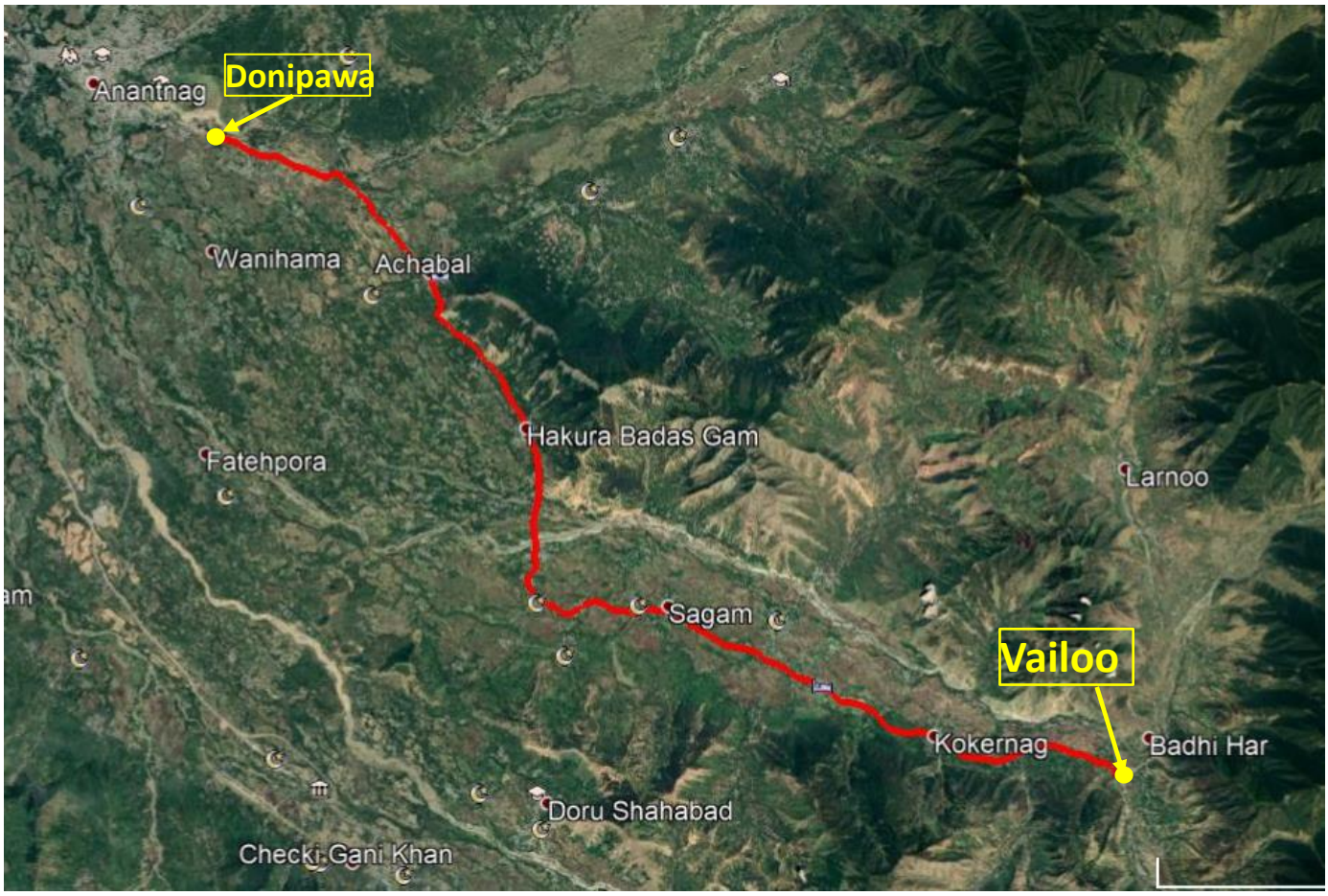
RC-1564-HO-DGN-RD -DPR -001 - D0

NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

(MINISTRY OF ROAD TRANSPORT & HIGHWAYS, GOVT. OF INDIA)
3RD FLOOR, PTI BUILDING, 4-PARLIAMENT STREET, NEW DELHI – 110001

Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing pre-construction services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.00 (Vailoo Village) to Km 269.00 (Khanabal) of Khellani- Kishtwar-Chattroo- Khanabal Section of NH 244 in the state of Jammu & Kashmir



FINAL DETAILED PROJECT REPORT
VAILOO TO DONIPAWA SECTION
VOLUME-I: MAIN REPORT

NOVEMBER 2020

RODIC CONSULTANTS PVT. LTD.
IN JV WITH
MONARCH SURVEYORS AND ENGINEERING CONSULTANTS PVT. LTD.

Final Detailed Project Report

Executive Summary

0.0 EXECUTIVE SUMMARY

0.1 Introduction

The **National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India** has been assigned **M/S Rodic Consultants Pvt. Ltd**., New Delhi in joint venture with **M/S Monarch Surveyors and Engineering consultant Pvt. Ltd.** as Consultants to carry out the "Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the newly formed Union Territory of Jammu and Kashmir.

The agreement was signed on 4th June 2019.

This report deals with **Vailoo – Khanabal** (which has been revised **Vailoo to Donipawa**) section, where according to contract the stretch of project road is from Ex. Km. 235.000 to Km. 269+000 with total length of 34Km. The project road starts from Vailoo and heads north west via Achabal through NH-244 and terminates at the junction of NH-44 at Khanabal.

However, actual Start point is at Vailoo village (Existing Km 235.070) and end at Donipawa (Existing km 263.107 i.e. Start of the Donipawa-Ashajipora Bypass) as per direction of NHIDCL official.

0.2 Project Overview

The project road is a part of a larger vision to improve the connectivity in UT of J&K in all-weather condition, reducing congestions and improved safety & comfort of freight and passenger vehicles. This project lies on NH-244 (previously NH-1B) and connects Vailoo with Donipawa, via Vailoo town, Achabal, Kokernag. This project is a connecting link between the Vailoo Tunnel project and Donipawa Ashajipora By-Pass project.

Proposal of the Vailoo-Donipawa section for a total length of 27.943 km in the Union territory of Jammu & Kashmir. Location of project road is shown in the fig. 0.1 below:

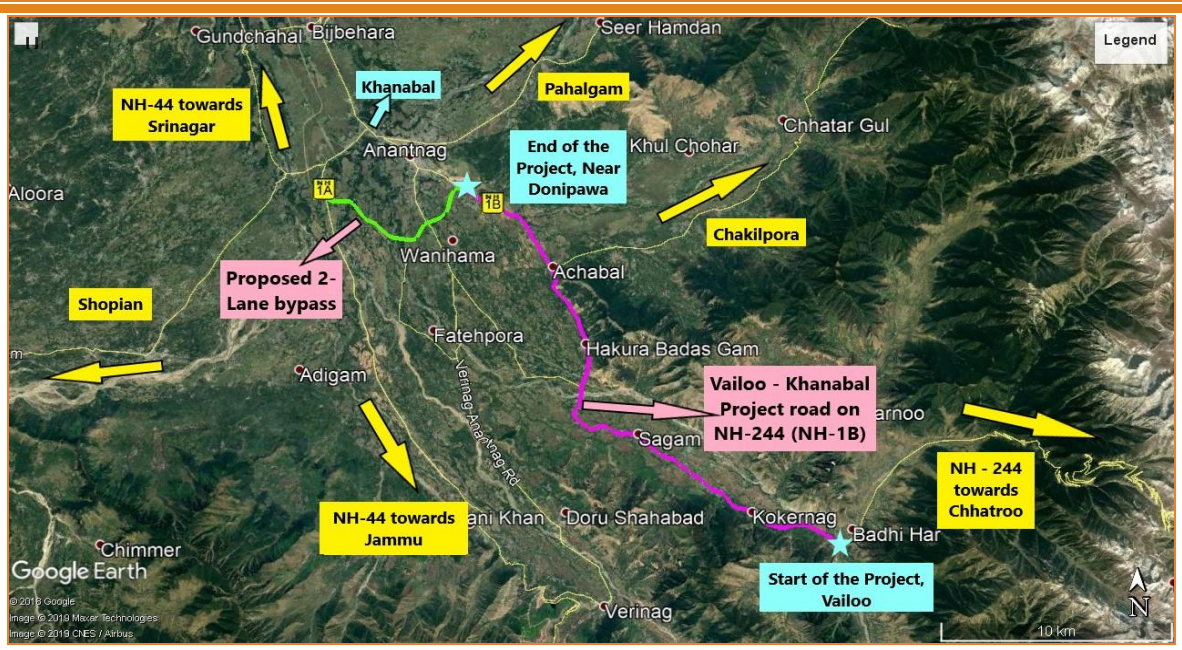


Figure 0.1: Location of Project road

2.1 Key Features of project

Key features of project road are represented in **Table1.**

Table1: Key features of project road

Attributes	Details
NH No.	244
Origin – Destination	Vailoo (Km 235+070) - Donipawa (Km 263+107) 33.5640° N, 75.3602° E 33.7184° N, 75.1677° E
Via Town	Vailoo, Achabal, Kokernag, Donipawa
Existing Carriageway	2lane (7m) over 90% of the road stretch with 14 m in 10% of the stretch in some urban area.
Service lanes and slip road	Nil
Shoulder	1 to 2m
Condition of Existing Pavement	Good to fair
Right of Way	Varying from 20 to 30 m as per visual
Land Use along project road	Built up & Agricultural
Traffic on the stretch	AADT-8059PCUs
Structures along the stretches	Major Bridge – 01 No. , Minor Bridge -14 nos. and Culverts-109nos. (107 Re-constructed and 02 new construction); Side Drain-01 with length of 50m and span of 1x4x3m.
Junctions	2 Major and 29 Minor
Terrain	Km 148+589 to Km 165+589 Mountainous/Hilly Terrain Km 165+589 to Km 176+532 is Plain/Rolling Terrain.
Key utilities in the proposed ROW	Electric poles & water pipeline etc. NP-4 Pipe of Dia 600 mm at spacing of 500m in Builtup

Attributes	Details
	areas and 2000 m spacing in Open area. And 300 mm dia HDPE pipe throught the section.
Rainwater Harvesting System	56nos. of rainwater harvesting pits are proposed along the road.
Bus Stops	38 nos. of bus stops have been proposed along the project route.
Protection Works	Toe Walls, Guard Railings and Jersey barriers.
Forest stretches along RoW	Nil
Rail Crossing along RoW	Nil
Other clearance related aspects	Utilities and Tree cutting

0.3 Project Description

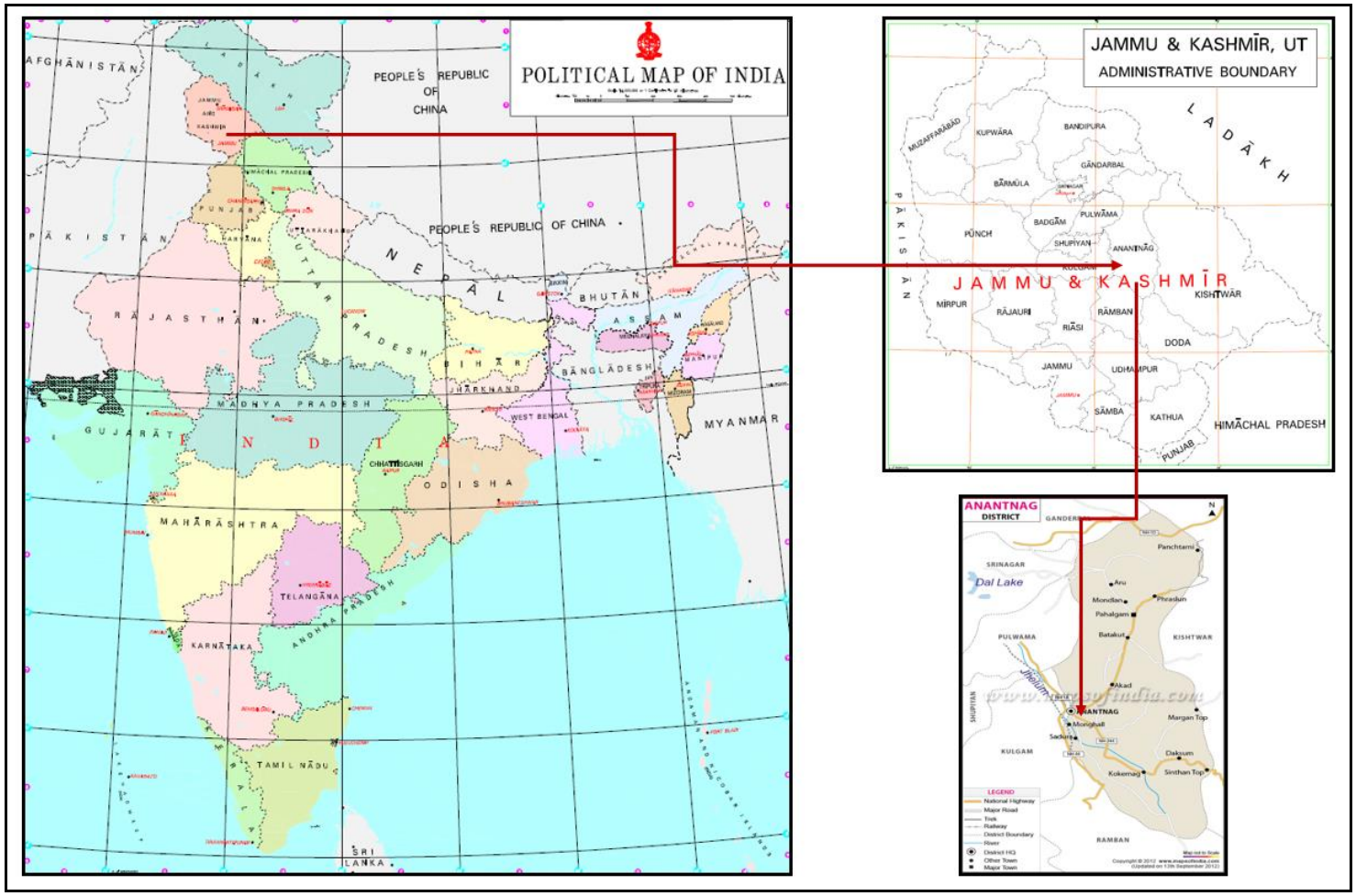
The project road of **Vailoo – Khanabal** (which has been revised **Vailoo to Donipawa**) lies entirely in Anantnag district in newly formed Union Territory of Jammu and Kashmir. The project road is part of NH-244 (old NH-1B) which runs from Batote to Khanabal via Khellani, Thatri, Kishtwar, Vailoo, Achabal and Anantnag. The Project Road is located in south-west part of Jammu and Kashmir.

The end point of project of "**Vailoo tunnel and its approach roads**" coincides with Vailoo – Donipawa project near its starting point at Existing Chainage 235+070. So, we have considered this location as our starting point for Vailoo – Donipawa project.

Now, there is already a DPR proposed for a new 2 -Lane bypass (**Donipawa-Ashajipora Project**) which bypasses the Anantnag city and ignores the heavy traffic of the city. This bypass is link road between NH-244(NH-1B) and NH-44 (NH-1A) which starts from Donipawa (NH-244) and terminates near Khudwani at NH-44 passing through Ashajipora. The starting point of this proposed bypass coincides with the road section of Vailoo – Donipawa at Ex. Ch. 263+107 on NH-244, So we have considered this point as the terminating point for the Vailoo – Khanabal project. So, that the traffic approaching from Vailoo side (NH-244) with intention to reach at NH-44, will divert from this proposed bypass without entering Anantnag city and cover the heavily congested area up to Khanabal.

Hence, all the traffic approaching from Doda, Khellani and Kishtwar side with intention to reach at NH-44, will divert from proposed Vailoo Tunnel and will reach at Vailoo – Donipawa project road section and here mixed with the local traffic of project road with the same intention, will reach eventually at NH-44 opting the newly proposed 2-lane bypass from Donipawa**.** Accordingly, the project road starts from Design Ch. 148+589 (Ex. Km 235+070 at Vailoo) and terminates at Design chainage 176+532 (Ex. Km 263+107 at Donipawa). The location of the Project Road has been shown in the **figures below.**

Project Key Map: Vailoo - Donipawa



0.3.1 Existing Road Features

The entire length of project road has a carriageway width varying from 7.0m – 14.0m but majority of portion traverses as carriageway of 7.0 m. There is no Bus bay/ Truck lay bye in the project stretches.

The project road traverses through mountainous to rolling terrain.

Chainage		Terrain	Village / Town Name
From	To		
235+000	235+100	Hilly / Rolling	Vailoo
235+100	236+300	Hilly / Rolling	Gad Wali
236+300	238+100	Hilly / Rolling	Wandevalgam
238+100	238+200	Hilly / Rolling	-
238+200	240+300	Hilly / Rolling	Zalangam
240+300	242+100	Hilly / Rolling	Bindoo
242+100	242+800	Hilly / Rolling	Bidder
242+800	244+300	Hilly / Rolling	Hangalgund
244+300	245+300	Hilly / Rolling	Dan Veth Pora
245+300	246+700	Hilly / Rolling	Sagam
246+700	247+400	Hilly / Rolling	Takia Ahamad Shah
247+400	248+400	Hilly / Rolling	Buchoo
248+400	249+200	Hilly / Rolling	Peertakia
249+200	249+300	Hilly / Rolling	-
249+300	251+200	Hilly / Rolling	Hiller
251+200	251+300	Plain/Rolling	-
251+300	252+400	Plain/Rolling	Hillar Arhama
252+400	252+500	Plain/Rolling	-
252+500	253+400	Plain/Rolling	Akingam
253+400	254+000	Plain/Rolling	-
254+000	255+100	Plain/Rolling	Badoora
255+100	255+900	Plain/Rolling	-
255+900	258+400	Plain/Rolling	Achabal
258+400	258+900	Plain/Rolling	-
258+900	259+500	Plain/Rolling	Koleh Garh
259+500	260+400	Plain/Rolling	Thajiwara
260+400	260+800	Plain/Rolling	-
260+800	263+200	Plain/Rolling	Barakpora
263+200	264+500	Plain/Rolling	Donipawa
264+500	264+900	Plain/Rolling	Chitti Singh Pora
264+900	265+500	Plain/Rolling	Sheerpora
265+500	265+600	Plain/Rolling	Sheerpora
265+600	265+700	Plain/Rolling	Sheerpora
265+700	265+900	Plain/Rolling	Janglat Mandi
265+900	266+300	Plain/Rolling	Lal Chowk

Chainage		Terrain	Village / Town Name
From	To		
266+300	266+400	Plain/Rolling	LHS-Bangidhar, RHS- Mehman Mohalla
266+400	266+500	Plain/Rolling	LHS-Bangidhar, RHS- Mehman Mohalla
266+500	266+900	Plain/Rolling	Mehandi Kadal
266+900	267+200	Plain/Rolling	Nai Basti
267+200	269+000	Plain/Rolling	Khanabal

0.3.2 Existing condition of project road

The major portions of the project road are in fair to good condition.

0.3.3 Road Junctions

There are number of earthen, gravel and bituminous roads meeting/crossing the project highway. The important junctions along the project road are Bahal Jn, Achabal Jn, Kadpoor Road Jn, Pahalgam Road Jn. and Khanabal Jn. at NH-44. The project road has 2no. Major junctions and about 29nos. of minor junctions in the project stretch. The intersection details are given in Chapter 4 of this report.

0.3.4 Existing Bridge & Cross Drainage Structures

There are 14 nos. Minor bridges, 01 no. Major Bridge and 107 nos. Culverts existing on the project road (Vailoo to Donipawa). Existing structures details are described in the engineering survey & investigation chapter (Chapter 4) and their improvement proposals are given in Chapter 8 of this report.

0.4 Traffic Survey Analysis and Forecast

It is very important, that the existing information on traffic flow, commodity movement and traffic pattern is required to assess the traffic behaviour on a project road. To collect such information to satisfy the Terms of Reference (TOR) and project requirements, following various types of traffic surveys were carried out:

- Classified Traffic Volume Count Survey
- Intersection Volume Count Survey
- Axle Load Spectrum Survey

- Origin – Destination (OD) Survey and commodity movement Surveys
- Speed and Delay Survey
- Truck Terminal Survey

0.4.1 Classified Volume Count Survey

A comprehensive traffic survey plan has been prepared for the project road after considering traffic intensity on homogeneous sections and travel characteristics. Traffic surveys were conducted between 10th July 2019 to 17th July 2019. Traffic survey locations were finalised by consultation with client officials.

