below:

a. The Consultant has carried out a detailed inspection of every bridge and other structures such as railway over/under bridges, overpasses, underpasses and grade separators including flyovers. (For guidance, see IRC: SP: 35 and IRC: SP: 52).
b. For each structure, the Consultant will indicate the distresses observed, if any, in respect of various components of the structures e.g. bearings, expansion joints, wearing coat, railings/crash-barriers, foundations, substructures (abutments, piers, pier caps), superstructure (Proforma-5). On the basis of the distresses observed, the Consultant shall divide the structures into the following categories:
c. Structures requiring reconstruction immediately as part of first stage development (all such structures shall be provided as new structures);
d. Structures where distresses are not so severe and reconstruction can be postponed to a subsequent stage say for a period of 7 to 8 years; if any major repairs are required in the meantime, these shall be so indicated for each such location;
e. Structures requiring repairs and/or rehabilitation (for such structures indicate preliminary proposals for repairs and/or rehabilitation);
f. Structures requiring widening (for such structures indicate widening methodology); and
g. Structures that shall be retained.

Soil, geotechnical, material, hydrology and drainage surveys

The activities and Deliverables forming part of the soil, geotechnical, material, hydrology and drainage surveys are described below:

(a) The characteristics of the existing soil, one samples from every three km of the Project or closer where change in soil type is encountered.
(b) The determination of subgrade CBR (soaked) every three km of the Project or closer where change in soil type is encountered.
(c) Benkelman Beam Deflection measurements on the Project – one set of ten readings in for every three of the Project.
(d) Investigations of the subsoil strata (one trial bore and/or test pit at embankment and one in river bed at locations where new bridges or other structures are proposed. The depth



of trial bore/ test pit shall be as per IRC standards).

(e) Preliminary hydraulic data for bridges, design discharge, HFL, LWL, etc. with a view to checking adequacy of existing waterway.

(f) A broad assessment of the drainage condition and requirement of the Project.

4.1 Pavement Condition Survey

The existing pavement for the most of the stretch is of bituminous or flexible surface, except at few stretches in built-up/settlement/villages sections from Design Km.50+200 to 51+200, Km 60+200 to 60+800, Km 72+800 to 72+500, Km 83+100 to 83+600, Km 87+200 to 87+300, Km 102+000 to 102+200, Km 104+450 to 104+850, Km 110+250 to 110+350, Km 111+000 to 111+100, Km 152+500 to 152+740, km 155+500 to 156+500, km 170+050 to 170+650 km 180+900, to 181+300 km 183+550 to 183+750 km 189+380 to 190+300 & 199+800 where the Pavement is of rigid surface.

The details of condition of Pavement by visual observation are given in **Table 0.4** below:

Table: 0.4 Pavement Condition

Description	Design Length (km)	% of total length	Details of Chainage
Good	46.213	27.91	130+090 to 151+400, 151+640 to 172+010, 200+600 to 203+850, 203+950 to 205+233
Poor	99.212	59.92	39+668 to 89+400, 100+400 to 128+250, 130+060 to 130+090,151+400 to 151+640, 179+340 to 200+600, 203+850 to 203+950
Overlapping	7.635	4.61	95+740 to 100+00, 172+010 to 175+385
Kuccha track	12.505	7.55	89+400 to 95+740, 100+000 to 100+400, 128+250 to 130+060, 175+385 to 179+340
Total	165.565	100.00	

At Km. 165+000 to 166+000 Good Pavement Condition

At Km. 203+000 to 205+000 Good Pavement Condition

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At Km. 55+000 to 56+000 Poor Pavement Condition	**At Km 128+00 to 130+000 Kuccha Track**

4.2 Pavement Structural Strength

Benkelman Beam deflection studies are carried out for evaluating the requirements of strengthening of Flexible pavements, because the existing road Performance of flexible pavement is closely related to elastic deflection under the wheel loads. The deformation under a given load depends upon sub-grade soil type, its moisture content and dry density, pavement surface temperature, drainage condition etc. The project road is divided into homogeneous sections based on the BBD survey. The homogeneous sections are mentioned in the following **Table 0.5**. Among the Homogeneous sections the characteristic deflection varies from 0.989mm to 2.323mm.

Table: 0.5 Homogeneous Sections with Respective Design

S. No.	Design Chainage (Km.)	Deflection LHS	Deflection RHS	Deflection Average
1	39+668 to 44+668	1.15	0.83	0.989
2	44+668 to 49+668	2.11	1.34	1.726
3	49+668 to 54+668	1.55	1.70	1.624
4	54+668 to 59+668	1.79	1.56	1.677
5	59+668 to 64+668	1.81	1.00	1.404
6	64+668 to 69+668	3.61	1.04	2.323
7	69+668 to 74+668	1.35	1.45	1.399
8	74+668 to 79+668	2.74	1.11	1.926
9	79+668 to 84+668	2.34	1.43	1.889
10	84+668 to 89+668	1.30	1.38	1.339
11	89+668 to 94+668	1.34	1.25	1.291
12	94+668 to 99+668	1.34	1.22	1.282
13	99+668 to 104+668	2.20	1.33	1.768
14	104+668 to 109+668	0.96	1.71	1.332
15	109+668 to 114+668	1.33	1.01	1.169
16	114+668 to 119+688	1.08	1.06	1.069
17	119+668 to 124+668	2.08	2.44	2.259
18	124+668 to 129+668	1.50	1.89	1.692
19	129+668 to 134+668	1.78	1.10	1.443
20	134+668 to 139+668	1.44	1.43	1.435
21	139+668 to 144+668	1.31	1.32	1.316
22	144+688 to 149+668	1.29	1.27	1.282

S. No.	Design Chainage (Km.)	Deflection LHS	Deflection RHS	Deflection Average
23	149+668 to 154+668	1.44	1.25	1.347
24	154+668 to 159+668	1.06	1.00	1.030
25	159+668 to 164+668	0.90	0.91	0.906
26	164+668 to 169+668	1.09	1.08	1.084
27	169+668 to 174+668	0.99	1.08	1.034
28	174+668 to 179+668	0.84	0.84	0.836
29	179+668 to 184+688	1.78	1.87	1.828
30	184+668 to 189+668	2.01	1.99	2.000
31	189+668 to 194+668	1.61	1.94	1.779
32	194+688 to 199+686	1.72	2.04	1.882
33	199+688 to 204+500	2.06	2.02	2.041

4.3 Sub grade Investigations

Investigations have been carried out by digging test pits to assess the adequacy of existing pavement layers including sub-grade soil properties to establish the strengthening / reconstruction requirements to cater for design traffic during service life. The laboratory investigations of sub-grade indicate that the existing sub-grade varies from location to location along the road. The summary of the sub-grade soil properties is given in **Table 0.6**.