Table2: Summary of Classified Volume Count Survey at all count stations

Sr. No.	Chainages	Justification/Rational
Classified Volume Count Surveys (CVC)		
1	Ex. Km 263.550 Barakpora	Km (263+550) has been selected to get the idea of traffic in homogeneous section from Achabal to Khanabal.

ADT (Average Daily Traffic)

The Average Daily Traffic (ADT) for all traffic survey locations is presented vide Table below and detail analysis is provided in Ch. 3 of main report.

Table 3: Summary of Average Daily Traffic (ADT)

Sr. No.	Location	Total ADT (No.)	Total ADT (PCU)	Fast Moving Vehicles (PCU)	Slow Moving Vehicles (PCU)
1	Barakpora (263+550)	8599	8856	8785	71

AADT (Annual Average Daily Traffic)

The seasonal correction factors are used to convert Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT). The Annual Average Daily Traffic for all traffic survey locations is presented vide Table below and detail analysis is provided in Ch. 3 of main report.

Table 4: Summary of Annual Average Daily Traffic (AADT)

Sr. No.	Location	AADT (Nos.)	AADT (PCU)	Fast Moving Vehicles (PCU)	Slow Moving Vehicles (PCU)
1	At Brakpora Ex. Km (263.550)	7844	8059	7988	71

Projected Traffic

Table 5: Summary of Projected Total AADT Traffic PCU Volume / day

Homogeneous Section	Year 2019	Year 2022	Year 2029	Year 2039	Year 2049
Vailoo To Khanabal	8055	10158	16810	30923	55249

0.4.2 Turning Movement Count

TMC survey count are conducted at one location on the project road namely Near Nai Basti Junction on NH-244 on the project road. The intersection volume count surveys at these intersections have been carried out during identified peak periods for 12 hours. The category-wise traffic is counted for all direction in a 60 - minute interval. The counts were recorded in the specified survey formats.

The survey data have been analysed to obtain the morning and evening peak hours with flow of vehicles in each direction. The detail summary of peak hour traffic flow through intersections are provided in Chapter 3 of main report.

0.4.3 Axle Load Survey

To estimate vehicle loading spectrum on the project road, and to determine vehicle damage factor for the commercial vehicles, the axle load surveys have been carried out at identified location. The survey is analysed to obtain Vehicle Damage Factor (VDF) and is presented below:

Table 6: Adopted VDF

VDF Summary		
Sr. No.	**Vehicle Type**	**VDF**
1	LCV	1.10
2	2 Axle	2.94
3	3 Axle	1.82
4	MAV	4.38
5	Bus	1.04

0.4.4 Speed-Delay Survey

Round trip was made on entire project road during identified peak period using new technology vehicle. The survey vehicle was kept maintaining the speed of existing traffic flow. Start time, delay occurred, distance covered, and end time were recorded on the specified survey format. The data thus obtained is analysed and presented below:

Table 7: Summary of Speed-Delay Survey

S. No	Section		Distance (Km)	Average travel Time during off-peak (minutes)	Average speed during off-peak (km/hr)	Travel Time during peak (minutes)	Average speed during peak hours (km/hr)	Delay (minutes)	Reason for delay
	From	To							
1	Vailoo	Khanabal	34	60	34	80	25.5	20	Delay due to road condition & local traffic

0.4.5 Growth Rate

The various methods specified vide IRC 108: 2015 are taken into consideration for arriving at reasonable growth rate for traffic in future. The results of such methods along with proposed growth rate for each type of vehicle are presented vide Table below and detail analysis is provided in Chapter 5 of main report:

Table 8: Comparative Analysis and Adopted of Growth Rates

S. no.	Description	Two Wheelers	Cars/jeeps	Buses	Trucks	LCV and Mini LCV
1	Trend Growth of Vehicles	9.04	15.56	3.66	4.16	17.62
2	Growth from regression analysis	9.45	14.95	3.31	3.33	17.21
3	Considered for Revenue/Capacity	9.24	15.26	3.49	3.75	17.42

S. no.	Period	Two Wheelers	Cars/jeeps	Buses	Trucks			LCV and Mini LCV
					2 Axle	3 Axle	M Axle	
1	Up to 2020	10.0	10.0	5.0	5.0	5.0	5.0	10.0
2	2021 -2025	9.0	9.0	5.0	5.0	5.0	5.0	9.0
3	2026 – 2030	8.0	8.0	5.0	5.0	5.0	5.0	8.0
4	2031 – 2035	7.0	7.0	5.0	5.0	5.0	5.0	7.0
5	Beyond 2035	6.0	6.0	5.0	5.0	5.0	5.0	6.0

0.5 Improvement Proposals

The improvement proposals for the existing road shall be widening and reconstruction from

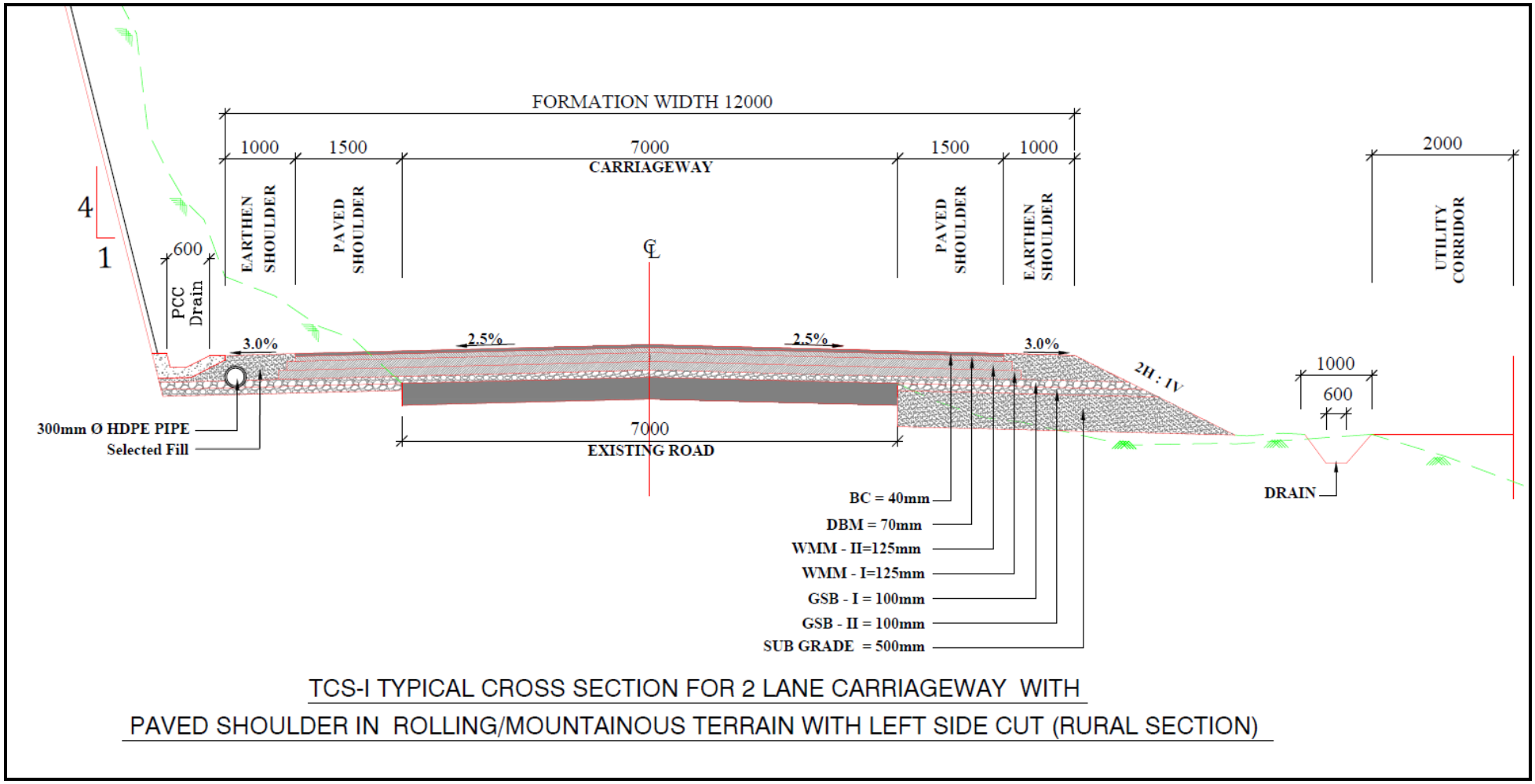
2-lane to 2x7m carriageway with 0.6 wide median in built-up area as per fig. 2.5 of clause 2.16 IRC: SP: 73:2015 and 2-lane with paved shoulder in rural area.

0.5.1 Widening Scheme

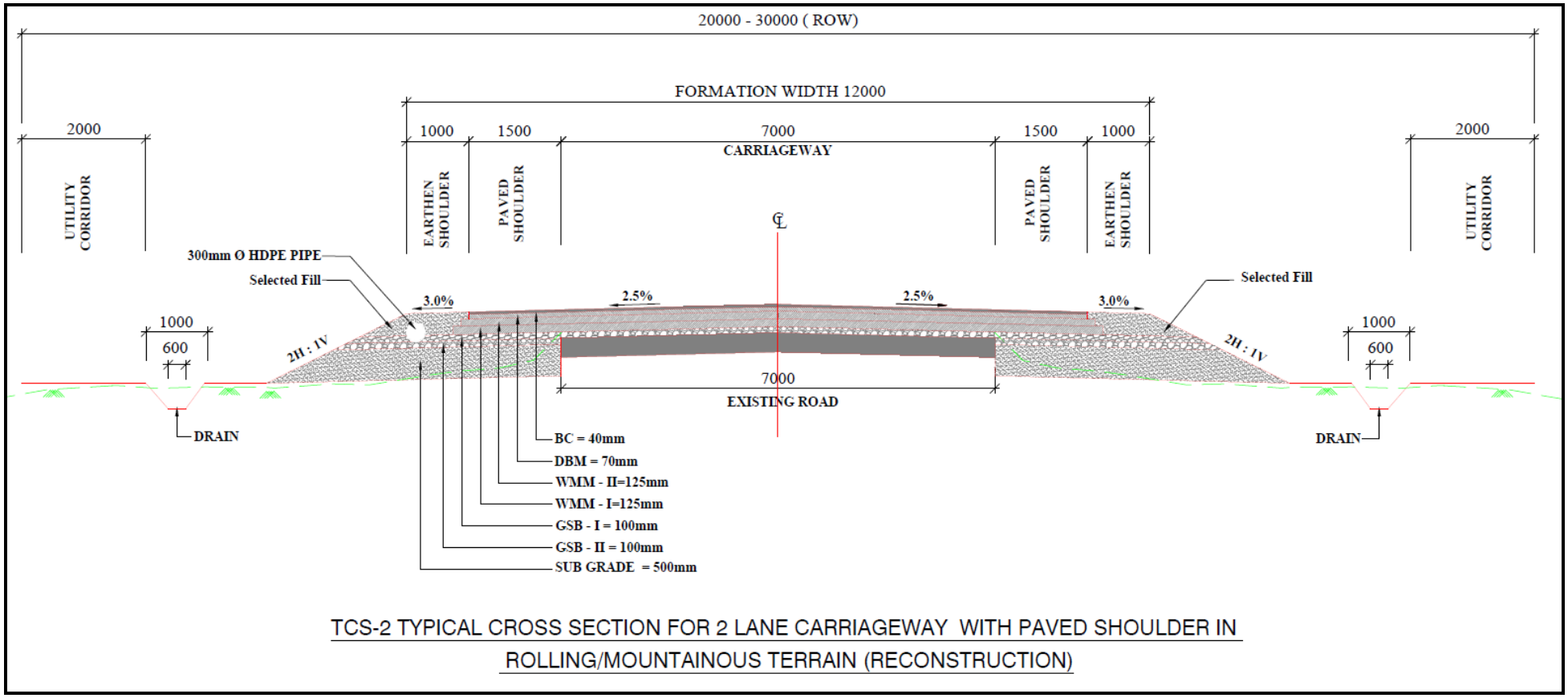
To meet future traffic requirement, the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety. Concentric/eccentric widening scheme is followed to accommodate within existing ROW and to ensure maximum utilisation of existing carriageway.

Table 10: Summary of widening scheme as per TCS

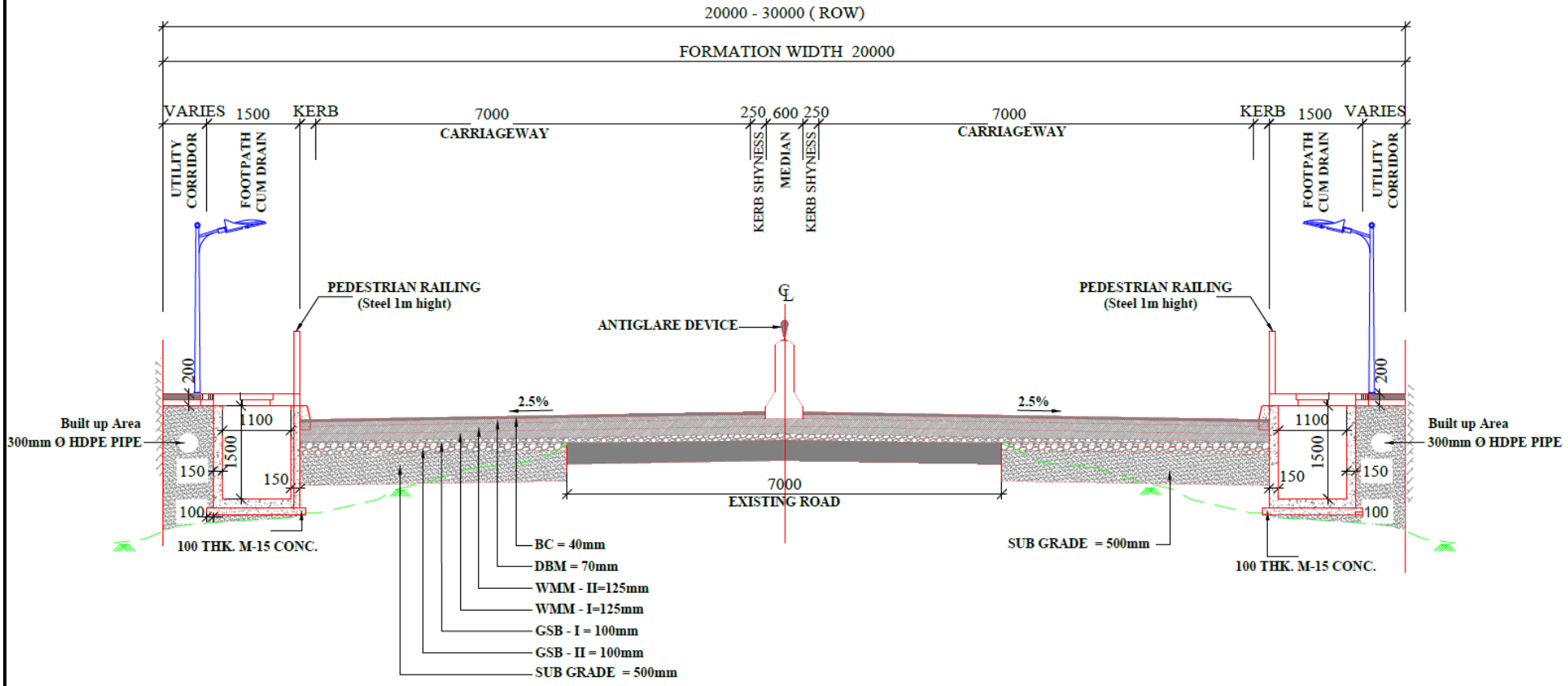
Sr. No.	Detail	TCS	Length	
			(m)	Km
1	2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN WITH LEFT SIDE CUT (RURAL SECTION)	TCS-1	201	0.201
2	2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN (RECONSTRUCTION)	TCS-2	8142	8.142
3	4 LANE CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN (RBAN SECTION FORMATION WIDTH-20M RECONSTRUCTION)	TCS-3	17510	17.510
4	(2x7 M CARRIAGEWAY INCLUDING LOADED DRAIN) DIVIDED CARRIAGEWAY IN ROLLING/MOUNTAINOUS TERRAIN (URBAN SECTION WITHOUT FOOTPATH FORMATION WIDTH. 15.10M RECONSTRUCTION)	TCS-4	1750	1.750
5	MAJOR BRIDGE	MAJOR BRIDGE	105	0.105
6	MINOR BRIDGES	MINOR BRIDGE	235	0.235
TOTAL DESIGN LENGTH			***27943***	***27.943***



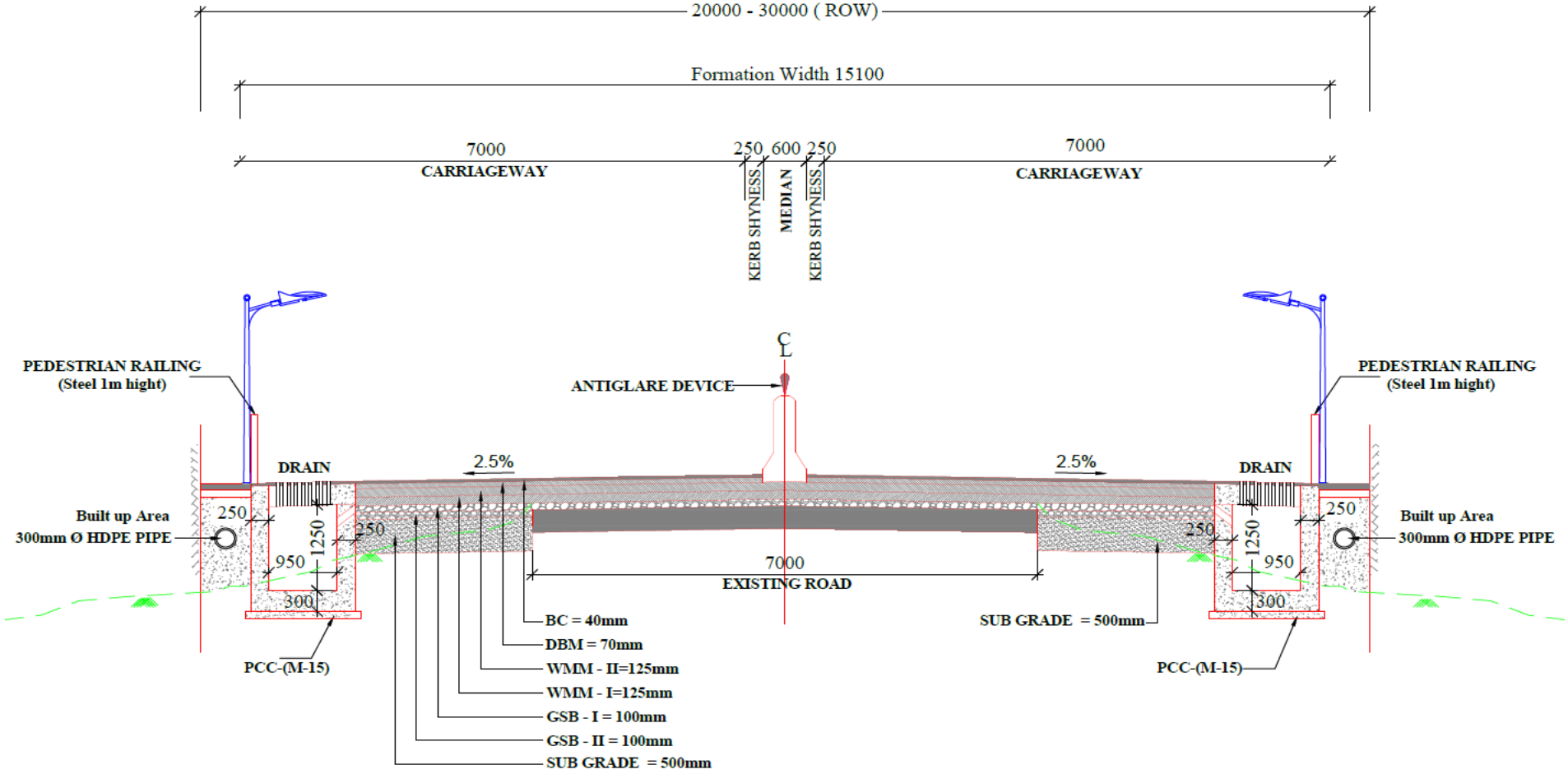
TCS-I TYPICAL CROSS SECTION FOR 2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN WITH LEFT SIDE CUT (RURAL SECTION)



TCS-2 TYPICAL CROSS SECTION FOR 2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN (RECONSTRUCTION)



TCS - 3 TYPICAL CROSS SECTION FOR 4 LANE CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN(URBAN SECTION RECONSTRUCTION)



TCS - 4 TYPICAL CROSS SECTION FOR 4 LANE DIVIDED CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN(URBAN SECTION WITHOUT FOOTPATH RECONSTRUCTION)

0.5.2 Pavement Design

Flexible pavement is proposed for new carriageway of the project road. Design period of 20 years considered for new carriageway. The Pavement improvement proposal for entire project road is presented in Table below.

Table 11: Improvement Proposal for New Pavement

Crust Composition for New Pavement as per IRC 37 – 2018										
Homogeneous Section	Design Chainage		CBR	MSA	Crust				Sub-Grade	Total Thickness
	From	To			BC	DBM	WMM	GSB		
1	148.589	176.532	10	20	40	70	250	200	500	**1060**

0.5.3 Major Bridge/ Minor Bridge & Cross Drainage Structures

A total of 15 bridges are proposed in which 03 are reconstruction due to re-alignment, 07 are reconstruction due to Masonry structure, 02 existing bridges are proposed for additional 2-lane bridge and 02 bridges are retained without widening, and 01 is for repair work for protection works. The details of improvement proposal for bridges are given in Chapter 8 and **Annexure-8.2.**

Table 12: Proposed Bridge List

Structure Proposals (Bridges)						
Sr. No	Design Chainage	Type of Structure	Proposed Span Arrangement	Total Deck Width (m)	Type of Superstructure	Proposed Lane
1	151+096	Minor Bridge (Wangon)	1 x 30	12.5	Composite Steel Plate Girder	2-lane
2	152+790	Minor Bridge	1 x 10	2x11	RCC Solid Slab	4-Lane
3	158+054	Minor Bridge	1 x 10	12.5	RCC Solid Slab	2-lane
4	159+083	Minor Bridge	1 x 10	2x11	RCC Solid Slab	4-Lane
5	159+297	Minor Bridge	1 x 10	2x11	RCC Solid Slab	4-Lane
6	163+289	Minor Bridge	1 x 10	2x11	RCC Solid Slab	4-Lane
7	163+794	Minor Bridge	1 x 10	12.5	RCC Solid Slab	2-lane
8	163+984	Major Bridge (HILLAR)	3 X 35	12.5	PSC Box Girder	2-Lane
9	164+119	Minor Bridge	1 x 10	12.5	RCC Solid Slab	2-lane
10	164+396	Minor Bridge	1x 24.4	12	RCC T Girder	2-lane
11	164+729	Minor Bridge	1 x 40.7	12.4	PSC Box Girder	2-lane
12	164+833	Minor Bridge	1 x 10	12.5	RCC Solid Slab	2-lane
13	164+949	Minor Bridge	1 x 25	1x11	PSC I Girder	4-Lane
14	165+010	Minor Bridge	1 x 25	1x11	PSC I Girder	4-Lane
15	170+454	Minor Bridge	1 x 10	12.5	RCC Solid Slab	2-lane

0.5.4 Culverts

A total of 109 nos. of culverts are proposed out of which 107nos. are to be re-constructed, 2nos. are proposed as new construction and 1no. Side Drain is proposed at Achabal. The improvement proposal for culverts is also given in **Annexure-8.3.**

0.5.5 Drainage Works

The longitudinal slope of the road alignment is generally varying in direction with respect to the countryside slope. Keeping this in view, it is proposed to locate the drain close to the toe of the road embankment on both sides in the rural area. In urban stretches, lined rectangular drains have been provided. In urban area the RCC cover drain with footpath & loaded RCC Cover drain has been considered for the ensuring the better drainage of rainwater.

Table 12: PCC Cover Drain

Roadside PCC Drainage List						
Design Chainage		Design Length (m)	TCS Detail	TCS Type	Side	Roadside Drain Length (m)
From	To					
148+589	148+790	201.463	2-Lane Left side Cut	TCS-1	LHS	201.46
Total Roadside PCC Drainage Length						**201.46**

Table 13: RCC Drain without footpath

RCC Drain Without Footpath							
Sr. No	Design Chainage		Design Length in m	TCS Detail	TCS Type	Both	Total Length
	From	To					
1	150+290	150+490	200	4-Lane Urban(15m)	TCS-4	Both	400
2	152+890	153+090	200	4-Lane Urban(15m)	TCS-4	Both	400
3	156+290	156+490	200	4-Lane Urban(15m)	TCS-4	Both	400
4	170+260	170+450	190	4-Lane Urban(15m)	TCS-4	Both	380
5	170+460	170+780	320	4-Lane Urban(15m)	TCS-4	Both	640
6	173+090	173+590	500	4-Lane Urban(15m)	TCS-4	Both	1000
7	175+160	175+300	140	4-Lane Urban(15m)	TCS-4	Both	280
Total Length							**3500**

Table 14: RCC Cover Drain with Footpath

RCC Cover Drain with Footpath							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Length
	From	To					
1	148+790	150+290	1500	4-Lane Urban	TCS-3	Both	3000
2	150+490	150+940	450	4-Lane Urban	TCS-3	Both	900
3	151+240	151+690	450	4-Lane Urban	TCS-3	Both	900
4	152+290	152+786	496	4-Lane Urban	TCS-3	Both	992
5	152+796	152+890	94	4-Lane Urban	TCS-3	Both	188
6	153+090	153+490	400	4-Lane Urban	TCS-3	Both	800
7	154+090	156+290	2200	4-Lane Urban	TCS-3	Both	4400
8	156+490	157+740	1250	4-Lane Urban	TCS-3	Both	2500
9	158+910	159+079	169	4-Lane Urban	TCS-3	Both	338
10	159+089	159+293	204	4-Lane Urban	TCS-3	Both	408
11	159+303	160+440	1137	4-Lane Urban	TCS-3	Both	2274
12	161+140	163+285	2145	4-Lane Urban	TCS-3	Both	4290
13	163+295	163+740	445	4-Lane Urban	TCS-3	Both	890
14	164+890	164+938	47.5	4-Lane Urban	TCS-3	Both	95
15	164+963	164+999	36	4-Lane Urban	TCS-3	Both	72
16	165+024	166+990	1966.5	4-Lane Urban	TCS-3	Both	3933
17	167+590	168+690	1100	4-Lane Urban	TCS-3	Both	2200
18	169+790	170+260	470	4-Lane Urban	TCS-3	Both	940
19	170+780	171+590	810	4-Lane Urban	TCS-3	Both	1620
20	172+410	173+090	680	4-Lane Urban	TCS-3	Both	1360
21	173+590	173+890	300	4-Lane Urban	TCS-3	Both	600
22	175+090	175+160	70	4-Lane Urban	TCS-3	Both	140
23	175+300	176+390	1090	4-Lane Urban	TCS-3	Both	2180
Total Length							**35020**

Table 15: Unlined Drains

Unlined Drain							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Total Length
	From	To					
1	148+589	148+790	201.46	2-Lane Left side Cut	TCS-1	One	201.46
2	150+940	151+082	142	2-Lane Rural	TCS-2	Both	284
3	151+112	151+240	128	2-Lane Rural	TCS-2	Both	256
4	151+690	152+290	600	2-Lane Rural	TCS-2	Both	1200
5	153+490	154+090	600	2-Lane Rural	TCS-2	Both	1200
6	157+740	158+050	310	2-Lane Rural	TCS-2	Both	620
7	158+060	158+910	850	2-Lane Rural	TCS-2	Both	1700
8	160+440	161+140	700	2-Lane Rural	TCS-2	Both	1400
9	163+740	163+790	50	2-Lane Rural	TCS-2	Both	100
10	163+800	163+933	132.5	2-Lane Rural	TCS-2	Both	265
11	164+038	164+115	77.5	2-Lane Rural	TCS-2	Both	155
12	164+125	164+385	259.8	2-Lane Rural	TCS-2	Both	519.6
13	164+409	164+710	300.45	2-Lane Rural	TCS-2	Both	600.9
14	164+750	164+829	78.65	2-Lane Rural	TCS-2	Both	157.3
15	164+839	164+890	51	2-Lane Rural	TCS-2	Both	102

Unlined Drain							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Total Length
	From	To					
16	166+990	167+590	600	2-Lane Rural	TCS-2	Both	1200
17	168+690	169+790	1100	2-Lane Rural	TCS-2	Both	2200
18	171+590	172+410	820	2-Lane Rural	TCS-2	Both	1640
19	173+890	175+090	1200	2-Lane Rural	TCS-2	Both	2400
20	176+390	176+532	142.04	2-Lane Rural	TCS-2	Both	284.08
Total Length							**16485.34**

0.5.6 Protection Works

Safety barriers have been provided for moving vehicles and as well as pedestrians. Jersey barriers have been provided and pedestrian guard rail has been adopted as per codal provisions (IRC: SP: 73-2018) in urban areas (as per TCS). The details have been provided below:

Table 16: Jersey barrier Crash Barrier

Jersey Barrier List					
Sr. No.	Design Chainage		Design Length (m)	TCS Type	Jersey Barrier Detail
	From	To			
1	148+790	150+290	1500	TCS-3	1500
2	150+290	150+490	200	TCS-4	200
3	150+490	150+940	450	TCS-3	450
4	151+240	151+690	450	TCS-3	450
5	152+290	152+786	496	TCS-3	496
6	152+796	152+890	94	TCS-3	94
7	152+890	153+090	200	TCS-4	200
8	153+090	153+490	400	TCS-3	400
9	154+090	156+290	2200	TCS-3	2200
10	156+290	156+490	200	TCS-4	200
11	156+490	157+740	1250	TCS-3	1250
12	158+910	159+079	169	TCS-3	169
13	159+089	159+293	204	TCS-3	204
14	159+303	160+440	1137	TCS-3	1137
15	161+140	163+285	2145	TCS-3	2145
16	163+295	163+740	445	TCS-3	445
17	164+890	164+938	47.5	TCS-3	47.5
18	164+963	164+999	36	TCS-3	36
19	165+024	166+990	1966.5	TCS-3	1966.5
20	167+590	168+690	1100	TCS-3	1100
21	169+790	170+260	470	TCS-3	470
22	170+260	170+450	190	TCS-4	190
23	170+460	170+780	320	TCS-4	320
24	170+780	171+590	810	TCS-3	810
25	172+410	173+090	680	TCS-3	680
26	173+090	173+590	500	TCS-4	500
27	173+590	173+890	300	TCS-3	300
28	175+090	175+160	70	TCS-3	70
29	175+160	175+300	140	TCS-4	140

Jersey Barrier List					
Sr. No.	Design Chainage		Design Length (m)	TCS Type	Jersey Barrier Detail
	From	To			
30	175+300	176+390	1090	TCS-3	1090
Total Length					**19260**

Table 17: Pedestrian railing Details

Pedestrian Railing Details						
Sr. No.	Design Chainage		Design Length (m)	TCS Type	Side	Pedestrian railing
	From	To				
1	148+790	150+290	1500	TCS-3	LHS+RHS	3000
2	150+290	150+490	200	TCS-4	LHS+RHS	400
3	150+490	150+940	450	TCS-3	LHS+RHS	900
4	151+240	151+690	450	TCS-3	LHS+RHS	900
5	152+290	152+786	496	TCS-3	LHS+RHS	992
6	152+796	152+890	94	TCS-3	LHS+RHS	188
7	152+890	153+090	200	TCS-4	LHS+RHS	400
8	153+090	153+490	400	TCS-3	LHS+RHS	800
9	154+090	156+290	2200	TCS-3	LHS+RHS	4400
10	156+290	156+490	200	TCS-4	LHS+RHS	400
11	156+490	157+740	1250	TCS-3	LHS+RHS	2500
12	158+910	159+079	169	TCS-3	LHS+RHS	338
13	159+089	159+293	204	TCS-3	LHS+RHS	408
14	159+303	160+440	1137	TCS-3	LHS+RHS	2274
15	161+140	163+285	2145	TCS-3	LHS+RHS	4290
16	163+295	163+740	445	TCS-3	LHS+RHS	890
17	164+890	164+938	47.5	TCS-3	LHS+RHS	95
18	164+963	164+999	36	TCS-3	LHS+RHS	72
19	165+024	166+990	1966.5	TCS-3	LHS+RHS	3933
20	167+590	168+690	1100	TCS-3	LHS+RHS	2200
21	169+790	170+260	470	TCS-3	LHS+RHS	940
22	170+260	170+450	190	TCS-4	LHS+RHS	380
23	170+460	170+780	320	TCS-4	LHS+RHS	640
24	170+780	171+590	810	TCS-3	LHS+RHS	1620
25	172+410	173+090	680	TCS-3	LHS+RHS	1360
26	173+090	173+590	500	TCS-4	LHS+RHS	1000
27	173+590	173+890	300	TCS-3	LHS+RHS	600
28	175+090	175+160	70	TCS-3	LHS+RHS	140
29	175+160	175+300	140	TCS-4	LHS+RHS	280
30	175+300	176+390	1090	TCS-3	LHS+RHS	2180
Total Pedestrian Railing Length						**38520**

0.6 Environmental Impact Assessment

A corridor of 10 km on either side from the project road is considered for study of various environmental attributes. The study is carried out as per the requirements stipulated by the Ministry of Environment and Forests, Government of India for Environmental Impact

Assessment of Rail / Roads / Highway Projects. Important features from environmental point of view observed along the project road are as mentioned below.

- From the preliminary inventory, local inquiry and as informed by the forest department, it is revealed there is Protected or reserve forest in the stretch of the Project Road.
- Project Corridor on both sides has significant amount of tree plantation. Different type of trees is existing along the project road. Trees will be impacted due to road widening. Along the project road which lies in toe line on either side of the road edge shall be made to avoid felling of trees which are not falling under corridor of impact. The removal of these trees and the loss of vegetation cover will have some effect on local ecological balance, such as the disruption of habitat for small birds, mammals, etc., that will be forced to migrate to other areas. With the addition of trees and shrubs, following re-forestation, the short-term impact of construction is expected to be reversed over the long term.
- There are cultural properties, and community properties / facilities exists within the ROW that are likely to be affected due to proposed project.

0.6.1 Social screening

The project road falls within Anantnag district of Jammu and Kashmir. During the initial social screening period, primary consultations were conducted along the project road.

- The consultations were held to build awareness about the project amongst the people, district level administration, and NGOs and to enlist their support in preparation and implementation of the project. Also, it served the purpose of understanding the reaction of the likely affected persons.
- Issues raised by individuals during the consultations were mainly related to land acquisition, loss of livelihood and income restoration, loss of religious structures, community structures, trees, etc.
- A preliminary baseline socio-economic survey identified that structures are likely to be affected due to the project. The remaining includes private and government structures that will be affected due to the proposed project. Most of the structures affected are of kuccha type i.e. temporary in nature.

0.7 Land acquisition Requirement

The existing Right of way (ROW) of the road is varying from 20m to 30m. However, the proposed widening scheme of project stretch is accumulated with the existing ROW.

Sr. No.	Chainage		EROW in Meter	Remarks
	From	To		
1	148+589	155+600	27	
2	155+600	157+800	28	
3	157+800	159+200	29	
4	159+200	160+000	28	
5	160+000	160+400	25	
6	160+400	161+200	27	
7	161+200	166+800	26	
8	166+800	167+600	28	
9	167+600	169+800	26	
10	169+800	170+600	28	
11	170+600	170+750	22	Masjid
12	170+750	171+600	27	
13	171+600	173+200	28	
14	173+200	173+600	27	
15	173+600	176+589	28	

0.8 Material investigation

Material investigations were carried out to explore the availability and identify sources of suitable material for the construction of the project.

0.8.1 Borrow pits for soil

Material investigation of borrow area indicates that soil suitable for embankment is available at an average lead of 5 km for the project stretch.

0.8.2 Sand

Sand is available at Sangam River. The location is 24 km from project site.

0.8.3 Gravel

Several quarries were identified for sourcing aggregates in the project zone. The quarries proposed for the project is Ashajipora Quarry which is 17km form the project site

0.8.4 Bitumen

Bulk bitumen of the VG-10 Grade is available at Panipat, refinery with an average lead of 644

km. For the project road VG -10 of bitumen has been proposed for DBM & BC.

0.8.5 Cement

Cement source is taken as from Gurdaspur which is 297 km from project site. The proposed cement grade shall be OPC-55.

0.9 Cost Estimate

Detail cost estimate for the project Road is finalised based on the improvement proposed. Bill wise quantities calculated for all the items of work to be executed in the project and rates derived after detailed analysis.

Table11: Summary of Cost estimate

SUMMARY OF COST		
Item No.	**Description**	**Total Amount (Rs. in Crores)**
BILL NO. 1	SITE CLEARANCE	0.58
BILL NO. 2	EARTH WORKS	5.37
BILL NO. 3	SUB-BASES AND BASES COURSES	27.56
BILL NO. 4	BITUMINOUS COURSES	35.02
BILL NO. 5	CROSS DRAINAGE WORKS (109 nos. of CULVERTS)	30.89
BILL NO. 6A	BRIDGES (1Major Bridge & 14 Minor Bridge)	24.31
BILL NO. 6B	REPAIR AND REHABILITATION OF EXISTING BRIDGES	0.12
BILL NO. 7	TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES	23.43
BILL NO. 8	DRAINAGE & PROTECTION WORK	
BILL NO. 8 A	DRAINAGE (RCC Covered Drain 2 x 19260m)	45.20
BILL NO. 8 B	PROTECTION WORK (Toe Wall= 280m)	0.59
BILL NO. 9	SAFETY AND TRAFFIC MANAGEMENT DURING CONSTRUCTION	2.55
BILL NO. 10	JUNCTIONS (Minor Junctions = 29 Nos. & Major Junctions= 02 Nos.)	2.71
BILL NO. 11	BUS STOP (38 Nos)	0.48
BILL NO. 12	MISCELLANEOUS ITEMS –(Roadside Plantation, Street Lighting, Rainwater Harvesting)	4.25
A	**Civil Cost**	**203.04**
B	**GST @ 12% Payable on Civil Cost only of (A)**	**24.37**
C	**Sub Total (A+B)**	**227.41**
D	Contingencies @ 2.8% of (A)	5.69
E	Construction Supervision Charges @ 3% of (A)	6.09
F	Agency Charge @ 3% of (A)	6.09
G	Escalation @ 5% per annum for 2nd year during construction Payable to Contractor of (A)	10.15
H	**Total Cost including centages (C+D+E+F+G)**	**255.43**

SUMMARY OF COST		
Item No.	**Description**	**Total Amount (Rs. in Crores)**
I	5 years Maintenance Period including structures: No maintenance charges shall be paid for the first year; 0.50%of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year	5.08
J	**Total Project Cost (TPC) (H+I)**	**260.50**
K	Rehabilitation & Resettlement Cost including fruit bearing trees (Approx.)	5.08
L	Utility Shifting (Electric pole, Transformer, PHE) (Approx.)	15.23
TOTAL CAPITAL COST (TCC) (J+K+L+M)		**280.81**

0.10 Conclusion and Recommendations

- Based on the traffic analysis results due to major tourist attraction of these places at Kokarnag & Mughal Garden at Achabal the project road is requires to improve with 2-lane with paved shoulder. However, as per DC, Anantnag direction and traffic congestion during tourist time, we have proposed the 4-lane with dived carriageway in Built-up area as per IRC:73-2015 & 2-lane with PS in rural area.

- The project road can be improved without causing significant adverse environmental impacts to the natural, social, economic, or cultural environments.

- The improvement proposal of the project corridor is proposed within the existing ROW as per Chapter 08.

- The project can be constructed within 24 months period with strategic planning and through one construction package. The construction work may begin from April 2021. The estimated basic cost is given below table

Table-15 Base Cost

Section	Proposed Length (km)	Base Cost including GST (crore)	Total Project Cost (Crores)
Vailoo – Donipawa	27.943	227.41	280.81

Chapter 1

Introduction

1.0 INTRODUCTION

1.1 General

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to two/four laning with paved shoulder according to NH Configuration.

In pursuance of the above, **M/S Rodic Consultants Pvt. Ltd., New Delhi** in joint venture with **M/S Monarch Surveyors and Engineering consultant Pvt. Ltd**. have been appointed as Consultants to carry out the "**Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chhatroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir**. The agreement was signed on 4th June 2019.

This project section deals with Vailoo- Khanabal section from ex. Km. 235.000 to Km. 269.000 (Proposed Chainage km 0.000 (Vailoo) to km 27.943 (Donipawa)).

1.2 Overview of MORT&H, NHDP and Project Financing

1.2.1 Introduction

The road network of India is comprised of (I) National Highways and Expressways – 1,01,011 Km, (II) State Highways -1,76,166 Km, (III) Major District Roads- 561,940, Rural Roads and Urban Roads- 44,45,067 Km (approx.). As National Highways comprise about 1.80% of the total road length in the country and yet carry over 40% of total traffic, there is an immediate need to augment the existing road network.