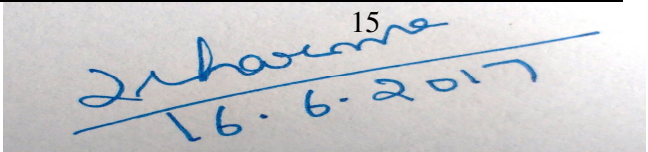
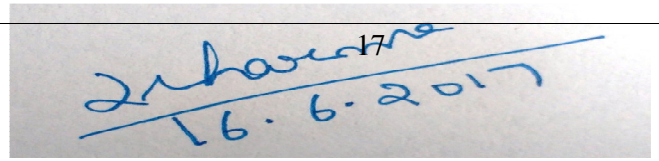


Table: 0.6 Field Soil Investigation

SAMPLE NO.	CHAINAGE NO.		PARTICAL SIZE ANALYSIS			ATTERBERG LIMITS		DFS (%)	CLASSIFICATION OF SOIL	STANDARD PROCTOR TEST		CALIFORNIA BEARING RATIO
	Design Ch.	Existing Ch.	Gravels (%)	Sand (%)	Silt + Clay (%)	W_L (%)	W_P (%)		SOIL TYPE	MDD (gm/cm3)	OMC (%)	CBR (%)
1	42+668	109+000 (SH-60)	19.58	59.50	20.92	24.52	NP	0.00	SM*	1.95	12.10	5.98
2	45+668	112+000 (SH-60)	6.84	70.76	22.40	28.21	NP	0.00	SM	1.88	11.20	5.16
3	48+668	115+000 (SH-60)	5.26	84.00	10.74	27.45	NP	0.00	SM	1.85	10.60	5.40
4	51+668	118+000 (SH-60)	37.90	42.06	20.04	23.87	NP	0.00	SM*	2.01	10.70	9.17
5	54+668	121+000 (SH-60)	5.84	83.46	10.70	28.34	NP	0.00	SM	1.88	12.00	5.89
6	57+668	124+000 (SH-60)	24.02	64.92	11.06	22.56	NP	0.00	SM*	1.95	10.20	7.86
7	60+668	127+000 (SH-60)	16.56	68.80	14.64	30.12	NP	0.00	SM*	1.92	12.10	7.04
8	63+668	130+000 (SH-60)	14.40	68.35	17.25	28.74	NP	0.00	SM*	1.93	13.20	6.88
9	66+668	133+000 (SH-60)	8.35	74.25	17.40	27.65	NP	0.00	SM	1.84	11.30	5.89
10	69+668	136+000 (SH-60)	43.80	43.50	12.70	27.98	NP	0.00	SM*	1.97	11.00	10.07
11	72+668	139+000 (SH-60)	19.70	66.00	14.30	21.88	NP	0.00	SM*	1.92	11.80	7.20
12	75+668	142+000 (SH-60)	22.05	63.35	14.60	23.65	NP	0.00	SM*	1.96	11.00	7.78
13	78+668	145+000 (SH-60)	12.06	72.96	14.98	27.41	NP	0.00	SM*	1.96	11.40	6.63
14	81+668	148+000 (SH-60)	14.21	64.61	21.18	28.19	NP	0.00	SM*	1.90	10.80	6.14
15	84+668	151+000 (SH-60)	21.16	64.56	14.28	24.28	NP	0.00	SM*	1.97	9.00	7.61
16	87+668	154+000 (SH-60)	18.25	51.95	29.80	21.58	NP	0.00	SM*	1.93	10.60	6.38
17	90+668	157+000 (SH-60)	31.74	53.90	14.36	25.15	NP	0.00	SM*	1.99	7.90	8.19
18	93+668	160+000 (SH-60)	10.02	53.20	36.78	27.32	NP	0.00	SM	1.85	11.20	5.48
19	96+668	174+000 (SH-60)	24.62	51.78	23.60	29.05	NP	0.00	SM*	1.91	11.30	6.55
20	99+668	177+000 (SH-60)	1.60	78.55	19.85	22.20	NP	0.00	SM	1.85	12.20	5.57
21	102+668	180+000 (SH-60)	23.85	58.10	18.05	23.61	NP	0.00	SM*	1.98	10.80	7.45
22	105+668	183+000 (SH-60)	16.28	70.80	12.92	27.24	NP	0.00	SM*	1.94	9.40	6.96
23	108+668	186+000 (SH-60)	12.85	71.75	15.40	23.54	NP	0.00	SM*	1.96	8.90	7.28
24	111+668	189+000 (SH-60)	15.20	63.83	20.97	26.72	NP	0.00	SM*	1.91	12.30	6.87
25	114+668	192+000 (SH-60)	0.00	67.15	32.85	26.22	NP	0.00	SM	1.88	11.60	6.06
26	117+668	195+000 (SH-60)	13.42	73.38	13.20	27.25	NP	0.00	SM*	1.92	8.70	6.63

16.6.2017

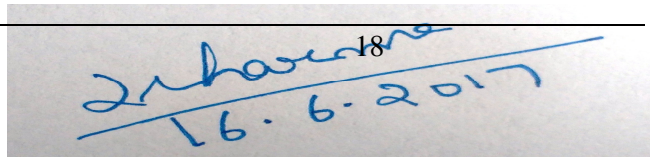
SAMPLE NO.	CHAINAGE NO.		PARTICAL SIZE ANALYSIS			ATTERBERG LIMITS		DFS (%)	CLASSIFICATION OF SOIL	STANDARD PROCTOR TEST		CALIFORNIA BEARING RATIO
	Design Ch.	Existing Ch.	Gravels (%)	Sand (%)	Silt + Clay (%)	W_L (%)	W_P (%)		SOIL TYPE	MDD (gm/cm3)	OMC (%)	CBR (%)
27	120+668	10+000 (SH-20)	2.45	84.45	13.10	29.66	NP	0.00	SM	1.82	12.20	6.47
28	123+668	7+000 (SH-20)	0.60	86.90	12.50	26.31	NP	0.00	SM	1.82	13.00	6.22
29	126+668	4+000 (SH-20)	8.70	76.00	15.30	28.75	NP	0.00	SM	1.85	10.70	5.32
30	129+668	1+000 (SH-20)	1.05	85.05	13.90	26.31	NP	0.00	SM	1.83	11.90	6.55
31	132+668	0+000	1.80	84.35	13.85	28.11	NP	0.00	SM	1.82	12.60	7.12
33	140+000		5.25	72.15	22.60	25.84	NP	0.00	SM	1.87	13.00	6.47
34	147+000		8.25	69.85	21.90	23.54	NP	0.00	SM	1.86	13.40	6.55
35	151+000		7.10	73.85	19.05	26.38	NP	0.00	SM	1.83	13.20	6.30
36	176+000		8.20	62.00	29.80	21.58	NP	0.00	SM	1.88	10.55	6.38
37	179+000		6.84	82.46	9.70	29.34	NP	0.00	SM	1.87	12.00	6.12
38	181+000		7.38	72.77	19.52	25.77	NP	0.00	SM	1.86	11.92	6.27
39	185+000		5.20	73.83	20.90	26.79	NP	0.00	SM	1.85	12.30	6.77
40	189+000		5.06	75.96	18.98	27.41	NP	0.00	SM	1.86	11.39	6.60
41	193+000		6.63	73.48	19.66	26.21	NP	0.00	SM	1.86	11.89	6.41
42	201+200		4.62	71.78	23.65	29.00	NP	0.00	SM*	1.81	12.80	6.15



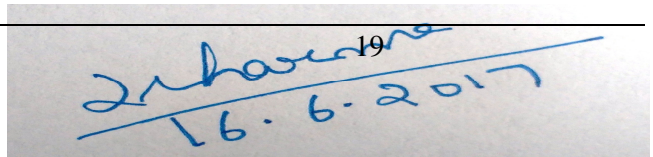
4.4 Existing Pavement Investigation

Table: 0.7 Existing Pavement Investigation

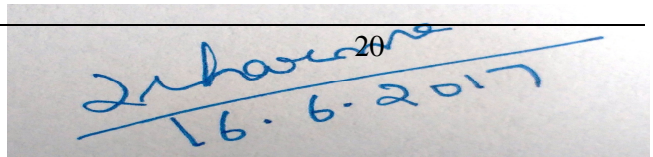
Design Chainage Ex. Chainage	Excavation upto Depth of :	Thickness of crust	Description
1	0.35 mtr.	5.0 cm	Surface Course (BT)
42+668		21.0 cm	WBM+GSB
109+000		Below this	Silty Sand (SM) mixed with Gravels
2	0.42 mtr.	7.5 cm	Surface Course (BT)
45+668		24.5 cm	WBM+GSB
112+000		Below this	Silty Sand (SM)
3	0.75 mtr.	5.5 cm	Surface Course (BT)
48+668		23.5 cm	WBM+GSB
115+000		Below this	Silty Sand (SM)
4	0.70 mtr.	6.0 cm	New Surface Course (BT)
51+668		5.0	Old Surface Course (BT)
118+000		26.0 cm	WBM+GSB
		Below this	Silty Sand (SM) mixed with Gravels
5	0.65 mtr.	4.0 cm	Surface Course (BT)
54+668		26.0 cm	WBM+GSB
121+000		Below this	Silty Sand (SM)
6	0.75 mtr.	2.5 cm	Surface Course (BT)
57+668		14.0 cm	WBM
124+000		26.5 cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
7	0.59 mtr.	2.0 cm	New Surface Course (BT)
60+668		6.0 cm	Old Surface Course (BT)
127+000		17.0 cm	WBM+GSB
		Below this	Silty Sand (SM) mixed with Gravels
8	0.45 mtr.	3.2 cm	Surface Course (BT)
63+668		28.0 cm	WBM+GSB
130+000		Below this	Silty Sand (SM) mixed with Gravels
9	0.672 mtr.	5.5 cm	Surface Course (BT)
66+668		26.5 cm	GSB
133+000		Below this	Silty Sand (SM)
9A	0.225 mtr.	3.0 cm	Surface Course (BT)
69+668		10.0 cm	WBM
134+000		7.5 cm	GSB
		Below this	Silty Sand (SM) mixed with Gravels
10	0.63 mtr.	4.0 cm	Surface Course (BT)



Design Chainage Ex. Chainage	Excavation upto Depth of :	Thickness of crust	Description
72+668		9.0 cm	WBM
136+000		120 cm	GSB
		Below this	Silty Sand (SM) mixed with Gravels
11	0.67 mtr.	3.0 cm	Surface Course (BT)
75+668		12.0 cm	WBM
139+000		6.0 cm	GSB
		Below this	Silty Sand (SM) mixed with Gravels
12	0.65 mtr.	3.0 cm	Surface Course (BT)
78+668		13.0 cm	WBM
142+000		12.0 cm	GSB
		Below this	Silty Sand (SM) mixed with Gravels
13	0.56 mtr.	6.50 cm	Surface Course (BT)
81+668		13.5 cm	WBM
145+000		13.5 cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
14	0.60 mtr.	4.5 cm	Surface Course (BT)
84+668		18.0 cm	WBM
148+000		Below this	Silty Sand (SM) mixed with Gravels
15	0.70 mtr.	4.5 cm	Surface Course (BT)
87+668		14.5 cm	WBM
151+000		9 cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
16	0.67 mtr.	3 cm	Surface Course (BT)
90+668		11 cm	WBM
154+000		13 cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
17	0.57 mtr.	6 Cm	Surface Course (BT)
93+668		24 cm	WBM
157+000		18 cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
18	0.60 mtr.	5.0 cm	New Surface Course (BT)
96+668		3.5 cm	Old Surface Course (BT)
0+000		16.5 cm	WBM
		Below this	Silty Sand (SM)
19	0.625 mtr.	6.5 cm	New Surface Course (BT)
99+668		3.0 cm	Old Surface Course (BT)
3+000		14.0 cm	WBM
		6.5 cm	Sub Base



Design Chainage Ex. Chainage	Excavation upto Depth of :	Thickness of crust	Description
		Below this	Silty Sand (SM) mixed with Gravels
20	0.67 mtr.	7.0 cm	New Surface Course (BT)
102+668		0.4 cm	Old Surface Course (BT)
6+000		17.5 cm	WBM
		Below this	Silty Sand (SM)
21	0.71 mtr.	4.5 cm	Surface Course (BT) New
105+668		7.0 cm	WBM
11+000		10.50 cm	GSB
		Below this	Silty Sand (SM) mixed with Gravels
22	0.675 mtr.	5.0 cm	Surface Course (BT)
108+668		5.5 Cm	WBM
14+500		22.5 Cm	Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
23	0.70 mtr.	3.5 cm	Surface Course (BT)
111+668		18.5 cm	WBM
17+500		26.5 cm	GSB / Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
24	0.70 mtr.	3.5 cm	Surface Course (BT)
114+668		18.5 cm	WBM
20+500		22.5 cm	GSB / Sub Base
		Below this	Silty Sand (SM) mixed with Gravels
25	0.69 mtr.	6.0 cm	Surface Course (BT)
117+668		14.0 cm	WBM
23+000		11.0 cm	Sub Base
		Below this	Silty Sand (SM)
26	0.61 mtr.	5.0 cm	Surface Course (BT)
120+668		10.0 cm	WBM
26+500		Below this	Silty Sand (SM) mixed with gravels
27	0.60 mtr.	3.0 cm	Surface Course (BT)
123+668		6.5 Cm	WBM
30+000		7.0 Cm	Sub Base
		Below this	Silty Sand (SM)
28	0.69 mtr.	7.0 cm	Surface Course (BT)
126+668		17.0 cm	WBM
32+500		Below this	Silty Sand (SM)
29	0.70 mtr.	3.0 cm	Surface Course (BT)
129+668		3.5 cm	WBM
35+500		17.0 Cm	Sub Base



Design Chainage Ex. Chainage	Excavation upto Depth of :	Thickness of crust	Description
		Below this	Silty Sand (SM)
30	0.60 mtr.	4.0 cm	Surface Course (BT)
132+668		5.0 cm	WBM
38+500		Below this	Silty Sand (SM)
31	0.65 mtr.	3.0 cm	Surface Course (BT)
135+668		5.0 cm	Sub Base
		Below this	Silty Sand (SM)

5. MATERIAL INVESTIGATIONS

The material investigation for road construction has been carried out to identify the potential sources of construction materials and to assess their general availability, mechanical properties and quantities. This is one of the most important factors for stable, economic and successful implementation of the road program within the stipulated time. For improvement work as well as for new carriageway / bypass the list of materials includes the following:

- Granular material for lower sub-base works
- Crushed stone aggregates for upper sub-base, base, surfacing and cement works
- Sand for filter material and cement, concrete works, sub-base and filling material
- Borrow material for embankment, sub grade and filling
- Manufactured material like cement, steel, bitumen, geo-textiles etc. for other related works.