- About 60% of freight and 85% passenger traffic is carried by the roads.
- National Highways constitute only about 1.80% of the road network but carry about 40% of the total road traffic.
- Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years.

Advantages of having a well-developed network of world class highways are many for a nation like India, poised to surge ahead. These are enlisted below.

- Savings in vehicle operating costs.
- Faster, comfortable journeys.

- Reduced fuel consumption.
- Safer travel.
- Benefits to trade especially in movement of perishable commodity.
- Reduced maintenance costs.
- Induced development in project influence area; and
- Overall boost in country's economy.

1.2.2 Ministry of Road Transport & Highways

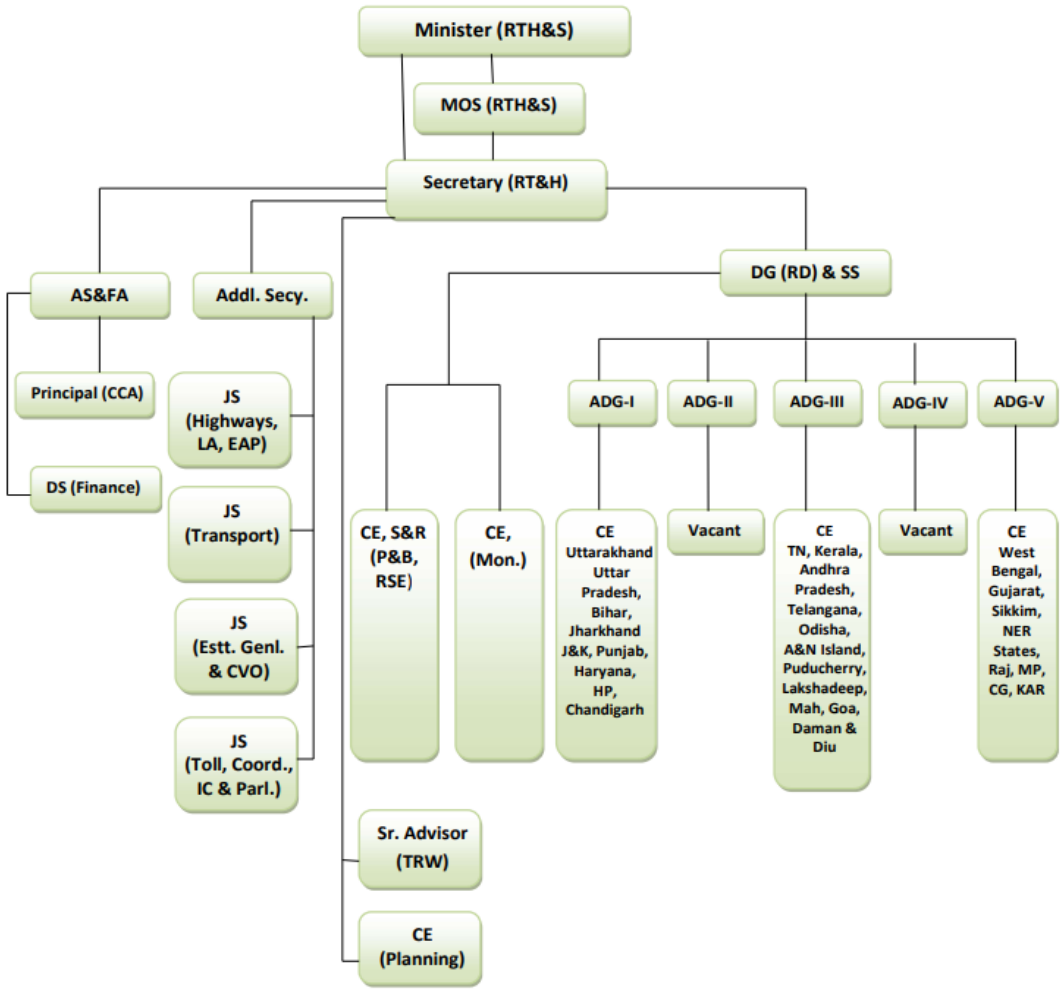
This Department is responsible for development and maintenance of National Highways, administration of the Central Road Fund and formulation and implementation of policies relating to road transport. The subjects allocated to the Department of Road Transport & Highways.

1.2.2.1 Organizational Set-up

The organizational chart of the Department is in **Figure 1.1.** There are five Wings viz. Administration Wing, Transport Wing, Transport Research Wing, Roads Wing and Finance Wing with the following organizational set-up.

Figure 1. 1: Organisational Chart

ORGANISATION CHART OF THE MINISTRY OF ROAD TRANSPORT AND HIGHWAYS



Note:- The matters relating to Vigilance, Land Acquisition, International Cooperation and Parliament shall be submitted directly to Secretary (RT&H) by the concerned Joint Secretary.

1) Administration Wing

The Administration Wing, which is headed by a Joint Secretary, provides administrative and infrastructure support to the officers/employees of the Department. The cadre management of the Central Engineering Services (Roads) Group 'A' and service matters in respect of other categories of posts is dealt with by this Wing. The various cadres are managed as per the instructions and guidelines issued by the Department of Personnel and Training, Ministry of Personnel, Public Grievances and Pensions.

2) Transport Wing

The Transport Wing is headed by a Joint Secretary and is concerned with the formulation of policies relating to regulation of road transport, legislation relating to road transport including aspects of road safety, environmental issues, and automotive norms besides

making arrangements for movement of vehicular traffic with neighbouring countries. The Motor Vehicles Act, 1988 is the main enactment for regulating motor vehicles in the country.

3) Transport Research Wing

The Transport Research Wing (TRW) headed by Adviser (Transport Research) is also common to both the Departments (the Department of Road Transport & Highways and the Department of Shipping). The TRW is responsible for collection, compilation and dissemination of statistics on road and water transport.

4) Roads Wing

The Roads Wing is headed by a Director General (Road Development), who is assisted by other technical and secretarial staff. The work of Roads Wing has been divided into sixteen zones, each headed by a Chief Engineer. There are ten project zones which look after the work of development and maintenance of National Highways and other centrally sponsored road works. In addition, Chief Engineers also look after Planning, Monitoring, Standards & Research, Project Implementation Cell and Mechanical zones. Roads Wing is concerned mainly with matters relating to (i) advising Government on all policy matters relating to Highways (ii) development and maintenance of roads declared as National Highways (iii) roads other than National Highways in Union Territories (iv) administration of Central Road Fund (CRF) pertaining to State Roads (other than rural roads) (v) evaluation of standards for roads and bridges and formulation of specifications (vi) road research.

5) Finance Wing

The Finance Wing is headed by the Additional Secretary & Financial Adviser (AS&FA) and is common to both the Department of Road Transport & Highways and the Ministry of Shipping; and renders financial advice on various matters. It also assists in planning, budgeting, monitoring and evaluation of schemes/programmes.

6) Autonomous Bodies

The following autonomous bodies are under the administrative preview of this Department:

a) National Highways Authority of India (NHAI)

The National Highways Authority of India (NHAI) was constituted by an Act of Parliament in 1988 under the administrative control of the Ministry of Road Transport and Highways. NHAI has been set up as a Central Authority to develop, maintain and manage the National Highways entrusted to it by the Government of India. The Authority, however, became operational in February 1995.The Authority consists of a full time Chairman, and not more than five full time Members and four part time Members who are appointed by the Central Government. The part time Members are

the Secretary (RT&H), Secretary (Expenditure), Secretary (Planning) and DG (RD) & SS. NHAI has Technical, Finance, Administrative and Vigilance Wings at its Headquarters. Project Implementation Units (PIUs) headed by a Project Director and supported by various technical and accounts officers have been set up at various sites to oversee timely completion of the projects.

b) Ministry of Road Transport and Highways (MoRT&H)

The Ministry of Road Transport and Highways is a ministry of the Government of India, that is the apex body for formulation and administration of the rules, regulations and laws relating to road transport, transport research and in also to increase the mobility and efficiency of the road transport system in India. Through its officers of Central Engineering Services (Roads) cadre it is responsible for the development of National Highways of the country. Road transport is a critical infrastructure for economic development of the country. It influences the pace, structure and pattern of development. In India, roads are used to transport over 60 percent of the total goods and 85 percent of the passenger traffic. Hence, development of this sector is of paramount importance for India and accounts for a significant part in the budget.

c) National Highways and Infrastructure Development Corporation Ltd. (NHIDCL)

National Highways and Infrastructure Development Corporation is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes, surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighbouring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner.

d) Indian Academy of Highway Engineer (IAHE)

Indian Academy of Highway engineer (IAHE) formerly known as the National Institute for Training of Highway Engineers (NITHE) is a registered Society under the administrative control of this Ministry. Hon'ble Minister-in-Charge is the President and the Secretary, Road Transport & Highways is the Vice- President of this Society, which is advised by a Governing Body comprising eminent and distinguished engineers and administrators. The Director General (Road Development) & Special Secretary of this Department is the Chairman of the Body. It was set up as a collaborative body of the Central and State Governments in 1983. This Institute has been shifted in 2001 to its permanent campus at A-5, Institutional Area, Sector-62, Noida, (U.P.). The campus has all facilities for providing training and has a trainees' hostel and staff quarters.

Training is imparted to freshly recruit as also to in-service highway engineers. The areas of training include different aspects of road and bridge engineering, contract

management, quality control, etc.

e) Border Roads Organisation (BRO)

The BRO was conceptualised initially in 1960, to construct and maintain roads in border areas as per the operational requirements of the Ministry of Defence. The road works so entrusted were classified as General Staff (GS) roads. Besides GS roads, the BRO also executes agency works entrusted by other Ministries of the Central Government. The BRO is under the administrative control of the Ministry of Defence. The Director General Border Roads (DGBR) is the executive head of the BRO.

1.2.3 NHDP

1.2.3.1 General

As National Highways comprises about 2% of the total road length in the country and yet carryover 40% of total traffic, the first and the foremost task mandated to the NHAI is the implementation of NHDP- comprising of the Golden Quadrilateral and North-South & East-West Corridors. In addition to the projects under NHDP, the NHAI is also currently responsible for about 1 000 km of Highways connecting major Ports & also on National Highways 8A, 24, 6, 45 & 27. Highways length with NHAI currently is around 70,000 km.

NHDP's prime focus is on developing roads of international standards with facilities for uninterrupted flow of traffic with:

- Enhanced safety features.
- Better riding surface.
- Better road geometry.
- Better traffic management and noticeable signage.
- Divided carriageways and service roads.
- Grade separators.
- Over bridges and underpasses.
- Bypasses; and
- Wayside amenities

1.2.3.2 Need of NHDP

There has been a major shift in transportation mode from railways towards the road sector since 1980s. Before inception of NHDP, country's road network was having the following bottlenecks.

- Growth rate of primary road network was hovering around 2%- 3%. Out of which, only 2.5% was four laned and 15% two laned.
- There was severe capacity constraint and lack of mobility in primary / secondary network.
- Tertiary network was plagued with lack of connectivity to primary / secondary network and nearly 40% habitations were not connected by all weather roads.
- Above all, main commuting mode remained to be road as depicted in the **Table 1.1**.

Table 1. 1: Mode of Transport

Type	Road	Railways
Passenger	85%	15%
Freight	60%	40%

1.2.3.3 NHDP Phase:

NHDP Phase-I: Government has approved four/ six/eight laning of 7,498 km of National Highways at an estimated cost of Rs. 30,300 crores. It mainly includes four/ six/eight laning of Golden Quadrilateral connecting four metropolitan cities i.e. Delhi, Mumbai, Chennai and Kolkata. Implementation of NHDP-I mainly on Item Rate Construction Contract (IRCC). All the contracts awarded and about 94% of NHDP –I project has been completed. Around 12% through PPP route on BOT (Toll) [6.0%] and BOT (Annuity) [6.0%] mode.

NHDP Phase-II: Under this Government has approved 6644 km of National Highways to be widened to four /six lane facility at a cost of Rs. 34,339 crores. Under this North South Corridor from Srinagar to Kanyakumari with Cochin Selam Spur and East West Corridor from Silchar to Porbandar are to be developed. Implementation of NHDP-II mainly on IRCC. Though around 24% through PPP on BOT (Toll) [11%] and BOT (Annuity) [13%]. 87.34% of length is awarded out of which around 19.51% completed.

NHDP Phase-III: Under this, Government has approved up gradation of 12109 km of existing National Highways to two lane with paved shoulders/ four /six lane having high traffic density, connecting important tourist locations, economically important areas, State capitals etc on build, operate and transfer (BOT) basis with a maximum viability gap funding (VGF) of 40%. The estimated cost for development of these stretches is Rs. 80,626 crores. 17.13% of length awarded, out of which 3.39% length completed. NHDP-III is scheduled for completion by Dec. 2013.

NHDP Phase-IV: There is a proposal under consideration for widening of 20,000 km of existing single /intermediate /two lane highways to two lanes with paved shoulders at an estimated cost of Rs. 27,800 crores through PPP route on BOT (Toll) /BOT (Annuity) basis.

NHDP Phase -V: Under this Government has approved six laning of 6500 km of National Highways at a cost of Rs. 41,210 crores through PPP route on BOT (Toll) mode using Design Build Finance and Operate (DBFO) pattern with a maximum VGF of 10%. In DBFO private parties needs the upfront cost of design, construction and expenditure on annual maintenance

and recovers the entire cost along with the interest from toll collection during the concession period. A length of 882 km awarded. NHDP-V is scheduled for completion by Dec. 2012.

NHDP Phase-VI: Under this Government has approved construction of 1000 km of expressways at an estimated cost of Rs. 16,680 crores through PPP route on BOT (Toll) mode following a DBFO pattern with a maximum VGF of 40%. Action is being taken for preparation of feasibility report. NHDP-VI is scheduled for completion by Dec. 2015.

NHDP Phase-VII: Under this Government has approved construction of 700 km of stand-alone ring roads/bypasses as well as grade separators, flyovers, elevated road, tunnels road over bridge, under passes etc at an estimated cost of Rs. 16,680 crores through PPP route on BOT (Toll) mode with a maximum VGF of 40% Action is being taken for preparation of feasibility study. NHDP-VII is scheduled for completion by Dec. 2014.

1.2.3.4 Finance Mechanisms

Government of Jammu and Kashmir proposes to finance its projects by a host of financing mechanisms. Some of them are as follows.

a) Through Budgetary Allocations from the Government of India

b) Cess

In a historic decision, the Government of India introduced a Cess on both Petrol and Diesel. This amount at that time (at 1999 prices) came to a total of approximately Rs. 2,000 crores per annum. Further, Parliament decreed that the fund so collected were to be put aside in a Central Road Fund (CRF) for exclusive utilization for the development of a modern road network. The developmental work that it could be tapped to fund, and the agencies to which it was available were clearly defined as:

I) Construction and maintenance of state highways by state governments.

II) Development of rural roads by state governments

III) Construction of rail over- bridges by Indian Railways

IV) Construction and maintenance of national highways by NHDP and Ministry of Road Transport & Highways (MoRTH).

Today, the Cess contributes between Rs. 5 to 6 thousand crores per annum towards NHDP.

c) Loan Assistance from International Funding Agencies

Loan assistance is available from multilateral development agencies like Asian Development Bank and World Bank or Other overseas lending agencies like Japanese Bank of International Co-Operation.

d) Market Borrowing

Government of Jammu and Kashmir proposes to tap the market by securities cess receipts.

e) Private Sector Participation

Major policy initiatives have been taken by the Government to attract foreign as well as domestic private investments. To promote involvement of the private sector in construction and maintenance of National Highways, some projects are offered on Build Operate and Transfer (BOT) basis to private agencies. After the concession period, which can range up to 30 years, the road is to be transferred back by the Concessionaires.

f) Special Purpose Vehicle

Funds are also leveraged by the setting up of Special Purpose Vehicles (SPVs). The SPVs will be borrowing funds and repaying these through toll revenues in the future. This model will also be tried in some other projects. Some more models may emerge in the near future for better leveraging of funds available such as Annuity.

The financial arrangement for the development of NHDP has been made as shown vide **Table 1.2**. Total cost of NHDP has been estimated to be Rs. 54,000 Crores or US$ 13.2 billions whose components are as below.

Table 1. 2: Financing of NHDP

Total Cost	**Rs.54,000 Crores**	**US$ 13.2 Billion**
Likely sources	***Rs.Cr.* (On 1999 prices)**	***US$ Billions* (On 1999 prices)**
Cess on Petrol and Diesel	20,000	4.90
External assistance	20,000	4.90
Market borrowings	10,000	2.40
Private Sector Participation	4,000	1.00

Source: www.nhai.org

1.2.3.5 Policy Initiatives for Attracting Private Investment

- Government will carry out all preparatory work including land acquisition and utility removal. Right of way (ROW) to be made available to concessionaires free from all encumbrances.
- Government of India to provide capital grant up to 40% of project cost to enhance viability on a case to case basis.
- 100% tax exemption for 5 years and 30% relief for next 5 years, which may be availed of in 20 years.

- Concession period allowed up to 20 years.
- Arbitration and Conciliation Act 1996 based on UNICITRAL provisions.
- In BOT projects entrepreneurs can collect and retain toll.

1.3 The Consultant

The Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder **from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244** in the state of Jammu and Kashmir (Total length 34.000 km) have been entrusted to **M/S Rodic Consultants Pvt. Ltd., New Delhi in joint venture with M/S Monarch Surveyors and Engineering consultant Pvt. Ltd.** The Corporate office of the Consultants is located at the following address.

Head Office	**Site Office**
Rodic Consultants Pvt. Ltd. 1, Jai Singh Marg (First Floor), YMCA Cultural Centre Building New Delhi – 110001 (INDIA) Ph: + 91 11 4943 4500 www.rodicconsultants.com	**Rodic Consultants Pvt. Ltd.** Joint Venture with **Monarch Surveyors and Engineering Consultants Pvt. Ltd.** 317, Sector-1, Channi Himmat Jammu Tawi (J&K)-180015

1.4 Objectives of Consultancy

- The main objective of the consultancy service is to establish the technical, economical, and financial viability of the project and prepare detailed project reports for rehabilitation and upgrading of the existing road to 2 lanes with paved shoulder configuration.
- The viability of the project shall be established taking into account the requirements with regard to rehabilitation, upgrading and improvement based on highway design, pavement design, provision of service roads wherever necessary, type of intersections, rehabilitation and widening of existing and/or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis within the given time frame.
- The Detailed Project Report (DPR) would inter-alia include detailed highway design, design of pavement and overlay with options for flexible or rigid pavements, design of bridges and cross drainage structures and grade separated structures, design of service roads, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial Viability analyses, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for international / local competitive bidding.
- The DPR consultant should ensure detailed project preparation incorporating aspects of value engineering, quality audit and safety audit requirement in design and

implementation. The Consultant shall ensure to carry out Road Safety Audit at various stages as per supplement-III (Additional Requirement for Safety Audit) of TOR.

- The consultant should, along with Feasibility Report, clearly bring out through financial analysis the preferred mode of implementation on which the Civil Works for the stretches are to be taken up. The consultant should also give cost estimates along with feasibility report/ detailed Project Report.

- If at inception stage or feasibility stage, employer desires to terminate the contract, the contract will be terminated after payment up to that stage.

1.5 Scope of Services

The general scope of services is given in the sections that follow. However, the entire scope of services would, inter-alia, include the items mentioned in the Letter of Invitation, terms of reference, general contract and any supplements and appendices to these documents.

1.5.1 ROW and Land related aspects

- The land for any Expressway will be acquired with a ROW of 100 m.

- As for the four-lane / six-lane Highway Road Projects, experience shows that all the existing two-lane Roads requiring upgradation to 4/6-lane involve acquisition of land, shifting of utilities, felling of trees and other statutory clearances etc. As such, keeping in view a futuristic approach, it has been decided that the land for any 4/6 lane Highway Road will be acquired with a RoW of 60 m irrespective of the width of the carriageway. Further, efforts shall be made to design the road for upgradation from 2 lane to 4 lane in such a way that the existing 2 lane shall be retained for one way traffic and separate one way 2 lane Greenfield shall be provided at an appropriate distance from existing 2 lane road with interlinking in between, to avoid higher LA cost, avoiding shifting of utilities and felling of trees depending upon specific site conditions and economic considerations.