Potential sources of soil for the construction of embankment and sub grade (for Reconstruction / New Carriageway) were identified on either side of the project road. The summary of test results of all the borrow areas investigated with their respective locations; corresponding chainage and description / properties of material are tabulated in **Table: 0.6** presented in previous chapter**.**

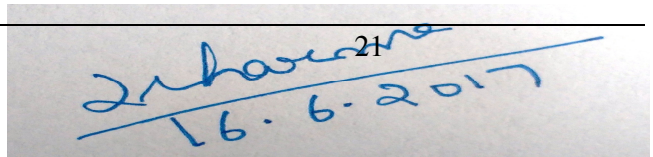
6. STONE AGGREGATES

The availability and quality of material as coarse and fine aggregate was explored and it was found that crushers are available near Jayal, Deedwana and Mukundgarh. This material is suitable for construction of road.

Bitumen (IS 73- 1961) is available at Mathura in Uttar Pradesh, which is around 310 km from Start of the Project road.

The steel to be used as reinforcement for cross drainage structures shall be Deformed Steel Bars conforming to IS 1786.

The cement of various types like Ordinary Portland Cement - 43 Grade, 53 Grade and Pozzolana Cement is required for the construction. The steel and Cement are available in Didwana, Salasar, Laxmangarh & Mukundgarh.



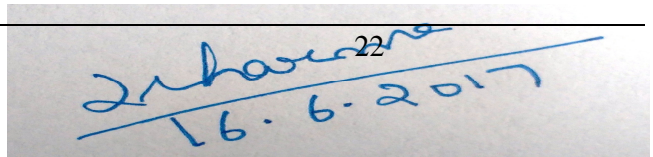
7. ALIGNMENT

The existing alignment of Road traverses through Nagaur, Sikar, Churu and Jhunjhunu Districts in the State of Rajasthan as shown under:

Project road completely passes through plain terrain. The road lies mostly in rural area, passing through few rural and quasi-urban settlements causing mild hindrance to the uninterrupted flow of traffic. The settlement locations are listed below.

Table 0.8: Settlement Locations along the Project Corridor

Sr. No.	Existing Chainage (km)		Design Chainage (km)		Length of Section	Name of Village
	From	To	From	To		
1	116.412	119.012	48.9	51.5	2.6	Jayal Village
2	127.57	129.07	60	60.800	1.5	Kathoti Village
3	133.695	134.295	66.1	66.7	0.6	Bhantri Village
4	136.75	137.35	69.2	69.8	0.6	Ransisar Charana
5	139.747	140.097	72.1	72.500	0.35	Kairap Village
6	144.48	144.68	77.75	77.95	0.2	Nozlon ki dhani
7	150.765	151.265	83.1	83.6	0.5	Koliya Village
8	157.08	171	89.4	95.74	6.34	Deedwana Town (Deedwana Bypass Proposed)
			95.74	100	4.26	Overlapping With SH-7D
9	172.59	172.79	102	102.2	0.2	Aas ki dhani Village
10	174.885	175.285	104.45	104.85	0.4	Thanu Village
11	180.72	180.92	110.250	110.350	0.10	Ambapa Village
12		180.415	111.00	111.100	0.100	Inderpura Village
13	187.26	190.86	118.05	121.75	3.7	Meethri Village (Bypass Proposed)
14	193.48	195.585	124.9	125.9	1	Bochi Village (Bypass Proposed)
15	196.96		128.4	130.06	1.66	Ganeri Village (Bypass Used)
16	52.14	39	140.1	142.435	2.335	Salasar Town
17	38.64	37.94	142.8	143.5	0.7	Juliyasar Village
18	30.045	30.245	152.5	152.740	0.240	Dhanani Village
19	16.5	15.5	155.5	156.5	1	Jajod Village
20	2.01	1.41	170.05	170.65	0.6	Sanwali Village
21	Overlapping With NH-11		172.01	175.385	3.375	Laxmangarh Town
	Laxmangarh P. Bypass		175.385	179.34	3.955	(Proposed Bypass)
22	2.785	3.135	179.7	180.05	0.35	Siagroda Dhani Village
23	4.015	4.415	180.9	181.3	0.4	Saigroda Village
24	6.635	6.835	183.55	183.75	0.2	Aantoril Village
25	12.525	13.445	189.38	190.3	0.92	Balaran Village
26	16.34	16.84	193.2	193.7	0.5	Churimiyan
27	5.645	43.005	199.8	203	3.2	Mukundgarh Town
28	43.982	44.082	203.95	204.05	0.1	Goribara khurd Village



7.1 Climate

These districts have dry climate. The cold season lasts for about three and half months from November to the end of February. The period from April to the end of June constitutes the hot season. The Monsoon starts in the end of June. The temperature rises to 50°C in summers and falls to a minimum of -5° to 4° in winters.

7.2 Land Use

Land use along the project road is mostly agricultural & residential. Scattered quasi-urban and rural settlements exist on both sides of the road with intervals.

7.3 Right of Way

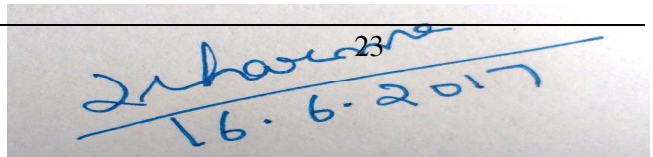
The existing right of way is not marked along the corridor and the same has been collected from Revenue Department. From the reconnaissance it is suggested to carry out concentric widening. However, the alignment would be so designed as to keep the resulting carriage in the centre of the final right of way for the sake of ease of future widening. Additional Land Acquisition, may be a necessary and will essentially be to accommodate geometric improvements and widening the road to 2-lane.

7.4 Roadway

The existing carriageway width for the entire project road is varying from 3.75 –15.00 m with a varying earthen shoulder.

Table 0.9: Table showing road way

SN	Road Section (Design)	Design Chainage	C/W	Formation Width
1	T-Junction Start of Project Road Km. 39+668 to 112+835 After Inderpura village (Nagaur)	39+668 to 89+400	7.00m	11.00 M
		89+400 to 95+500	Kuccha Track (Proposed Bypass)	
		95+740 to 100+000	RIDCOR Section	
		100+000 to 112+835	3.75	7.0
2	Km. 112+835 After Inderpura Village to 139+350 Salasar Bypass Start (Sikar)	112+835 to 118+100	7.0	11.0
		118+100 to 121+840	Meethari Bypass Kuccha Track	
		121+840 to 124+840	7.0	11.0
		124+840 to 125+840	Kuccha track Bochi Bypass	
		125+840 to 127+990	3.75	7.0
		127+990 to 129+690	Ganeri Bypass	
		129+690 to 140+050	5.5	9.0
3	Km. 139+350 Salasar Bypass Start to 151+950 Dhanani Village (Salasar)	140+050 to 152.650	5.5	9.0
4	Km. 151+950 Dhanani Village to 200+500 Before Mukundgarh (Sikar)	151+950 to 171+970	7.00	12.00
		179+270 to 175+345	NH-11 Overlap	
		175+345 to 179+270	Kuccha Track (Laxmangarh Bypass)	



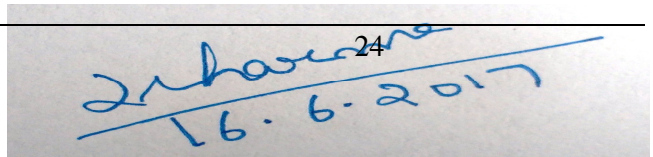
SN	Road Section (Design)	Design Chainage	C/W	Formation Width
		179+270 to 195+790	5.5	9.0
5	Km. 200+500 Before Mukundgarh to 209+795 After Y-Junction at Of Project Road (Jhunjhunu)	195+790 to 199+270	3.75	9.0
		199+270 to 200+550	15.00	16.00
		200+550 to 205+233	5.5	9.0

7.4.1 Intersections

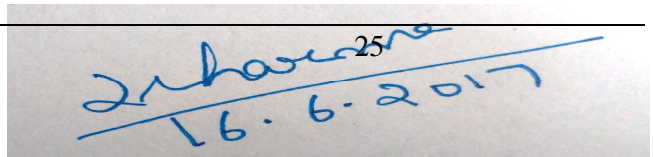
A total of 68 roads meet the project road, 22 Major Junctions and 46 Minor Junction. The details of junctions are given below:

Table 0.10: List of Intersections

S.No.	Existing Chainage	Type of Junction	Design Chainage	Direction	Type Cross Road	Remarks	
1	**107.188**	⊢	**39.668**	**Right**	**Paved**	**Nawa**	**Major**
2	**116.14**		**48.615**	**Left**	**Paved**	**Mundwa Mataji Mandir Road**	**Major**
3	116.97	⊢	49.43	Right	Paved	Uchaina	Minor
4	117.62	⊢	50.09	Right	Paved	Chhajoti	Minor
5	117.7	+	50.2	Both	Paved	L- Station Road ,R- Barnel	Minor
6	117.94	⊣	50.42	Left	Paved	Gujariyas	Minor
7	119.4	⊣	51.9	Left	Paved	Nokha Jodha	Minor
8	127.59	⊣	60.02	Right	Paved	Kathoti Village	Minor
9	**128.48**	⊣	**60.9**	**Left**	**Paved**	**Nimbi Jodha**	**Major**
10	**128.535**	⊢	**60.955**	**Right**	**Paved**	**Khatu Kala**	**Major**
11	**133.77**	⊣	**66.175**	**Left**	**Paved**	**Nimbi Jodha**	**Major**
12	**134.225**	⊣	**66.63**	**Right**	**Paved**	**Chhoti Khatu**	**Major**
13	138.325	⊣	70.68	Left	Paved	Ransisar Jodha	Minor
14	138.415	⊣	70.78	Right	Paved	Sagoo Kalan	Minor
15	140.49		72.84	Left	Paved	Agrot	Minor
16	145.52	⊣	77.85	Right	Paved	Nozlon ki Dhani Village	Minor
17	148.925	⊣	81.32	Left	Paved	Minning	Minor
18	**150.13**	⊣	**82.48**	**Right**	**Paved**	**Khunkhuna**	**Major**
19	**157.075**	⊢	**89.4**	**Both**	**Paved**	**Deedwana Town (Used Deedwana Bypass)**	**Major**
20	**118.055 (SH-7D)**	⊣	**95.74**	**Left**	**Paved**	**Sujangarh/Ladnoo**	**Major**
21	117.595	⊢	96.2	Right	Paved	Deedwana Town	Minor
22	**113.6**	+	**100**	**Both**	**Paved**	**Kuchaman , Deedwana**	**Major**
23	172.64	⊢	102.13	Right	Paved	Khichiya basni	Minor



S.No.	Existing Chainage	Type of Junction	Design Chainage	Direction	Type Cross Road	Remarks	
24	175.2	⊣	104.7	Left	Paved	Gheezdod Meetha	Minor
25	176.44	⊣	106.4	Right	Paved	Darathi	Minor
26	180.8	+	110.3	Both	Paved	Kanwai , Jestan	Minor
27	183.85	+	114.7	Both	Paved	Kheenwaj , Dhayawa	Minor
28	186	⊣	116.85	Left	Paved	Rampuriya	Minor
29	187.25	⊢	118.05	Right	Paved	Lacchari	Minor
30	**187.3**	**⊢**	**118.1**	**Right**	**Paved**	**Meethadi**	**Major**
31	On Meethadi Bypass	+	119.42	Both	Paved	Aaspura Pipakuri/ Meethri Village	Minor
32		+	120.81	Both	Paved	Ringun town , Meethari town	Minor
33	**190.335**	**+**	**121.75**	**Right**	**Paved**	**Meethri Village**	**Major**
34	**193.48**	**⊣**	**124.9**	**Left**	**Paved**	**Bochi Village**	**Major**
35	**194.38**	**⊣**	**125.8**	**Left**	**Paved**	**Bochi Village**	**Major**
36	**198**	**⊣**	**128.25**	**Left**	**Paved**	**Ganeri Town**	**Major**
			130.06	**Right**	**Paved**	**Sikar**	**Major**
37	**42.775**	**Y**	**130.8**	**Both**	**Paved**	**Ganeri**	**Major**
38	43.275	⊣	131.2	Left	Paved	Ganeri , Salasar	Minor
39	44.47	+	132.47	Both	Paved	Pranavaashram, Dhani Ridmal	Minor
40	46.6	+	134.66	Both	Paved	Suthod/ Dhani Ridmal	Minor
41	**52.14**	**Y**	**140.1**	**Both**	**Paved**	**Sujangarh , Salasar Village**	**Major**
42	**39**	**⊣**	**142.44**	**Both**	**Paved**	**Salasar**	**Major**
43	38.25	⊣	143.2	Left	Paved	Juliasar Town	Minor
44	33.665	+	147.78	Both	Paved	Talab ki Dhani/ Mangloona	Minor
45	29.66	⊣	151.76	Right	Paved	Deewan ji ka bass	Minor
46	15.94	⊣	156	Right	Paved	Nechawa	Minor
47	15.72	+	156.22	Both	Paved	Dhani Charna , Jajod Village	Minor
48	9.18	+	162.92	Both	Paved	Chota Bhuma , Bada Bhuma	Minor
49	8.05	⊣	164	Right	Paved	Kheri Dookiya	Minor
50	6.1	⊣	166.1	Left	Paved	Banai	Minor
51	5.675	⊣	166.47	Right	Paved	Kheri	Minor
52	**375.75**	**+**	**172.01**	**Both**	**Paved**	**Bikaner NH-11 , Sikar ,**	**Major**
53	376.35	+	172.58	Both	Paved	Bagri/ Laxmangarh Town	Minor



S.No.	Existing Chainage	Type of Junction	Design Chainage	Direction	Type Cross Road	Remarks	
54	**378.48**	⋋	**175.385**	**Right**	**Paved**	**Bikaner NH-11, Laxmangarh**	**Major**
55		⊣	177.65	Left	Paved	Basni	Minor
56	2.415		179.3	Right	Paved	Laxmangarh Town	Minor
57	4.615		181.5	Left	Paved	Bairas	Minor
58	7.72	⊣	183.62	Left	Paved	Dishnau	Minor
59	8.9	⊣	185.82	Right	Paved	Kaswali	Minor
60	10.435	+	187.3	Both	Paved	Bhaironpura, Sawai ki Dhani	Minor
61	13.05	+	189.96	Both	Paved	Bhinchari. Dundlod	Minor
62	14	⊣	190.9	Left	Paved	Chrumiyan	Minor
63	16.335	+	193.24	Both	Paved	Banklu , Chrumiyan Village	Minor
64	3.83	⊣	198.8	Right	Paved	Pabhana	Minor
65	40.66	≺	200.62	Both	Paved	Navalgarh	Major
66	43	⊣	203.005	Left	Paved	Mandawa	Minor
67	44.04	⊣	203.93	Left	Paved	Ghoribara Khurd	Minor
68	**45.26**	≺	**205.233**	**Both**	**Paved**	**Nawalgarh/ Jhunjhunu**	**Major**

7.4.2 Submergence

The project road does not come under submergence at any location.