- All efforts shall be made to avoid any road alignment through National Parks and Wildlife Sanctuaries, even if it requires taking a longer route / bypass. However, where it becomes unavoidable and necessary to keep the alignment through such reserve forest / restricted areas, land would be acquired with RoW of not more than 30 metres. The cross-section in such areas may be kept as 3.25m, (shoulder / Utility Corridor) + 10.5m (three-lane one side carriageway) + 2.5m (Median) + 10.5m (2nd three-lane carriageway) + 3.25m (shoulder / Utility Corridor).

- Similarly, though it may be difficult, while determining the alignment for any bypass, efforts be made to see if these could be along the revenue boundaries of two revenue estates thereby minimizing the compulsions of land owners / farmers for cross-overs to the other side. In case such an alignment is not found feasible, it should be ensured that access to common facilities for the local people (e.g. schools, Healthcare facilities etc.) is maintained only on one side of the alignment, thereby minimizing the need for cross-over for day-to-day life.

- Protection of the acquired ROW against any possible encroachments is extremely important. Boundary stones be provided at the end of the ROW as per Clause 9.8 of IRC: SP: 84-2019 and supplemented as per Circular dated 08.12.2015 issued by NHIDCL. The boundary pillars alone, which are subject to removal with passage of time, may not be enough to save against encroachments. As such, the typical cross-section of a Highway Road is being re-visited separately with the intention of providing permanent features in this behalf. For a typical ROW of 60 metres, starting from one end, these will require the following:

  a) Use barricading of the ROW with plantation of hedge-like species (Ficus / Poplars) within a 3m wide strip area, dug up to 0.6 to 0.9 metres, of which 2.0 metres to serve as a Utility Corridor.

  b) Provision of a Service Road (along the inhabited area) with its drainage slope towards the drain / area reserved for Strip Plantation, for a width of 9.0 metres.

  c) Earmark width of 1.5 metres for construction of a drain so as to be able to capture the rainwater flow from the Service Road (wherever provided) and the main carriageway.

  d) Three lanes with paved shoulders: Main carriageway – 10.5 metres, paved shoulder – 1.5 metres and earthen shoulder – 2.0 metres (Total – 14 metres).

  e) Median – 5.0 metres (effective width 4.5 m), and

  f) A Mirror Image on the other end.

- Provisions of short bypasses, service roads, alignment corrections, improvement of intersections shall be made wherever considered necessary, practicable and cost effective. However, bypasses proposals should also be considered, wherever in urban areas, improvement to 4/6/8-lane, as the case may be, of the existing road is not possible.

- The Consultant shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition. Consultant shall also submit 3a, 3A and 3D draft notification for acquisition of land.

- Support in land Acquisition process till the receipt of land possession certificate from CALA

  a) The Consultant shall identify all land parcels needing to be acquired as part of project ROW and shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition.

  b) Assist CALA in preparation and verification of draft 3A/3D/3G/3H notifications, collecting information/documents, claims hearing etc.

  c) Liaison with state departments like land revenue department and registrar's office for collection and verification of revenue records, surveys, sale deeds, circle rates and for valuation of land related assets.

d) Conduct all required surveys/valuation including joint measurement survey and valuation of land assets.

e) Support CALA by providing technical manpower (like Amins) clerical manpower and other resources (like vehicles, printers)

f) Assist PIU in verification of 3A/3D/3G/3H drafts from CALA, drafting of documents (to be forwarded to RO/HQ), receipt of land possession certificate and in related activities till award of civil work

g) Assist PIU in all official communications with CALA and other State department.

- **Approach to the provision and specifications for Structures:**

a) The structures on roads viz. Bridges, ROB's (Road Over Bridges, and Flyovers), RUBs (Road under Bridges) etc. are designed for more than 50 years. It is difficult to increase the width of the structures later which may also have larger financial implications apart from construction related issues in running traffic. Therefore, it has been decided to keep provision for all the structures including approaches comprising of retaining structures as 6-lane (length of such approaches shall, in no case, be less than 30m on either side) on all the four-lane highways except in the following cases (i) Reserve Forest (ii) Wild life Areas (iii) Hilly Areas (iv) Urban Areas where site condition do not permit this. Wherever elevated sections are designed through any inhabited areas, these should be six-lane structures supported on single piers so that the road underneath serves as effective service roads on both sides.

b) Highway projects shall be designed for separation of local traffic especially for Vulnerable Road Users (VRUs), for longitudinal movements and crossing facilities through viaduct(s) located at convenient walking distance. Provision of PUPs and CUPs with size of 7.0m x 3.0m, as specified in para 2.10 of the IRC specifications, has proved to be insufficient keeping in view the increased use of mechanization in agriculture practices. These structures do not support the easy passage / crossing for the tractors with trolleys so often used for agricultural operations. As traffic on cross roads is increasing day-by-day, it has been decided to substitute the provision of Pedestrian Underpass (PUP) / Cattle Underpass (CUP) [for para 2.10 of IRC specifies the dimensions of 7.0m x 3.0m] with a VUP Grade-II with a minimum size of 12m (lateral clearance) x 4m (vertical clearance). Out of 12m lateral width, 2.5m width on one side shall be raised for pedestrian sidewalks with grills to make pedestrian movement convenient and safe. These structures shall be located at the most preferred place of pedestrian / cattle / day-to-day crossings. Depending on the site conditions, feasibility of clubbing the crossing facilities through service roads shall also be explored. Further, the bed level of these crossings shall not be depressed as any such depression, in the absence of proper drainage facilities becomes water-logged rendering the same unusable. Ideally, the bed level of the crossings should be a bit higher with proper connectivity to a drain, which could serve the drainage requirements of the main carriageway, the underpass and the service road as well.

c) Wherever the alignment of 4-lane Highway road project is retained in-situ while passing through inhabited areas (e.g. villages), it should be ensured that Service Roads are provided on both sides of the carriageway, connected underneath with a cross-over structure (VUP/PUP/CUP). Thus, each habitation should preferably have crossing facility at the highways with a vertical clearance of 4 m.

d) To ensure that bypass once constructed serves the intended purpose during its life, all the bypasses shall be well designed, and access controlled. The entry / exit from / to side roads shall be controlled such that they are grade separated at major roads or at spacing not less than 5 km. Side roads at closer spacing shall be connected to the service roads on either side and taken to major roads for provision of grade separated interchange.

- The provision of embankments shall be kept minimum so as to save land as well as earth which are scarce resources. This can be decided on case to case basis with due deliberations. However, economic considerations may also be given due weightage before deciding the issue.

- The Consultant shall study the possible locations and design of toll plaza if applicable to the project. Wayside amenities Land (minimum 5 acres, length and depth preferably in the ratio of 3:2) shall also be acquired for establishment of Way-side amenities at suitable locations at distances varying from 30 to 50 km on both sides of the Highway. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.

- The Consultant will also make suitable proposals for widening/improvement of the existing road and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. The Consultants shall prepare documents for EPC/PPP contracts for each DPR assignment.

- Already to implement "good for construction" drawings shall be prepared incorporating all the details.

- Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/ World Bank/JICA, etc.

- Wherever required, consultant will liaise with concerned authorities and arrange all clarifications. Approval of all drawings including GAD and detail engineering drawings will be got done by the consultant from the Railways. However, if Railways require proof checking of the drawings prepared by the consultants, the same will be got done by NHIDCL and payment to the proof consultant shall be made by NHIDCL directly. Consultant will also obtain final approval from Ministry of Environment and Forest for all applicable clearances. Consultant will also obtain approval for estimates for shifting of utilities of all types from the concerned authorities and NHIDCL. Consultant is also required to prepare all Land Acquisition papers (i.e. all necessary schedule and draft 3a, 3A, and 3D, 3G notification as per L.A. act) for acquisition of land either under NH Act or

State Act.

- The DPR consultant may be required to prepare the Bid Documents, based on the feasibility report, due to exigency of the project for execution if desired by NHIDCL.

- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.

- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.

- The consultant shall prepare separate documents for BOT as well as EPC contracts at Feasibility stage / DPR stage. The studies for financing options like BOT, Annuity, EPC will be undertaken in feasibility study stage.

- The consultant shall be guided in its assignment by the Model Concession/ Contract Agreements for PPP/ EPC projects, as applicable and the Manual of Specifications and Standards for four/ six laning of highways published by IRC (IRC: SP:84 or IRC: SP:87, as applicable) along with relevant IRC codes for design of long bridges.

- The consultant shall prepare the bid documents including required schedules (as mentioned above) as per EPC/ PPP documents. For that it is suggested that consultant should also go through the EPC/PPP documents of ministry before bidding the project. The Consultant shall assist the NHIDCL and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the Project Highway and Bid Documents.

- Consultant shall be responsible for sharing the findings from the preparation stages during the bid process. During the bid process for a project, the consultant shall support the authority in responding to all technical queries, and shall ensure participation of senior team members of the consultant during all interaction with potential bidders including pre-bid conference, meetings, and site visits etc. In addition, the consultant shall also support preparation of detailed responses to the written queries raised by the bidders.

1.5.2 General

Primary Tasks

- General Scope of Services shall cover but be not limited to the following major tasks (additional requirements for Preparation of Detailed Project Report for Hill Roads and Major Bridges are given in Supplement I and II respectively):

i. Review of all available reports and published information about the project road and the

project influence area;

ii. Environmental and social impact assessment, including such as related to cultural properties, natural habitats, involuntary resettlement etc.

(a) Public consultation, including consultation with Communities located along the road, NGOs working in the area, other stakeholders and relevant Government departments at all the different stages of assignment (such as inception stage, feasibility stage, preliminary design stage and once final designs are concretized).

iii. Detailed Reconnaissance.

iv. identification of possible improvements in the existing alignment and bypassing congested locations with alternatives, evaluation of different alternatives comparison on techno-economic and other considerations and recommendations regarding most appropriate option;

v. traffic studies including traffic surveys and Axle load survey and demand forecasting for next thirty years;

vi. Inventory and condition surveys for road;

vii. Inventory and condition surveys for bridges, cross-drainage structures, other Structures, river Bank training/Protection works and drainage provisions;

viii. Detailed topographic surveys using LiDAR equipped with minimum engineering grade system or any other better technology having output accuracy not less than

(a) Specified in IRC SP 19

(b) Total Station

(c) GPS/ DGPS.

The use of conventional high precision instruments i.e. Total Station or equivalent can be used at locations such as major bypasses, water bodies etc. where it may not be possible to survey using LiDAR. Use of mobile / Aerial LiDAR survey is preferable.

ix. Pavement investigations.

x. Sub-grade characteristics and strength: investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design and sub soil investigation.

xi. Identification of sources of construction materials.

xii. Detailed design of road, its x-sections, horizontal and vertical alignment and design of embankment of height more than 6m and also in poor soil conditions and where density consideration require, even lesser height embankment. Detailed design of structures preparation of GAD and construction drawings and cross drainage structures and

underpasses etc.

xiii. Identification of the type and the design of intersections.

xiv. Design of complete drainage system and disposal point for storm water

xv. Value analysis / value engineering and project costing.

xvi. Economic and financial analysis.

xvii. Contract packaging and implementation schedule.

xviii. Strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over- and underground) and the scheme for their relocation, trees to be felled, transplanted and planted and land acquisition requirements including schedule for LA: reports documents and drawings arrangement of estimates for cutting/ transplanting of trees and shifting of utilities from the concerned department;

xix. Develop 3D engineered models of terrain and elevation, as-is project highway, proposed and project highway along with all features, current and proposed structures, current and proposed utilities and land acquisition plans.

xx. To find out financial viability of project for implementation and suggest the preferred mode on which the project is to be taken up.

xxi. Preparation of detailed project report, cost estimate, approved for construction Drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources.

xxii. Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings

xxiii. Design of weighing stations, parking areas and rest areas.

xxiv. Any other user oriented facility en-route toll facility.

xxv. Tie-in of on-going/sanctioned works of MORT&H/ NHIDCL/ other agencies.

xxvi. Preparation of social plans for the project affected people as per policy of the lending agencies/ Govt. of India R&R Policy.

- While carrying out the field studies, investigations and design, the development plans being implemented or proposed for future implementation by the local bodies, should be considered. Such aspect should be clearly brought out in the reports and drawings.

- The consultant shall study the possible locations and design of toll plaza, wayside amenities required and arboriculture along the highway shall also be planned.

- The local and slow traffic may need segregation from the main traffic and provision of service

roads and physical barrier including fencing may be considered, wherever necessary to improve efficiency and safety.

Standards and Codes of Practices

1) All activities related to field studies, design and documentation shall be done as per the latest guidelines/ circulars of MoRT&H and relevant publications of the Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS). For aspects not covered by IRC and BIS, international standards practices, may be adopted. The Consultants, upon award of the Contract, may finalize this in consultation with NHIDCL and reflect the same in the inception report.

2) All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC: 71.

1.6 Project Stages

The Project must be completed in eight stages as described herein below:

No	Stage	Key activities	Report/deliverable submitted
1	Inception	Project planning and mobilization	Inception Report and QAP
2	Feasibility	Alignment finalization, preliminary surveys	Alignment Options Report and Feasibility Report
3	LA and Clearances I	LA, utilities identification; creation of draft notifications and proposals	Strip Plan, LA Report (3a, 3A), Clearances and Utility Shifting proposals
4	DPR	Detailed design of highway, preparation of detailed project report with drawings,	Draft DPR Report, Final DPR Report, documents and drawings
5	Technical Schedules	Preparation of bid documents and technical schedules	Civil Works Contract Agreement and Schedules
6	(i) LA II (ii) Project Clearances	Land acquisition process, obtaining final utilities estimates and required clearances	JMS and 3D Report, Final Project Clearances and Utilities Report
7	LA III- Award Determination	Land acquisition award determination	3G Report
8	LA IV- Possession	Obtaining possession of land	Land Possession Report

1.7 The Draft Detailed Project Report

The Final Detailed Project Report consists total of 12 volumes as following details.

Volume-I	Main Report
Volume-I (A)	Annexure to Main Report
Volume-I (B)	Hydrology Report
Volume-II (A)	Design Report Highways
Volume-II (B)	Design Report Structures
Volume-III	Material Report

Volume-IV	EIA & EMP
Volume-V	Technical Specification
Volume-VI	Rate Analysis
Volume-VII	Cost Estimate
Volume-VIII	Bill of Quantities
Volume-IX	Drawings

Table 1.3: Volume-I Main Report of Draft Detailed Project Report consists of following chapters.

Chapter No.	Name
0	Executive Summary
1	Introduction
2	Socio- Economic Profile
3	Traffic Surveys and Analysis
4	Engineering Surveys, Investigations and Analysis
5	Traffic Forecast
6	Social Screening Report
7	Environmental screening Report
8	Improvement Proposal and Design
9	Cost Estimate (Road & Structures)
10	Economic Analysis
11	Financial Analysis
12	Conclusion and Recommendations

1.8 Compliance of TOR

Para 10.4 of TOR stipulates the requirement of Feasibility Report, which has been fully complied with. The responses of various compliance are tabulated herein below.

Table 1.4: TOR Requirements

Sr. No.	Requirement	Location
1	Executive Summary	Executive Summary
2	Overview of NHIDCL organization and activities, and project financing and cost recovery mechanisms	Chapter 1 of Main Report
3	Project description including possible alternative alignments/bypasses and technical/engineering alternatives	Chapter 4 and 8 of Main Report
4	Methodology adopted for the feasibility study	Chapter 3 of Inception Report
5	Socioeconomic profile of the project areas	Chapter 2 of Main Report
6	Indicative design standards, methodologies and specifications	Chapter 8 of Main Report
7	Traffic surveys and analysis	Chapter 3 and 5 of Main Report
8	Environmental screening and preliminary environmental	Chapter 7 of Main

Sr. No.	Requirement	Location
	assessment	Report
9	Initial social assessment and preliminary land acquisition/resettlement plan	Chapter 6 of Main Report
10	Cost estimates based on preliminary rate analysis and bill of quantities,	Chapter 9 of Main Report
11	Cost analysis of all alternate identified alignments	Chapter 9 of Main Report
12	Conclusions and recommendations	Chapter 10 of Main Report

Chapter 2

Socio-Economic Profile of the Project Influence Area

2.0 SOCIO-ECONOMIC PROFILE OF THE PROJECT INFLUENCE AREA

2.1 Background

The entire proposed project road is in the union territory of Jammu and Kashmir. The UT occupies a total area of 42,241 square kilometres. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south, Ladakh to the east, Jammu and Kashmir has an international border with Pakistan on the east. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts.

The Vailoo-Khanabal road section situated in west part of Jammu and Kashmir is having total existing length of about 34.00 Kilometres. The consultants have proposed road stretch from Vailoo to Donipawa with design Chainage km 148.589 to km 176.532 having total design length of 27.943 km. The project road has significant influence on Jammu and Kashmir, specifically on the Anantnag district since it lies entirely in that district. Jammu and Kashmir is located around 33.7782°N, 76.5762°E.

2.2 Delineation of the Project Influence Area (PIA)

The entire project road is passing within the Anantnag district. Hence, for analysing the immediate influence area of the project road Anantnag District in Jammu and Kashmir Union Territory have been considered.

2.3 Demographic Profile of PIA: UT and Districts

2.3.1 Jammu and Kashmir (Union Territory)

2.3.1.1 Location and Geography

The Union Territory of Jammu and Kashmir covers an area of 42,241 sq.km. The state is very rich in natural heritage since it is located mostly in Himalayan Mountains. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border Pakistan on the east, the Line of Control separates it from the Pakistan. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts. Jammu and Kashmir is home to several valleys such as the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley. The main Kashmir Valley is 100 km. The Indus, Tawi, Ravi and Chenab are the major rivers flowing through the state. Jammu and Kashmir is home to several Himalayan glaciers. With an average altitude of 5,753 metres (18,875 ft) above sea-level, the Siachen Glacier is

76 km (47 mi) long making it the longest Himalayan glacier. In the south around Jammu, the climate is typically monsoonal. In the hot season, Jammu city is very hot and can reach up to 40 °C whilst in July and August, very heavy though erratic rainfall occurs with monthly extremes of up to 650 millimetres.

2.3.1.2 Administrative Setup

Jammu and Kashmir consist of three divisions: Jammu, Kashmir Valley and is further divided into 20 districts. The major cities in Jammu and Kashmir are:

Table 2.1: Population Census of Jammu and Kashmir

Division	Districts	Area (Square-Km)	Population	Headquarters
Jammu	Kathua District	2651	616,435	Kathua
	Jammu District	2336	1,529,958	Jammu
	Samba District	1002	3,18,898	Samba
	Udhampur District	5550	554,985	Udhampur
	Reasi District	1719	314,667	Reasi
	Rajouri District	2630	642,415	Rajouri
	Poonch District	1674	476,835	Poonch
	Doda District	2625	409,936	Doda
	Ramban District	1329	283,713	Ramban
	Kishtwar District	7737	230,696	Kishtwar
	Total for division	**29253**	**5059640**	**Jammu**
Kashmir	Anantnag District	3574	1,078,692	Anantnag
	Kulgam District	1067	424,483	Kulgam
	Pulwama District	1398	560,440	Pulwama
	Shopian District	612.9	266,215	Shopian
	Budgam District	1370	753,745	Budgam
	Srinagar District	1979	1,236,829	Srinagar
	Ganderbal District	1979	297,446	Ganderbal
	Bandipora District	345	392,232	Bandipora
	Baramulla District	3353	1,008,039	Baramulla
	Kupwara District	2379	870,354	Kupwara
	Total for division	**18056.9**	**6,888,475**	**Kashmir**

2.3.1.3 Demographic Features

The major ethnic groups living in Jammu and Kashmir include Kashmiris, Gujjars/Bakarwals, Paharis, and Dogras. The Kashmiris live mostly in the main valley of Kashmir and Chenab valley of Jammu division with a minority living in the Pir Panjal region. The Pahari-speaking people mostly live in and around the Pir Panjal region with some in the northern Kashmir valley. The nomadic Gujjars and Bakarwals practice transhumance and mostly live in the Pirpanjal region. The Dogras are ethnically, linguistically and culturally related to the neighboring Punjabi people and mostly live in the Udhampur and Jammu

districts of the state.

Jammu and Kashmir is one of India's two administrative divisions (the other being the Union territory of Lakshadweep which is overwhelmingly Muslim) with a Muslim majority population. According to the 2011 census, Islam is practised by about 68.3% of the state population, while 28.4% follow Hinduism and small minorities follow Sikhism (1.9%), Buddhism (0.9%) and Christianity (0.3%). About 96.4% of the population of the Kashmir valley are Muslim followed by Hindus (2.45%) and Sikhs (0.98%) and others (0.17%).

Religion in Jammu and Kashmir

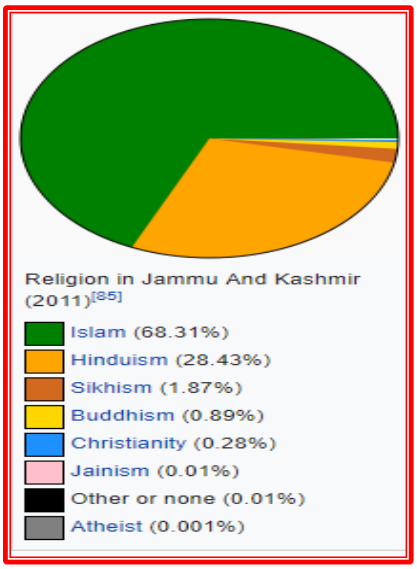


Fig 2.1: Religion Chart of Jammu and Kashmir

According to the 2011 census of India, the total population of Jammu and Kashmir is 42241 Km sq. The official language of the state is Urdu. Among other languages Kashmiri, Dogri, Hindi, Punjabi, Pahari, Balti, Gojri, Shina and Pashto are also spoken in other parts of Jammu and Kashmir. Jammu and Kashmir have a rich literary heritage with roots that lie deep in the sociological and historical movements of the region. Its literature reflects the regional consciousness and the evolution of an identity distinct from others in Northern India. The literacy is about 68.74%.

Table 2.2: Demographic Profile of Jammu and Kashmir

Division	% Muslim	% Hindu	% Sikh	% Buddhist & others
Kashmir	96.40%	2.45%	0.98%	0.17%

Jammu	33.45%	62.55%	3.30%	0.70%

2.3.2 Anantnag District

2.3.2.1 Location and Geography

The project bypass stretch lies in the Anantnag district. Anantnag is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

Anantnag is located about 54 Km from Srinagar and about 254 Km from Jammu. The district is well connected with other districts and National Highway NH-1A (44) and NH-1B (244) pass through the district. The district has a good road network. District Anantnag is called the Gateway of Kashmir Valley. The nearest airport is located at Srinagar, which is about 65 Km away and the nearest Railhead is located at Jammu. The general approach to the whole of the District is through road and one can avail the transport facilities like Taxi, Deluxe Buses etc. both from Jammu and Srinagar. The ambitious project of bringing the Kashmir Valley on the railway network map has been started. Geographically the district lies between 33-20' to 34 -15' north latitude and 74-30 to 75 -35 East Longitude bounded by north west by Srinagar and Pulwama districts and in the north east by Kargil district, in the southeast by district Doda, Kishtwar and in the south and south west by Ramban and Kulgam districts respectively.

2.3.2.2 Administrative Setup

Anantnag district comprises Kokernag, Shangus, Anantnag (town), Bijbehara, Doru Shahabad, Pahalgam and Qazigund tehsils. The district consists of seven blocks: Breng, Shangus, Achabal, Dachnipora, Qazigund, Khoveripora and Shahabad. Each block consists of a number of panchayats such as Akingam, Dialgam, and Vailoo etc.

Table 2.3- Tehsil and Blocks in Anantnag District

District	Tehsil	Blocks
ANANTNAG	1. Bijibehara	1. Khveripora
	2. Doru	2.Shanabad
	3. Kokernag	3.Achabal
	4. Shangus	4.Breng
	5. Qazigund	5.Shangus
	6. Pahalgam	6.Qazigund

District	Tehsil	Blocks
	-	7. Dachipora

Table 2.4: Demographic Profile of Anantnag District

Category	No
Area	2917 Sq. Kms.
No. of Revenue Villages	387
No. of Sub-Divisions	04
No. of CD Blocks	16
No. of Tehsils	12
No. of Gram Panchayats	303
No. of Municipalities	10
No. of Municipal Corporations	2
No. of Patwar Halqas	99
Literacy Rate	62.69%
Total Population	1078692

2.3.2.3 Climate

The existing project road starts at Vailoo Village and terminates at Khanabal of NH-244 having total project length of 34 km. This project road lies entirely in Anantnag District of Jammu and Kashmir. Anantnag features a moderate climate (Köppen climate classification. The climate of Anantnag is largely defined by its geographic location, with the towering Karakoram to its east and the Pir-panjal range to the south. It can be generally described as cool in the spring and autumn, mild in the summer, and cold in the winter. As a large city with a significant differences in Geo location among various districts, the weather is often cooler in the hilly Areas of east as compared to the flat northern part of Anantnag. Weather conditions are unpredictable. The record high temperature is 33 °C and the record low is -18 °C. On 5–6 January 2012, after years of relatively little snow, a wave of heavy snow and low temperatures shocked the city covering it in a thick layer of snow and ice, forcing them to officially declare a state of emergency and calling the following two days (6 and 7 January) off for the whole valley.

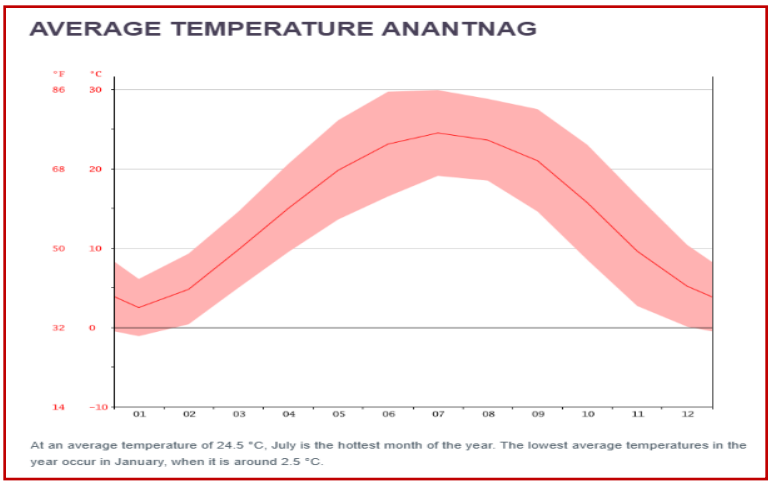


Fig 2.2: Average Temperature Anantnag

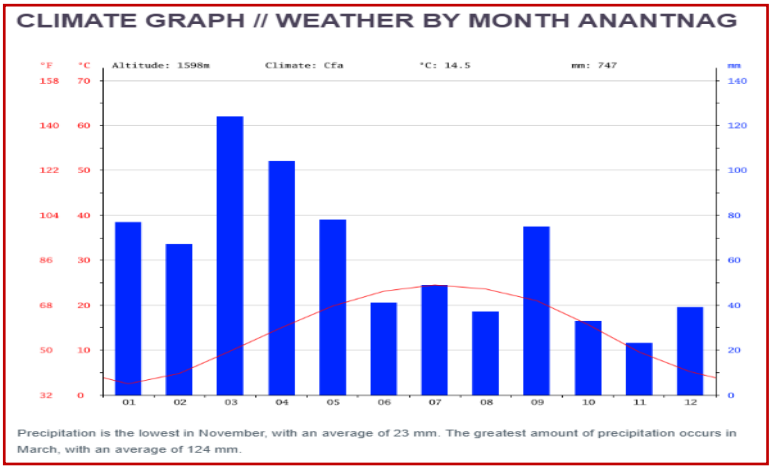


Fig 2.3: Climate Graph of Anantnag

2.4 Employment Pattern and Economy

This micro level study, conducted in Union Territory of Jammu and Kashmir to examine the income and employment pattern, has revealed that Due to limited job opportunities available for job seeker youth in the region, the number of job seeker youth has been increasing with every passing year. The number of job seeker youth registered in various District Employment & Counselling Centres of the J&K region is 6.01 lakhs ending September 2011. The given table provide the combined data of J&K and Ladakh region.

Table 2.5: Qualification-wise job seekers in 2011 of Jammu and Kashmir

Qualification	Kashmir Division	Jammu Division	Total
Illiterate	2771	432	3203
Middle	21211	55876	77087
Matric	78991	86217	165208
PUC	18774	656	19430
TDC	102621	83846	186467
Graduate			
Arts	26585	11977	38562
Science	15181	6620	21801
Commerce	3798	1565	5363
Others	13191	6105	19296
Total	58755	26267	85022
Post Graduate			
Arts	5432	4575	10007
Science	3227	2143	5370
Commerce	913	573	1486
Others	2690	1217	3907
Total	12262	8508	20700
Diploma Holders			
Civil	554	464	1018
Elect.	447	695	1142
T/Com	291	466	757
Mechanical	428	506	934

In India estimates of the rates of unemployment are provided by the NSSO and uses three different criterions of unemployment:

(i) Number of persons unemployed based on Usual Principle Status.

(ii) Number of persons unemployed based on the Current Weekly Status and

(iii) Number of person-days unemployed based on the Current Daily Status.

Table 2.6: Unemployment of Jammu and Kashmir

Area	J&K (%)			All India (%)		
	Male	Female	Persons	Male	Female	Persons
Rural						
UPS	2.7	16.6	3.9	2.1	2.9	2.3
CWS	3	6.3	3.8	3.3	3.5	3.4
CDS	5	11.8	6.1	5.5	6.2	5.7
Urban						
UPS	4.7	25.6	7.8	3.2	6.6	3.8
CWS	4.5	21.8	7.6	3.8	6.7	4.4
CDS	5.3	24.2	8.4	4.9	8	5.5
Combined (Rural + Urban)						
UPS	3.2	20.2	4.9	2.4	3.7	2.7
CWS	3.4	8.8	4.7	3.5	4.2	3.7
CDS	5	14.7	6.7	5.3	6.6	5.6

The economy of Jammu and Kashmir has suffered from disturbed conditions. It would be therefore necessary to put the economy back to the rails to enable an average person get employment opportunities. In this direction, the following 8 sectors of economy have been identified for generation of gainful employment opportunities in the region on sustainable basis:

1. Agriculture (including Horticulture, Floriculture, Food Processing and Animal Husbandry)
2. Handlooms and Handicrafts
3. Industries (including Small Scale industries and Rural industries)
4. Tourism & travels,
5. Education & health
6. Large infrastructure projects (Roads & Railways),
7. Information Technology & Telecommunication
8. Construction Sector

Jammu and Kashmir's economy is predominantly dependent on agriculture and allied activities. The Kashmir Valley is known for its sericulture and cold-water fisheries. Wood from Kashmir is used to make high-quality cricket bats, popularly known as Kashmir Willow. Kashmiri saffron is very famous and brings the UT a handsome amount of foreign

exchange. Agricultural exports from Jammu and Kashmir include apples, barley, cherries, corn, millet, oranges, rice, peaches, pears, saffron, sorghum, vegetables, and wheat, while manufactured exports include handicrafts, rugs, and shawls.

Horticulture plays a vital role in the economic development of the area. With an annual turnover of over ₹3 billion. Apart from foreign exchange of over ₹800 million, this sector is the next biggest source of income in the UT's economy. The region of Kashmir is known for its horticulture industry and is the wealthiest region in the Union Territory. The table provide the combined data of J&K and Ladakh Region.

Table 2.7 (a): Economy of Jammu and Kashmir

Economy of Jammu and Kashmir	
Statistics	
GDP	₹1.32 lakh crore (US$21 billion) (2016–17 est.)
GDP rank	21st
GDP growth	14% (2016–17 est.)[142]
GDP by sector	Agriculture 22% Industry 25% Services 53% (2015)[142]
Labour force by occupation	Agriculture 64% Industry 11% Services 25% (2015) [142]
Public finances	
Public debt	49.25% of GDP (2016–17 est.)[142]
Revenues	₹53,202 crore (US$8.3 billion) (2016–17 est.)[142]
Expenses	₹64,669 crore (US$10 billion) (2016–17 est.)[142]

Table 2.7 (b): Economy of Jammu and Kashmir

Year	State's Gross Domestic Product (in million INR)
1980	11,860
1985	22,560
1990	36,140
1995	80,970
2000	147,500
2006	₹539,850 million (US$8.4 billion)
2016	₹132,307 crore (US$21 billion)[157]

2.4.1 Agriculture and Irrigation

Jammu and Kashmir is essentially a mountainous region. Only about 30 per cent of the combined area of J&K and Ladakh region is under cultivation. Agriculture is the mainstay of the people as it provides employment, directly or indirectly to about 70 per cent of the workforce. It contributes about 65 per cent of the state revenue which explains the overdependence of the state on agriculture. Land is, however, limited and therefore, its judicious utilization is necessary to meet the growing need of the tremendously increasing population and for the sustainability of soils, ecosystems and environment. The general picture of land-use and the proportion of area under different categories have been given below.

Table 2.8: Land Pattern of Jammu and Kashmir

Jammu and Kashmir General Landuse, 1995-96			
Sr. No.	**Use of Land**	**Total Reporting Area in (Hect.)**	**Percentage**
1	Forest	658	27.24
2	Net area shown	730	30.22
3	Land out to non-agricultural uses	291	12.04
4	Barren Land	293	12.13
5	Permanent pastures and other grazing grounds	125	5.17
6	Land under miscellaneous trees and other groves	72	2.98
7	Cultivable waste	141	5.84
8	Fallow other than current fallow	7	0.29

Jammu and Kashmir General Landuse, 1995-96			
Sr. No.	**Use of Land**	**Total Reporting Area in (Hect.)**	**Percentage**
9	Current fallow	99	4.00
	Total	**2416.00**	**100.00**

Being, hilly, mountainous and snow covered, it is only the gentle slopes (below 15°) which may be developed as orchards and pastures after heavy investment. The proportion of old fallow and current fallow is 0.29 and 4.0 per cent respectively. About 12 per cent of the total reporting area is put to non-agricultural uses, e.g., settlement, roads, cemetery, guls (canals) and water bodies. In general, the Jammu plain has a high concentration of wheat, rice, maize, pulses, fodder and oilseeds, while the Valley of Kashmir is well known for its paddy, maize, orchards (apples, almond, walnut, peach, cherry, etc.) and saffron cultivation. In Ladakh, barley, wheat, maize, vegetables, berseem and fodder are the main crops. The Kashmir Valley has a large capacity of fruit production. Apples, walnuts, almonds, cherries and pears are imported by many foreign countries.

Over 70 percent of the Net Sown Area is under food crops and the area under fruits is a little over 13 percent. Viability of agriculture as a profession is presently affected capital inadequacy, lack of infrastructural support and controls on movement, storage and sale etc of agricultural produce. Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation.

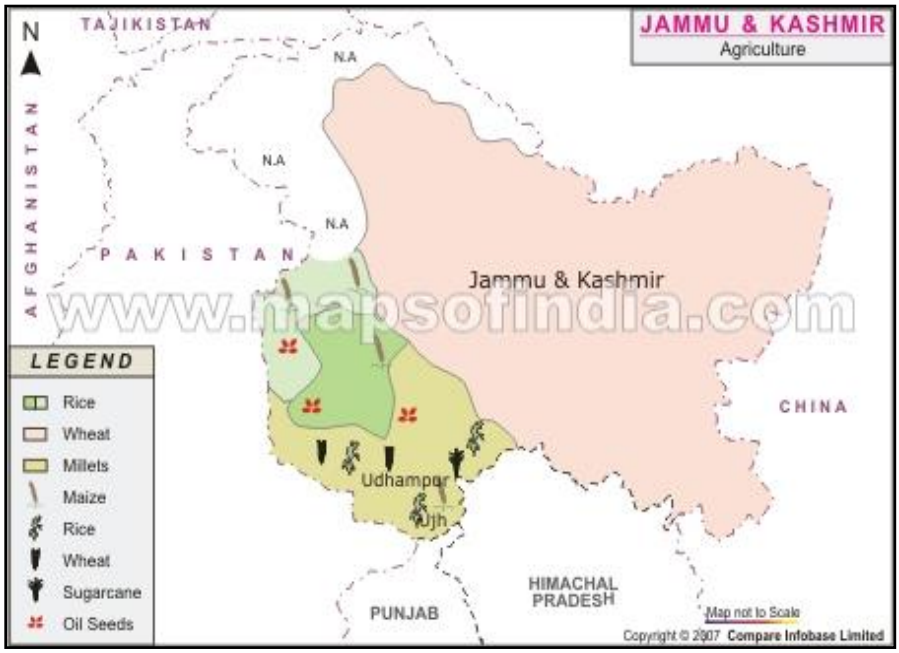


Fig 2.4: Agriculture in Jammu and Kashmir

Irrigation

Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation. Hilly terrain puts limits to mechanical farming and transportation of products, especially horticulture produce. Fragile soil in hilly areas is susceptible to soil erosion and a single cropping season is available in temperate and high-altitude areas. Net irrigated area in the region is just 24 percent and double and multiple cropping is followed on a larger scale in the intermediate and warmer plain sub-tropical areas. Wheat, maize and rice crops grown in about 250, 000 hectares 210,000 hectares and 110,000 hectares area respectively are the major cereal crops of Jammu division. Basmati rice and rajmaah (pulses) are valuable cash crops of the region. Vegetables, oil seeds, spices and condiments, aromatic and medicinal plants and fodder are also grown in specific areas of the region.

Table 2.9: Net area Irrigated Data of Jammu and Kashmir

(000 hac.)

S.No	Year	Net Area Irrigated by				
		Canals	Tanks	Wells	Other Sources	Total
1)	1950-51	244.00	3.00	3.00	11.00	261.00
2)	1955-56	277.00	1.00	3.00	9.00	290.00
3)	1960-61	256.00	-	5.00	13.00	274.00
4)	1965-66	270.00	Neg	1.00	7.00	278.00
5)	1968-69	252.00	Neg	1.00	11.00	264.00
6)	1974-75	279.00	Neg	3.00	13.00	295.00
7)	1980-81	285.00	2.00	4.00	13.00	304.00
8)	1985-86	288.69	2.67	4.12	14.13	309.61
9)	1990-91	278.58	1.98	1.33	16.20	298.09
10)	1995-96	284.86	2.57	1.42	17.73	306.58
11)	1998-99	283.81	2.60	1.32	21.42	309.15
12)	1999-00	278.35	2.57	1.37	20.80	303.09
13)	2000-01	284.15	2.71	1.53	22.48	310.37
14)	2001-02	284.42	2.79	1.61	21.35	310.17
15)	2002-03	274.50	2.66	1.57	20.49	299.67
16)	2003-04	282.41	3.87	1.06	19.19	306.53
17)	2004-05	286.28	3.93	1.08	19.60	310.89
18)	2005-06	289.28	4.21	1.05	17.57	312.11
19)	2006-07	286.64	4.24	1.04	17.52	309.44
20)	2007-08	285.78	4.22	0.99	17.05	308.04
21)	2008-09	287.77	4.84	3.80	17.32	313.73
22)	2009-10	287.80	5.11	4.33	20.03	317.27
23)	2010-11	288.48	6.22	11.65	14.28	320.63
24)	2011-12	285.40	7.11	7.42	19.33	319.26
25)	2012-13	285.35	8.03	10.42	21.29	325.09

2.4.2 Industrialisation and Minerals

Main industrial activity is concentrated in the Jammu and Kathua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of

raw material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The Industry sector has been declared as the main vehicle for accelerating economic activity besides providing employment opportunities to the unemployed educated youth in the State. To attract investment, the government has come up with a new eco-friendly industrial policy in 2004, which is valid until 2015. The industrial policy is designated to promote rapid industrialization and has evoked a great deal of interest in the private investment. The policy has slew of incentives in the form of subsidies for all sorts of industries, especially for small-scale industries to make them capable of competing in the present market. The policy also lays emphasis on promoting industries based on local raw materials and skills. The State has set up two industrial growth centers - one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

- Horticulture
- Floriculture
- Handloom & Handicraft
- Tourism.
- Mineral based Industries.
- Gem & Jewellery
- Sericulture
- Information Technology
- Pharmaceuticals
- Insecticides
- Pesticides
- Electronics
- Hardware

Infrastructure

Housing

As per the census 2001 there were 155768 households in the state. Census 2001 has revealed that 55% of the households occupy permanent house whereas 32.16% resided in semi-permanent houses and 12.68% of household in temporary and unclassifiable houses.

Geology and Mining Activities

The UT of J&K and Ladakh is endowed with tremendous mineral resources covering an area of 13334 Sq. Kms., out of which 60% are reported to be commercially viable for mining of various minerals. The Department of Geology and Mining, Jammu & Kashmir was established in 1960 to identify/ locate minerals like Limestone, Gypsum, Marble, Lignite, Granite, Bauxite, Coal, Magnesite, Slates, Sapphire, Dolomite, Borax, Graphite, Quartzite etc. in a big way, the quality and quantity of which are estimated for establishment of mineral based industries. A number of cement based industries as well as units for manufacture of plaster of Paris, Marble and Granite cutting units have been established in the state.