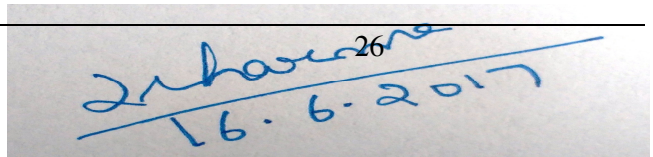
8. PROPOSED ALIGNMENT

The present scope of work is to develop the existing two-lane/ intermediate Lane carriageway configuration to 2-lane standard carriageway configuration in order to ensure better speed of travel with comfort and safety. Minimum cutting of road side trees, relocation of temples and relocation of existing utility lines situated with-in ROW has been taken in to consideration while finalising widening proposals. Existing road has two-lane to intermediate lane carriageway. Project road sections witness annual average daily traffic (AADT) in the range of 1818-4605 vehicles (2122-6416 PCUs).

That has already exceeded prescribed for SL design service volume of 2000 PCU for National/ State Highway by Indian Roads Congress. Based on traffic analysis and forecasting, capacities augmentation to 2-lane configurations is required immediately. Thus the proposed cross-sections for improvement of existing road is worked out in accordance with the design standards and the Major features are given here:

Table 0.11: Proposed Section Wise Carriageway Width

Section	Design Chainage	Width of Carriageway	Width of Shoulder
Tarnau to Ganeri	39.668 to 130.090	**7.00 m**	**2.50 m (on either side)**
Ganeri to Laxmangarh	130.090 to 172.010	**2-Lane with Paved shoulder**	**1.00 m (on either side)**
Laxmangarh to Mukundgarh	172.010 to 205.233	**7.00 m**	**2.50 m (on either side)**



Widening in the form of concentric widening has been proposed to minimise the interruption to the traffic movement during the construction. However, in case of geometric improvement the small realignment stretches have been planned to ease the alignment over the existing scenario. The widening has been proposed concentric wherever it is passing through the settlements. Design of widening scheme is governed by the roadside constraints and availabilities of right of way. The proposed alignment has been designed for 100 kmph but in some cases this has not been possible to avoid major improvement. All such locations had been discussed with working group who decided to reduce the design speed. The proposed geometric standards are given in the following table.

Table 0.12: Cross Sectional Elements

Particulars	Design Values
Width (m) Lane	3.5
Hard shoulder	2.50
Camber (%)	
Carraigeway	2.5
Shoulders	3
Embankment Side Slope Gradient (%) Maximum	1(V) : 2(H) 4
Right of Way (m)	24
Overall width (m) between Building lines	24
Overall width (m) between Control lines	24

Table 0.12: Sight Distances

Design Speed (kmph)	Sight distance (m)		
	Stopping Sight distance	Overtaking Sight Distance	Intermediate Sight Distance
100	180	640	360
80	120	470	240

Table 0.13: Geometric Design Standards for Horizontal Alignment

Particular	Design Speed (Kmph)	
	100	80
Minimum Radius (m) of horizontal curves	360	230
Maximum Super Elevation (%)	7	7
Rate of change of Super elevation	1 in 200	1 in 200

Table 0.14 Min. Radius (for 2.5% camber) not requiring super elevation

Design Speed (kmph)	Radius (m)
100	1800
80	1100

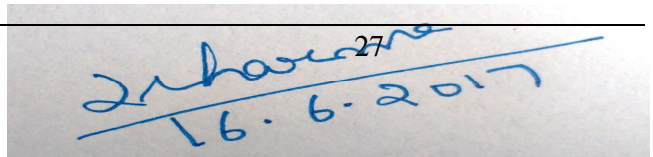


Table 0.15 : Radius of circular curves not requiring transition curves

Design Speed (kmph)	Radius (m)
100	2000
80	1200

9. BYPASSES

The available ROW all along the project road is 7-15m and hence five bypasses have been proposed. This has been done in consultation with the working group of PWD.

Table 0.16: Details of Proposed Bypasses

S.No.	Design chainage		Design Lengh (Km.)	Name of Village
	From	To		
1	89.4	95.74	6.34	Deedwana Bypass Proposed
2	118.1	121.75	3.65	Meethari bypass Proposed
3	124.9	125.8	0.9	Bochi bypass Proposed
4	128.4	130.06	1.66	RUN ON GANERI (SIKAR B/P) {Not Part of This Project}
5	175.385	179.34	3.955	Proposed Laxmangarh Bypass

10. PAVEMENT DESIGN

Flexible pavement has been adopted for new carriageways, widening of existing flexible pavement carriageway portion in plain and rolling terrains.

Flexible/Rigid Pavement Design

The pavement design basically aims at determining the total thickness of the pavement structure well as thickness of individual structural components. The following assumptions are considered for the preliminary pavement design. The input parameters and pavement design compositions are presented in **Table 0.17** below**.**

Section –

Tarnau to Mukundgarh

Design Life : 15 Years for Sub Base and Base Course and 10 years for Bituminous Course
CBR : 6%
MSA (Design) : 42 / 25

The project road has been considered as four traffic homogeneous sections based on traffic intensity in terms of commercial vehicles.

16.6.2017

Table: 0.17 Input Parameters for Flexible Pavement Design Flexible Pavement Composition (IRC: 37-2012) for section I to II Strengthening of Existing Road (Partial/Full Construction)

S. No	Design Chainage	15 Years Design Life		10 Years Design Life		Design CBR	MSA (Design) for 15 Years	MSA (Design) for 10 Years
		GSB	WMM	DBM	BC			
1	38-50 Kms	260	250	100	40	6	42	25
2	51-91 Kms	260	250	100	40	6	42	25
3	91-93 Kms	260	250	100	40	6	42	25
4	93 - 101 Kms	260	250	100	40	6	42	25
5	101 – 176 kms.	260	250	100	40	6	42	25
6	176-205 kms.	260	250	100	40	6	42	25

Table: 0.18 Overlaying on Existing Pavement

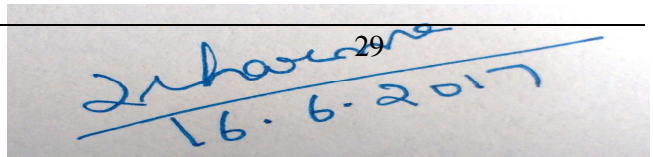
S. No.	DBM	BC	Design Length
1	100	40	128.450 Km – 152.410 Km.
2	50	40	Km. 152.650 – Km.171.970 Km.

Table 0.19: New Construction due to Horizontal Improvement

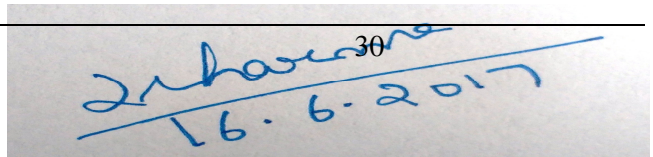
S. No.	Start Chainage	End Chainage	Design Length
1	100.00	100.40	0.400
2	128.250	128.400	0.150
3	130.00	130.090	0.090
		Total	**0.640**

Table 0.20: New Construction due to Vertical Improvement/ Raising of Pavement

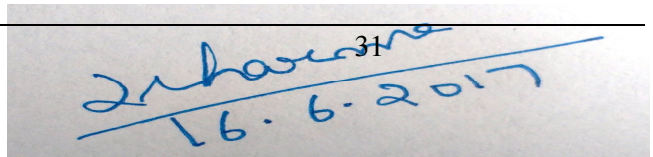
S. No.	Start Chainage	End Chainage	Design Length
1	48.760	48.880	0.120
2	50.040	50.200	0.160
3	60.660	60.820	0.160
4	61.140	61.280	0.140
5	62.220	62.240	0.020
6	73.060	73.100	0.040
7	75.620	75.680	0.060
8	108.060	108.140	0.080
9	110.420	110.460	0.040
10	110.520	110.760	0.240
11	110.920	111.140	0.220
12	111.660	111.880	0.220
13	111.940	112.320	0.380
14	112.560	112.680	0.120
15	113.380	113.480	0.100
16	113.720	113.780	0.060



S. No.	Start Chainage	End Chainage	Design Length
17	114.120	114.300	0.180
18	115.750	115.900	0.150
19	118.100	118.400	0.300
20	118.580	119.160	0.580
21	119.560	119.700	0.140
22	119.860	119.980	0.120
23	125.100	125.420	0.320
24	125.540	125.780	0.240
25	125.820	125.920	0.100
26	126.060	126.140	0.080
27	126.260	126.740	0.480
28	131.400	131.460	0.060
29	145.600	145.720	0.120
30	145.880	146.040	0.160
31	147.680	147.880	0.200
32	150.780	150.960	0.180
33	154.380	154.420	0.040
34	154.500	154.560	0.060
35	156.960	157.080	0.120
36	157.400	157.620	0.220
37	176.760	176.980	0.220
38	177.120	177.300	0.180
39	178.480	178.620	0.140
40	178.960	179.040	0.080
41	180.220	180.480	0.260
42	182.860	182.980	0.120
43	183.760	184.260	0.500
44	184.380	184.800	0.420
45	185.740	185.800	0.060
46	186.280	186.460	0.180
47	186.860	186.920	0.060
48	187.100	187.160	0.060
49	187.560	187.680	0.120
50	187.780	188.220	0.440
51	188.300	188.620	0.320
52	189.080	189.180	0.100
53	190.280	190.380	0.100
54	192.080	192.240	0.160
55	192.640	192.840	0.200
56	192.980	193.260	0.280
57	193.540	193.680	0.140
58	194.120	194.280	0.160
59	195.860	195.940	0.080



S. No.	Start Chainage	End Chainage	Design Length
60	196.040	196.080	0.040
61	197.880	198.000	0.120
62	198.740	198.840	0.100
63	199.520	199.580	0.060
64	201.120	201.160	0.040
65	201.360	209.500	8.140
66	201.840	202.060	0.220
67	204.120	204.180	0.060
68	204.360	204.480	0.120
		Total Length	**19.290 Km**

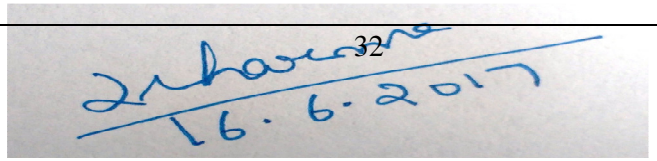


11. PROPOSAL FOR STRUCTURES

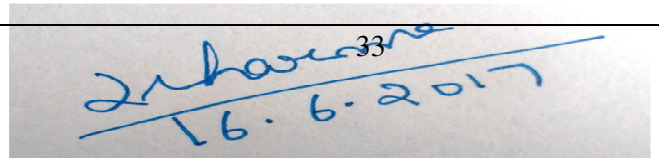
11.1 Culverts

Table: 0.21 Detail of existing culverts

S. No.	Design (chainage)	Type Of Structure(RCC Boy / Slab / Pipe / Masonry Arch)	Design Length (m)	Span arrangement		Width of culvert		Height above bed level		Condition assessment						Whether waterway adequate (yes/ no)	Remarks
				Number of Spans	Width of span (m)	Total (m)	Carriageway (m)	U/s Side (m)	D/s side (m)	Box/slab/pip/arch	Head Wall	Wing wall	Return Wall	Parapet/Handrail	Recommendation on widening/Reconstruction etc.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	50+340	Slab	2	2	2	14.4	6	1.3	1.3	Poor	-	-	Poor	-	**Reconstruction**	Yes	Replaced by 2mx2.5mx2.5m Box Culverts
2	54+306	Slab	2	2	2	8.3	10	1.3	1.3	Poor	-	-	Poor	-	**Reconstruction**	Yes	Replaced by 1mx3mx3m Box Culverts
3	70+690	Slab	3	1	3	13.7	3.5	1.5	1.5	Good	-	Good	Good	Good	**Wearing Coat**	Yes	**Overlaying**
4	81+225	Slab	3	1	3	13.9	6	3.5	3.5	Good	-	Good	Good	Good	**Wearing Coat**	Yes	**Overlaying**
5	82+410	Slab	3	1	3	12.5	7	3.5	3.6	Good	-	Good	Good	Good	**Wearing Coat**	Yes	**Overlaying**
6	83+300	Slab	1	1	1	13.5	6	1	0.9	Poor	-	-	Poor	-	**Reconstruction**	Yes	Replaced by 1mx1.5mx1.5m Box Culverts
7	86+710	Slab	3.6	1	3.6	12.5	7	3.3	3.5	Good	Poor	-	-	-	**Rehabilitation**		-
8	88+045	Slab	1	0.8	1	12	7	1.2	1.3	Fair	Fair	-	-	-	**Reconstruction**	Yes	Replaced by 1mx1.5mx1.5m Box Culverts



		
Existing Structure at Km.50+340	**Existing Structure at Km. 54+306**	**Existing Structure at Km. 70+690**
		
Existing Structure at Km. 81+225	**Existing Structure at Km. 82+410**	**Existing Structure at Km. 83+300**
		
Existing Structure at Km. 88+045		



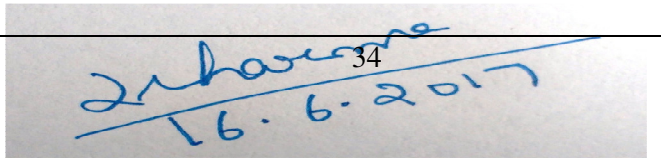
11.2 Bridges

There is no major bridge in the alignment. There is no causeways are present along this alignment.