Table 2.10: Geology Activities of Jammu and Kashmir

						Samples		
S.No	Period	Drilling (000 Mts)	Exploratory Mining (000 Mts)	Geological Mapping (detailed) (Million Sq.Mts)	Geological Mapping (Reconnaisance) (Million Sq.Kms)	Collected (000 Nos)	Analysed (000 Nos)	Royalty Realised (rs. In Lakhs)
1)	1969-70	4.60	1.30	4.80	NA	260	1.00	NA
2)	1973-74	2.00	1.10	5.90	982.00	4.00	0.40	2.60
3)	1975-76	1.70	NA	2.11	225.00	3.20	0.60	NA
4)	1977-78	3.80	0.20	4.78	1734.00	2.70	1.70	8.20
5)	1978-79	5.30	0.04	4.25	1384.00	3.30	1.40	11.90
6)	1979-80	7.40	0.01	0.03	1353.00	3.30	1.00	13.30
7)	1980-81	5.92	0.36	3.78	1995.00	4.32	0.50	14.60
8)	1981-82	5.30	0.10	3.38	1022.00	2.59	0.44	19.62
9)	1985-86	5.50	0.36	3.38	2771.00	3.14	0.46	20.10
10)	1986-87	4.23	0.20	2.17	653.37	3.15	0.40	20.36
11)	1987-88	10.20	0.12	2.47	1995.00	2.76	0.53	27.61
12)	1988-89	9.89	0.12	3.13	3091.50	3.09	0.54	49.64
13)	1989-90	10.17	0.14	3.49	3152.30	3.32	0.60	63.73
14)	1990-91	5.23	0.12	1.68	1049.00	0.78	NA	16.83
15)	1995-96	1.45	0.08	1.81	2093.50	0.50	NA	1.80
16)	1996-97	0.79	0.17	2.44	803.00	0.63	NA	64.56
17)	1998-99	0.59	-	2.81	1762.50	0.69	NA	85.25
18)	2000-01	0.61	-	0.96	776.00	0.32	0.30	296.01
19)	2001-02	0.68	-	0.79	985.00	0.40	-	328.18
20)	2002-03	1.46	-	0.82	197.50	1.04	0.36	304.51

Minerals in Jammu and Kashmir

Fig 2.5: Minerals in Jammu and Kashmir

There is a wide source of mineral resources in the state that includes Limestone, Gypsum, Dolomite, Quartz etc.

Table 2.11: Minerals in Jammu and Kashmir

Mineral	Occurrence	Reserves	Uses
Limestone	All districts of Valley, Kathua, Udhampur,Rajouri,Poonch, Kargil and Leh	6081 Million tonnes	Manufacture of Cement, Calcium Carbide, Quicklime, Bleaching- Powder, Glass, Paper, paints
Gypsum	Baramullah,Kathua,ramban and Doda Distt.	150 Million tonnes	Cement, fertilizer, Filler in Paper, Paints, Rubber, Textile industry, Plaster of Paris & sanitary ware,
Marble	Kupwara, Kargil, Leh	400 Million Cubic mtrs	Decorative building stone.
Granite	Kargil, Leh, Ganderbal, Baramullah,Poonch and Doda	5.2 Million Cubic mtrs. However, stretched over an area of 800 sqkms	Decorative building stone.
Bauxite	Udhampur and Ramban	8.6 Million tonnes	Manufacture of aluminum, aluminum products, and

Mineral	Occurrence	Reserves	Uses
			aircraft industry
Coal	Udhampur,Rajouri (Kalakot)	9.5 Million tonnes	As fuel
Lignite	Nichome, Handwara, Distt Kupwara	8 Million tonnes	Thermal power and low grade fuel
Magnesite	Udhampur	7 Million tonnes	Refractory Bricks for furnaces. Pharmaceuticals
Slates	Poonch,Kathua,Doda and Baramullah	9.6 Million cubic mtrs	Building Material
Sapphire	Doda (Paddar)	2 kms mineralized zone	Precious Stone
Quartzite	Anantnag, Baramullah and Kupwara	2 Million tonnes	Glass & IT industry
Borax	Puga valley, Leh	400 tonnes annual crop	Medicine, glass, ceramics, nuclear industry, rocket fuel
Dolomite	Rajouri,Udhampur, Reasi	12.37 Million tonnes	Refractory bricks
China clay	Doda,Udhampur	28 Million tonnes	Ceramics, pottery

Population & Literacy

As per details from Census 2011, the following data is given by the Department of Ecology Environment and Remote Sensing.

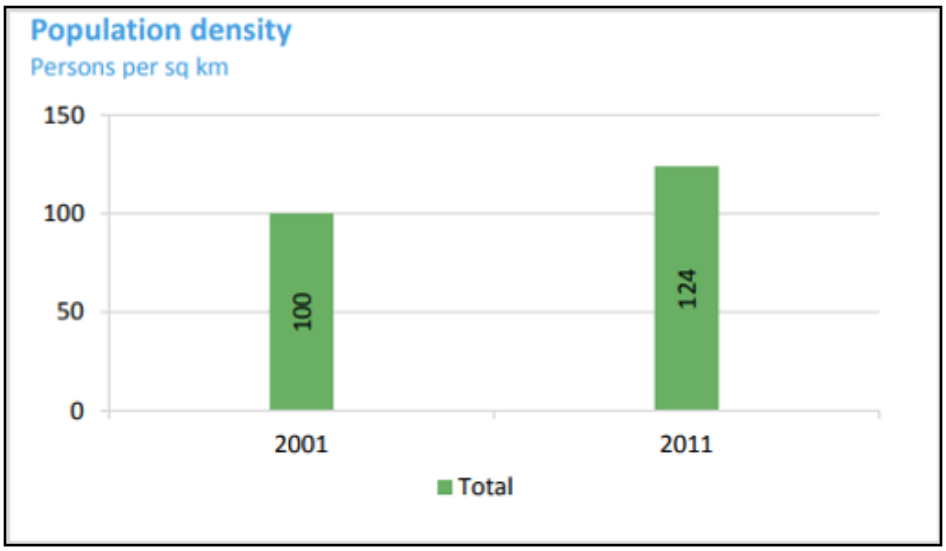
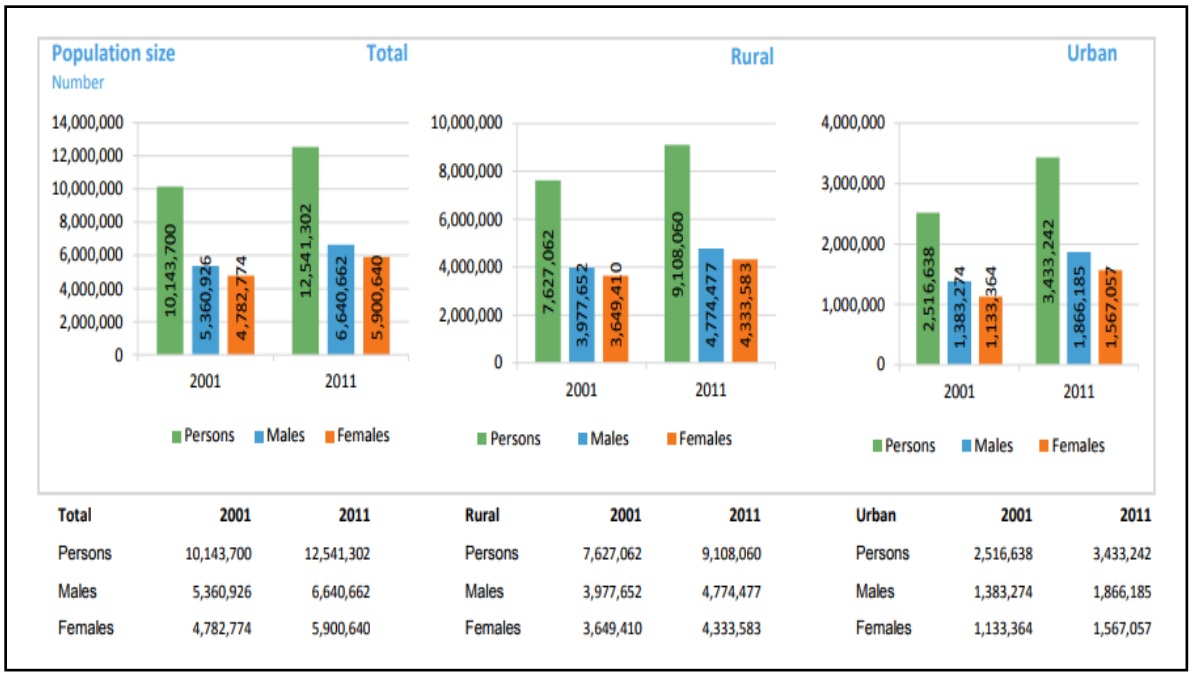
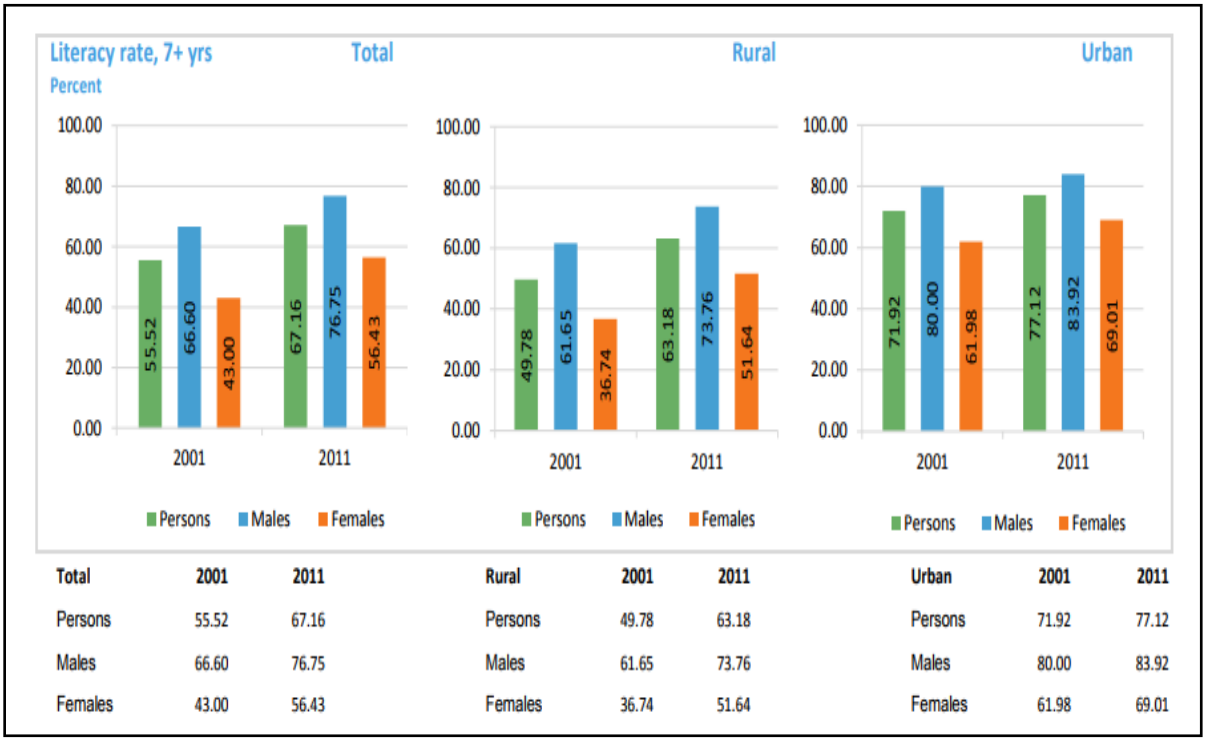


Fig 2.6(a): Population Density of Jammu and Kashmir



Total	2001	2011	Rural	2001	2011	Urban	2001	2011
Persons	10,143,700	12,541,302	Persons	7,627,062	9,108,060	Persons	2,516,638	3,433,242
Males	5,360,926	6,640,662	Males	3,977,652	4,774,477	Males	1,383,274	1,866,185
Females	4,782,774	5,900,640	Females	3,649,410	4,333,583	Females	1,133,364	1,567,057

Fig 2.6 (b)-Population Size of Jammu and Kashmir



Total	2001	2011	Rural	2001	2011	Urban	2001	2011
Persons	55.52	67.16	Persons	49.78	63.18	Persons	71.92	77.12
Males	66.60	76.75	Males	61.65	73.76	Males	80.00	83.92
Females	43.00	56.43	Females	36.74	51.64	Females	61.98	69.01

Fig 2.6 (c) -Literacy Rate of Jammu and Kashmir

Tourism

Jammu & Kashmir with its vast potential and growing economy has immense potential for the sustenance of the tourism industry. Tourism has historically remained an instrument of economic growth in the State of Jammu & Kashmir and has contributed a lot in developing the economy, particularly in Kashmir Valley and Ladakh. This sector has given jobs to many people and generated economic activities especially in the tertiary sectors. Its impact is visible in service industry sectors of the State such as transport, hospitality, horticulture and small scale industry. The tourism activities at a particular place are directly related to the arrival of tourists at that place. The more the arrival, the more economic activities get generated and make impact on the related sectors accordingly. Tourist expenditure generates multiple effects on the service sector such as agriculture, horticulture, poultry and handicrafts.

Jammu & Kashmir is an important tourist destination and has been a place of attraction for tourists since centuries. The lush green forests, sweet springs, perennial rivers, picturesque alpine scenery and pleasant climate of Kashmir valley has remained an internationally acclaimed tourist destination, whereas Jammu region is attracting a large number of pilgrim tourists and the important destination has been Shri Mata Vaishno Devi Shrine at Katra.

Fig 2.7 (a) Shikara in Dal Lake

Fig 2.7 (b) Vaishno Devi Temple

2.5 Transport system Network

2.5.1 Roads

An effective communication network is essential not only to cater to the needs of travel and

transport but also for Socio-economic development of a region and the country. In case of J&K, the same is more important for promotion of tourism as well. Revival of Tourism and restoration of damaged infrastructure, which had become the target during the period of disturbance in the State has been a priority of the State Government.

The Government, with the supplementation of Central resources, made concerted efforts in rebuilding of destroyed infrastructure in the shape of roads, bridges, school buildings and the social infrastructure, etc. With this objective in view, special schemes were launched, besides giving a boost to the ongoing schemes of the Department. Many new roads are under construction and many existing roads are under improvements.

Jammu and Kashmir has a wide range of road network that connects all the cities. The major highways in Jammu and Kashmir are NH 1, NH 3, NH 44, NH 144, NH 244, NH 144-A, NH 301, NH 444, NH 501, NH 701, NH 701-A, Srinagar-Jammu National Highway, Udhampur -Jammu Highway and Skardu Kargil Road. A detail road network in the state is shown as below in the map.

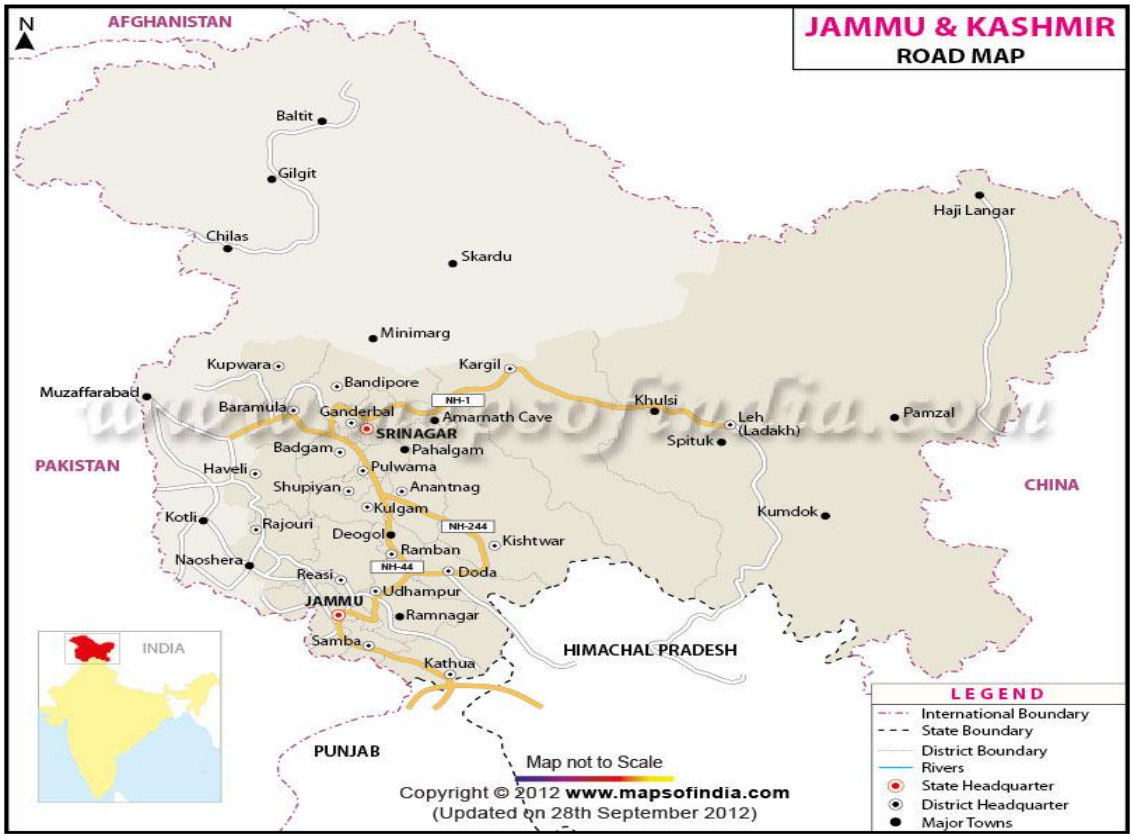


Fig 2.8: Jammu and Kashmir Road Map

2.5.2 Railways

Jammu & Kashmir have railway network of only 238.77 km. The state government has recognised the crucial role of railways in the process of economic development and in response to that the government of India has also extended full cooperation in all respects by providing technical and financial support for developing railways links in the state at a very fast speed. The Jammu–Srinagar–Baramulla railway line is a railway track being laid to connect the Kashmir Valley in the Indian state of Jammu and Kashmir with Jammu railway station and hence to the rest of the country. This railway line will connect the state with mainstream of country and will lead to boost in trade, economy and tourism in the state.

The list of railway stations in J&K and Ladakh region can be divided into 3 parts:-

- Railway stations in Jammu region,
- Railway stations in Kashmir region
- Railway stations in Ladakh Region

A detail Railway network in the state is shown as below in the map.

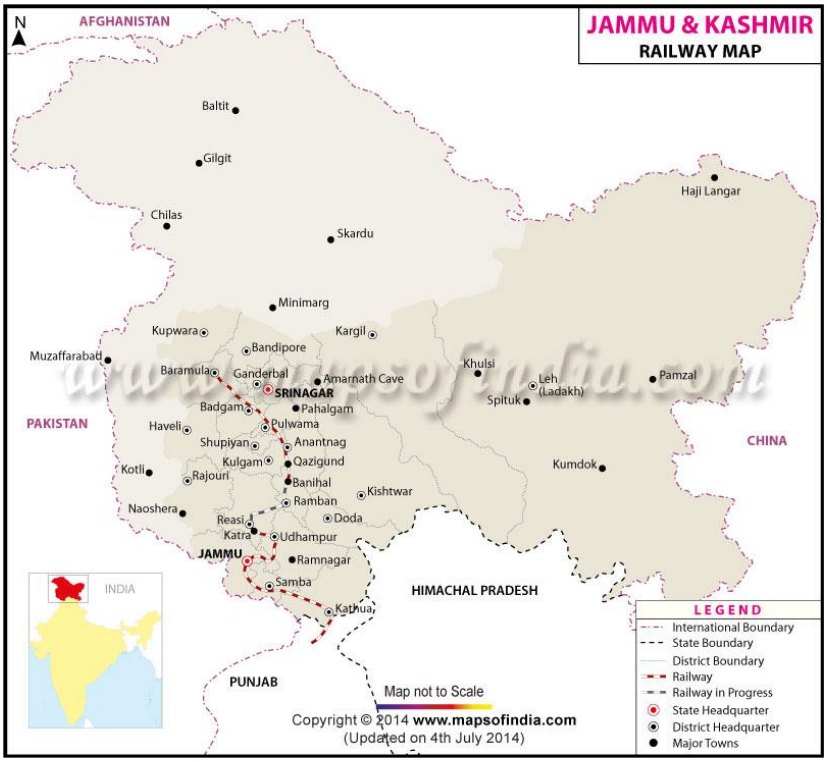


Fig 2.9: Jammu and Kashmir Rail Map

2.6 Economic Perspective

The future traffic growth will thus depend on the future economic development in the newly formed Union Territory. The economic perspective for the state is based on the past performance of the economy and the economic growth.