Table: 0.22 Inventory of Minor Bridge

S.No.	Design Chainage	Type of Structure (R.C.C.,Box/ Slab/ Pipe, Masonry arch)	Design Length (m)	Span arrangement		Width of bridge		Height above Bed Level		Condition Assessment						Whether waterway adequate (Yes/No)	Remarks
				No. of Span	Width of span (m)	Total (m)	Carriage way (m)	u/s side (m)	D/sside (m)	Box/ slab/ pipe/Arch	Head Wall	Wing Wall	Return wall	Parapet/Hand rail	Recommendation widening/ reconstruction		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Location	Type of Structure	Flooding history	Condition of Bridge												
			Bearings	Expansion Joints	Wearing coat	Parapets/Railings /crash barriers/Gaurd Piller	Foundations	Abutments	Piers	Super Structure	Approach slabs	Guide bunds	Other Protective works	Other items (specify)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	



11.3 Railway Crossings

The Project Road Crosses Railway lines at three locations. Details are given below:-

Table: 0.23 Railway Crossings

S. No.	Design Chainage	LC No.	TVU	Remarks
1	95.900	-	86832	Deedwana on RIDCOR road (ROB already proposed under other scheme)
2	175.870	Between LC – 28 & LC – 29	-	Laxmangarh ROB Proposed On Bypass (No Level Crossing)
3	203.700	LC – 24C	-	Mukundgarh ROB not proposed (Level Crossing not commissioned)

11.4 Trees in ROW

Since the corridor is mainly passing through existing alignment, not many numbers of trees have been observed adjacent to the existing shoulder. Widening scheme has been so evolved as to cause minimum damage to existing trees, wherever this damage becomes unavoidable, loss will be compensated by planting new tress in consultations with Social Forestry Department of the Government of Rajasthan. Many trees along the new proposed bye-passes will have to be cut but the same shall be compensated. Total trees to be cut for Construction of Project are 901 Nos. Details given separately in EIA / SIA reports.

11.5 Utilities

There are electric lines, water pipe lines, water taps and OFC lines observed within the proposed ROW which may require re-location. Utilities, re-location plan has been evolved and submitted. The plans for shifting any water pipe lines, if found in the urban and quasi-urban areas will be made, after consultations with the concerned municipalities or agencies, as per design requirements. A separate plan for proposed different utility shifting has been prepared to submit with this report.

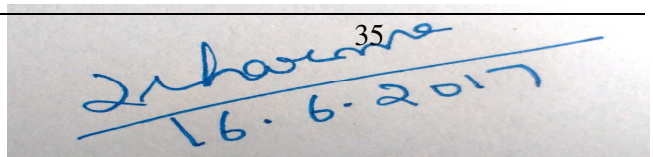
12. ENVIRONMENTAL IMPACT ASSESSMENT

An institutional mechanism needs to be incorporated in the proposed project management and execution system. The PWD will be responsible for the implementation of all the mitigation and management measures suggested in EMP for project road. The PWD is also responsible for implementation of the complete resettlement and rehabilitation for all those affected by the project and is committed to ensure the income restoration of the project affected and project displaced families.

The PWD has certain organizational and institutional capacity, for satisfactory implementation of the EMP.

Environmental Monitoring Plan

To ensure the effective implementation of the mitigation measures and environmental management plan during construction and operation phase of project road, monitoring plan has



been designed for Ambient Air Quality (AAQ) Monitoring, Water Quality Monitoring, Noise Levels measurements, Soil Erosion and Plantation.

13. COST ESTIMATE AND FINANCIAL ANALYSIS

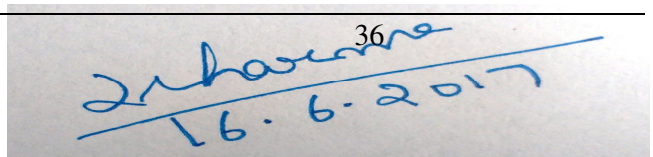
The cost estimates for the construction were developed from the basic unit rates for cost of labour, material and equipment. These basic costs have been derived from various sources. These sources include the Ministry of Road Transport and Highways (MoRT&H) standard data book for Rate Analysis published in 2003 and SOR.

The source data was reviewed and analyzed to provide realistic unit rates for the basic work items at current market prices. The item rates were derived based on the MoRT&H data book for rate analysis of 2003. These unit rates were considered to calculate the unit costs. For the suggested pavement design and also on the basis of maintenance regime suggested for cross drainage structures, bill of quantities are worked out. Later on PWD issued fresh guideline in the month of July 2015 wherein it was desired that the Item rates of all the materials has to be taken from BSR Nh Circle Jaipur 2013. The preliminary construction cost is given in Table 0.23.

13.1 ABSTRACT OF COST

Table 0.24: Preliminary Construction Cost

Abstract of Cost				
S. No.	**Name of Item**	**Length / Nos**	**Unit**	**Amount (in lacs)**
1	Upgradation & Strengthening of Existing Road	132.885	Kms	19091.57
2	Construction of New Road	17.85	KMs	2950.77
3	Rigid Pavement and Drains	8.01	Kms	2302.59
4	Toll Plaza	4	Nos	740.00
5	New CD Works (Balancing Culvert)	33	Nos	128.83
6	Road Furniture for entire length			759.59
7	New Box Culverts Proposed	6	Nos	105.00
8	Truck Layby	3	Nos	84.34
9	Bus Shelters	20	Nos	25.00
10	Development of Junction	75	Nos	809.55
11	ROB	1	Nos.	2850.00
			Total (Base cost)	**29847.6**
			Escalation @ 5% per annum for 2 years	**2984.76**
			TPC @ 15%	**37757.24**



13.2 FINANCIAL ANALYSIS

Table 0.25: Traffic Data Inputs

Section	Tarnau To Deedwana	Deedwana To Ganeri	Ganeri to Laxmangarh (NH-11 Junction)	Laxmangarh To Mukundgarh
Design Length in km	56.072	32.660	50.940	25.893
Cumulative Length	56.072	88.732	139.672	165.565
Section Toll Road Length in km	56.072	32.660	50.940	25.893
Cumulative Toll Road Length in km	56.072	88.732	139.672	165.565
TVC Location Used	Before Bhantri	Thanu/ Aas ki Dhani	Chhota bhuma	Balaran
TVC No.	TVC-II	TVC-III	TVC-V	TVC-VI
Car / Jeep /Van	761	371	2914	1196
Buses	173	60	96	105
LCV	58	148	356	237
2AT	289	133	386	185
3AT	255	91	227	218
MAV	161	56	105	4

Table 0.26: Financial Inputs

Project Cost	-	Rs. 328.32 Crores
Project Cost with Financial overheads (15%) – TPC	-	Rs. 377.57 Crores
Construction starts at	-	Jan 2016
Construction period	-	18 Months
Road opens to traffic	-	June 2017
Phasing of Project Cost	-	1st Year – 40%
	-	2nd Year – 60%

Table 0.27 Structuring of Project Finance

Tollable PCUs - Average of PCUs		
Non-Toll able PCUs - Average of TPs	250	5.31 % of Total PCUs
Total PCUs - Average of TPs	3020	

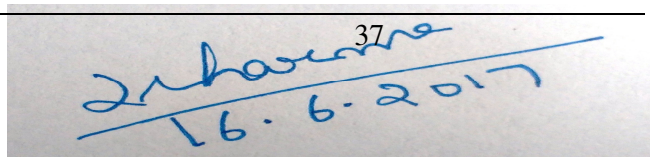


Table 0.28 Maintenance Cost

Annual Maintenance Costs	-	0.0175 Crores Per Km
Periodic Maintenance Cost (Every 5th Year)	-	0.30 Crores Per Km
Annual Toll Plaza O&M Cost	-	0.75 Crores Per toll Plaza
Electrical & Petroleum Cost	-	0.003 Crores Km Per Annum
Insurance Cost	-	Rs. 0.15%

14. Conclusion

The Project may be developed with 2 Lane specifications for the Section from Tarnau to Ganeri and Laxmangarh to Mukundgarh. The section from Ganeri to Laxmangarh is proposed for Development to 2 Lane with Paved Shoulder along with additional 3.00 m wide pedestrian walk way on the RHS for the pedestrian during Festivals.