2.6.1 Past Performance

The data available is the combined data of J&K and Ladakh Region hence same is illustrated below. The details of **GSDP** are given in Table below.

Table 2.12: Gross State Domestic Product (GSDP) Estimates (Revised) by Economic Activity at Constant (2004-05) Prices

(Unit Rs. in Lakhs)

Sr. No	Sector	2011-12 (Q)	2012-13 (Q)	2013-14 (A)
1	Agriculture including Livestock	743878	745110	756742
2	Forestry and Logging	130261	130059	131083
3	Fishing	18071	18160	18347
(A)	**Agriculture & Allied (1+2+3)**	**892209**	**893330**	**906171**
4	Mining and Quarrying	10446	44768	313638
(a)	**Sub-total Primary (A+4)**	**902655**	**938098**	**50300**
5	Manufacturing	290872	305100	956471
5.1	Manufacturing (Registered)	134062	138905	313638
5.2	Manufacturing (Un-registered)	163740	166195	142740
6	Construction	476989	489583	170898
7	Electricity, Gas, Water Supply	185792	188497	508922
(b)	**Sub-total Secondary (5-7)**	**690583**	**983180**	**194022**
(B)	**Industry (b+4)**	**971029**	**1027949**	**1016582**
8	Transport, Storage & Communication	326981	349799	233485
9	Trade, Hotels & Restaurants	290376	299924	379532
10	Banking & Insurance	232571	256991	286321
11	Real Estates, Ownership of Dwelling, Legal & Business Services	228437	238825	249603
12	Public Administration	684436	747025	823423
13	Other Services	519803	554075	594528
(C)	**Sub-total Tertiary (Services Sector) (8-13)**	**2200827**	**2366546**	**2566892**
	Total GSDP (a + b + c)	**4064065**	**4287825**	**4539945**
	Population in Lakhs	118.06	119.52	120.96
	Per Capita GSDP (Rs.)	**34424**	**35875**	**37533**
	Growth Rate	**6.19**	**5.51**	**5.88**

Table 2.13: Net State Domestic Product (NSDP) and Per Capita Income

Sr. No	Year	NSDP (Rs. in Crore)		Per capital income (Rs.)	
		At Current Prices	At Constant (1980-81) Prices	At Current Prices	At Constant (1980-81) Prices
1	1980-81	1049.50	1049.50	1776	1776
2	1985-86	1929.23	1229.84	2874	1832
3	1986-87	2134.01	1245.82	3108	1809
4	1987-88	2086.26	1109.63	2954	1571
5	1988-89	2547.67	1257.47	3517	1736
6	1989-90	2688.38	1285.35	3618	1730
7	1990-91	2908.26	1359.89	3816	1784
8	1991-92	3249.87	1390.48	4157	1779
9	1992-93	3564.56	1452.27	4457	1816
10	1993-94	5500.20	5500.20	6543	6543
11	1994-95	6001.44	5744.99	6915	6619
12	1995-96	6973.05	6031.48	7783	6732
13	1996-97	7850.89	6320.65	8667	6978
14	1997-98	8857.86	6652.24	9491	7128
15	1998-99	11128.21	7005.33	11591	7296
16	1999-00	13532.97	13532.97	13816	13816
17	2000-01	14328.40	13917.48	14268	13859
18	2001-02	15456.42	14184.90	15019	13784
19	2002-03	17399.87	14907.16	16739	14341
20	2004-05	23292.21	23292.21	21734	21734
21	2005-06	25278.10	24371.09	23240	22406
22	2006-07	27652.09	25794.32	25059	23375
23	2007-08	30720.05	27387.31	27448	24470
24	2008-09	34290.32	29102.03	30212	25641
25	2009-10	38718.20	30513.15	33650	26519
26	2010-11	4674012	3225589	40089	27666
27	2011-12 (Q)	5336075	3431596	45198	29067
28	2012-13 (Q)	6154429	3625604	51493	30335
29	2013-14 (A)	7087432	3843266	58593	31773

(Data Source: Digest of Statistics, 2012-13)

Chapter 3

Traffic Surveys and Analysis

3.0 TRAFFIC SURVEYS AND ANALYSIS

3.1 General

Traffic surveys, analysis and demand forecast are an important element of any feasibility /detailed project report preparation. Traffic analysis and demand forecasting are directly related to several important aspects of project road planning and design i.e. capacity augmentation proposals, geometric design features, planning and design of toll plaza, pavement design, economic and financial analysis etc. Towards this the consultant has undertaken detailed traffic surveys, analysis, forecasting and carry out laning requirements. Various steps followed in this regard are described in the subsequent paragraphs.

3.2 Objectives

- To carry out traffic surveys and estimation of base year traffic demand
- Identification of travel pattern and influence area of project road
- Traffic demand forecasting up to project life
- Assess capacity requirement of project road, to estimate tollable traffic & to identify toll plaza locations.

3.3 Project Road

The project road deals with the section of Vailoo-Khanabal from Ex. Chainage 235.000 to 269.000 of NH-244. The total existing length of the project road is 34.0 Km. The consultants have proposed road stretch from Vailoo to Donipawa with design chainage Km 148.589 to Km 176.532 having total design length of 27.943 km. The project road Vailoo – Khanabal has a very significant role since it starts near the point where the Vailoo Tunnel project ends. Thus, the project road of Vailoo – Donipawa is expected to carry the traffic movement of the Vailoo tunnel side directly towards Khanabal and Ashajipora side via Donipawa-Ashajipora Bypass and eventually to Anantnag side and transferring this traffic load eventually to NH-44 (NH-1A) at Khanabal.

The Project Road falls entirely in the Anantnag district in the newly formed

Union Territory of Jammu & Kashmir and traverses through many built-up areas and agricultural lands. The Project Road starts from Existing Km 235.000 in Vailoo Village and passes through Gad Wali, Wandevalgam, Zalangam, Bindoo, Bidder, Hangalgund, Dan Veth Pora, Sagam, Takia Ahamad Shah, Buchoo, Peertakia, Hiller, Hillar Arhama, Akingam, Badoora, Achabal, Koleh Garh, Thajiwara, Brakpora, Donipawa, Chitti Singh Pora, Sheerpora, Janglat Mandi, Lal Chowk, Bangidhar, Mehman Muhalla, Nai Basti and terminates at Khanbal at Existing Km. 269.000. The total Length of the existing road is 34.0 Km. The location of the Project Road has been shown in the **Fig. 3.1 – Project Route.**

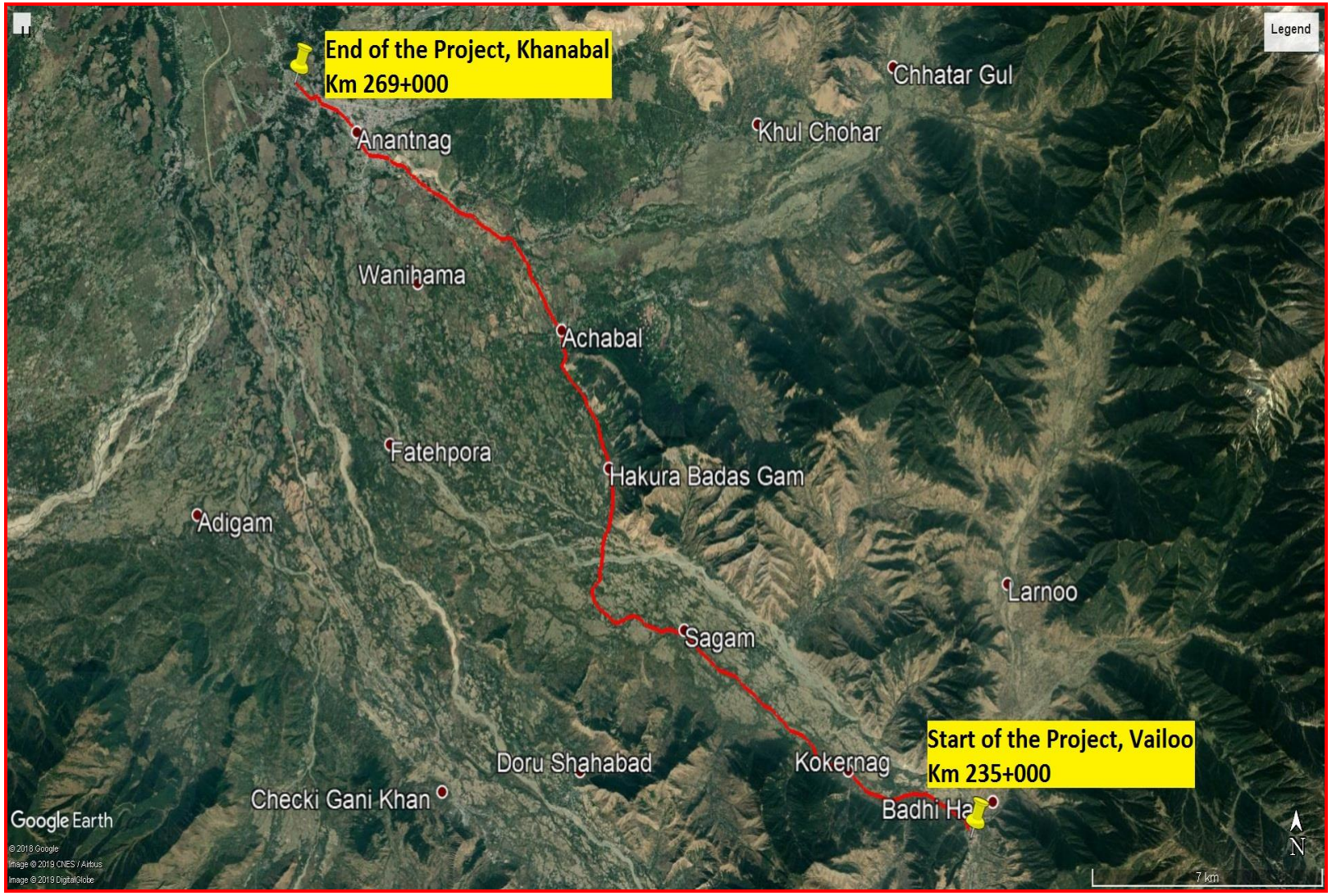


Figure 3.1 Project Road Transport Route Network

3.4 Traffic Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic generators and diversion locations along the project corridor. The passenger traffic has been observed to vary with respect to the influence of village/towns falling along the project corridor. The major traffic generators settlements and its connections (diversion) points are:

- Vailoo to Khanabal

Traffic surveys locations were selected to capture representative traffic volume on the homogeneous sections with a view to capture section wise traffic flow characteristics, the total stretch has been segmented in to one homogeneous sections, based upon the major intersections that act as main collectors or distributors (diversion) of traffic along the project road. The traffic homogeneous section in the road section is as follows:

Table 3.1: Traffic Homogenous Section

Sr. No.	Homogeneous Section	Existing Chainage	
		From (Km)	To (km)
1	Vailoo – Khanabal	235+000	269+000

Traffic Survey Planning and Selection of Survey Location

A comprehensive traffic survey plan has been prepared for the project road after considering traffic intensity on homogeneous sections and travel characteristics. Detailed site visit of project road and its influence/alternative transport network has been carried out between on 10th July 2019 to 24th July 2019. Traffic survey locations were finalised by consultation with client officials. Reasoning with detailed justification for selection of each traffic survey location is given in **Table 3.2**

Table 3.2: Traffic Survey Locations Justification/Rational

Sr. No.	Existing Chainage	Justification/Rational
Classified Volume Count Surveys (CVC) & Origin and Destination		
1	Km 263.550, Brakpora (near Donipawa)	Km (263+550) has been selected to get the idea of traffic in homogeneous section from Achabal to Khanabal

Sr. No.	Existing Chainage	Justification/Rational
Traffic Movement Count		
1	Km 268.000	Junction at New Basti

3.5 Traffic Surveys Schedule

It is very important, that the existing information on traffic flow, commodity movement and traffic pattern is required to assess the traffic behaviour on a project road. To collect such information to satisfy the Terms of Reference (TOR) and project requirements, following various types of traffic surveys were carried out:

1) Classified Volume Count (CVC) Survey

2) Axle Load Spectrum Survey

3) Origin – Destination and Commodity Movement Surveys

4) Intersection Volume Count Survey

5) Speed and Delay surveys

Traffic survey locations were selected after detailed reconnaissance survey and in line with the TOR. All the traffic surveys were carried out as per the IRC guidelines given in IRC: SP 19-2001, IRC 37:2018, IRC: 108-2015, IRC SP: 41-1994, IRC: 102-1988, IRC 103- 2012 and IRC: 09-1972 etc.

All the above surveys were carried out manually by employing sufficient number of trained enumerators recording information in the pre-designed formats. The enumerators were selected from locally available educated people familiar with traffic characteristics and condition of the project road. They were properly briefed and trained about the survey work before putting them on actual survey work in field. An experienced supervisor was kept in-charge for all the locations.

The locations for the various surveys were so selected that all vehicles can be viewed and interpreted easily without endangering the safety of enumerators and drivers.

The most important part of all traffic survey was to exercise adequate quality control. The quality assurance was achieved through:

- Proper briefing and demonstration to enumerators before the start of work;
- Continuous independent checking by Traffic engineers / supervisor in the field during the survey work;
- Checking of filled in survey formats by Traffic engineer; and
- Validation of computer data entry with raw surveyed data

The survey data were recorded in the pre-designated approved formats for each type of survey. All the above traffic surveys were carried out as per the schedule finalised after considering requirements of TOR and project requirements as presented below.

Table 3.3: Traffic Survey Schedule

Type of Survey	Location	Survey Date		Duration
		From	To	
Classified Traffic Volume Count Survey	Km 263+550	10-07-2019	17-07-2019	7 days (24 Hrs)
Turning Movement Survey	Km 268+000	24-07-2019		12 Hrs
O-D Survey	Km 263+550	10-07-2019		24 Hrs
Speed & Delay Surveys	Entire project road			
Axle load survey	Km 263+550	10-07-2019		24 Hrs

3.6 Traffic Surveys Methodology

3.6.1 Classified Volume Count Survey

The objective of classified traffic volume count survey is to estimate traffic intensity on the project road. The classified volume count surveys at one strategic location has been carried out for 7 days, @ 24 hours/day. The traffic is counted in number of vehicles by vehicle category-wise in each direction in a 60-minutes interval over 24 hrs a day for 7 days. The counts were recorded in the approved formats as per IRC specifications.

3.6.2 Axle Load Spectrum Survey

Axle load survey is carried out to estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles. The data collected from the Axle Load Survey is further used to calculate MSA for the design of pavement.

3.6.3 Origin-Destination and Commodity Movement Survey

In a transportation study, it is necessary to estimate the number of trips with respect to origin and destination. These calculations help in studying travel trends of passenger and commercial vehicles. The trend pattern determines the basis for adopting techniques for estimating traffic growth projections. O-D survey was carried out at one location to get travel and loading patterns.

The Origin-Destination survey was carried out to study the travel pattern of goods and passenger traffic along the project road. O-D surveys shall help calculate future diverted traffic on project roads once a better transportation facility is made available. The location of origin and destination zones has been determined in relation to each individual station and the possibility of traffic diversion to the project road from/to other routes including bypasses.

Roadside Interview Method was adopted for conducting the survey. A sample proportion of vehicles were interviewed from the total traffic. Randomly picked vehicles were stopped and interviewed. Designated trained enumerators interviewed the drivers. Variable sampling flow requires a classified hourly count of all vehicles that pass in the direction being studied while interview is in progress. A volume count survey was carried out simultaneously to get the number of vehicles passing in both the directions. The O-D survey was limited to cars/Jeeps, bus, LCV, and 2 axles / 3 axles, Multi Axle. The following information on travel was collected during the O-D and commodity movement surveys

- Origin and destination of trips;
- Trip Purpose
- Travel Route
- Trip length;
- Vehicle Occupancy;
- Type of commodity and loading in case of the goods vehicles; and
- Frequency of trips etc.

Appropriate zoning system was adopted, and coding was done for zones and type of vehicle & commodity being carried.

3.6.4 Intersection Volume Count Survey

The objective of turning movement count survey is to estimate the traffic contribution and diversion to and from the project road. The Intersection Turning Movement count was carried out with primary objective for identifying the type of control measures required for the junction improvement. Intersection Volume Count Survey has been carried out at one major intersection in Nai Basti along the project road. Each turning movement at the intersection was recorded by deploying sufficient trained enumerators on each arm traffic intensity.

3.6.5 Speed and Delay Survey

The purpose of the travel time and delay study is to evaluate the quality of traffic movement along a route and to determine the locations, types and extents of traffic delays. The efficiency of flow is measured by travel and running speeds. In the actual study, total travel and running times are observed and then converted into speed measures.

Before starting the test runs, major intersections or suitable control points were selected along the study route as reference/control locations. The project road was divided into one homogenous sections based on the traffic characteristics and pavement condition of the corridor. Time readings are taken at these locations to permit the development of travel speeds by sections along the travelled route.

A test vehicle is driven along the study route in accordance with moving car technique, in which, a safe level of vehicular operation is maintained by observing proper following and passing distances and by changing speed at reasonable rates of acceleration and decelerations. Delay information is recorded when the traffic flow is stopped or greatly impeded. The duration of traffic delay is measured in units of time along with notations of the corresponding location, cause and frequency of delay to travel. Following information was collected during the survey:

- Number of vehicles in the opposite direction of test car.
- Number of vehicles overtaken by the test car.
- Number of vehicles overtaking the test car.
- Amount of delay occurred; and
- Reasons for the delay etc.

3.7 Analysis of Traffic Surveys - Base Year Traffic Estimation

3.7.1 General

The base year traffic pattern is the primary input for checking existing level of service and determination of future traffic demand of project influence area. The consultant has conducted Classified Volume Count Surveys, Intersection Volume Count, O-D and commodity, Axle load and speed & delay surveys to examine the base year traffic intensity, travel characteristics, loading patterns and travel speed on project road. For traffic estimation and projection, the year 2019 has been taken as base year.

The following section provides detailed traffic analysis and important observations about traffic pattern along the project corridor. The data collected during traffic surveys were entered into the computer for further analysis and to obtain information about traffic characteristics and travel pattern along the project road. The results of the analysis can be further used for designing the pavement crust, road cross-section, planning and way side amenities, and for economic and financial analysis. The traffic analysis was carried out as per the guidelines given in IRC: SP 19-2001, IRC: 108-2015, IRC: 64-1990, IRC SP: 41-1994.

3.7.2 Classification of Vehicles and PCU Values

To convert recorded vehicles into a common scale, the Passenger Car Units (PCU) equivalent factor as per IRC: 64-1990 has been adopted. The PCU equivalent factors adopted are as given in **Table 3.4.**

Table 3.4: Classification of Vehicles Recommended PCU Equivalents Factors

Sr. No.	Vehicle Type	PCU Value
Fast Moving Vehicles		
1	Cars/Utility Vehicles/Jeeps/Vans & 3 Wheelers	1.0
2	2 Wheelers	0.5
3	LCV Passenger/LCV Goods/Minibus	1.5
4	Standard Bus	3.0
5	Two and 3 Axle Truck	3.0
6	Multi Axle Truck/Heavy Construction Machinery/Trailer	4.5
7	Agricultural Tractor (with Trailer)	4.5
8	Agricultural Tractor (without Trailer)	1.5
Slow Moving Vehicles		
1	Bicycle	0.5
2	Cycle Rickshaw	2.0
3	Animal Drawn Vehicle (Bullock cart)	8.0
4	Animal Drawn Vehicle (Horse drive)	4.0
5	Hand cart	3.0

3.8 Analysis of Classified Volume Count Survey

3.8.1 Average Daily Traffic (ADT)

7-Day, 24 hrs Continuous volume counts were undertaken to obtain a realistic picture of the current volume and composition of the traffic. The analysis of traffic counts provided an estimate of the Average Daily Traffic (ADT) and the analysis has been carried out in terms of total number of vehicles as well as in respect to Passenger Car Unit (PCU). Location wise results of traffic analysis are discussed below:

a) At Brakpora (Near Donipawa) Km 263+550

Classified Volume count survey was carried out at Km 263+550 at Brakpora near Donipawa.

Total ADT at this station were recorded as 8599 in terms of number and 8856 in terms of PCU. Fast moving vehicles were recorded as 99% of the total traffic (in No.). Peak hour traffic flow of 1020 nos. formed around 11% of the total traffic. Peak hour is identified during 17:00-18:00 hours. The directional distribution for all vehicles observed is 48 percent flow towards up direction and 52 percent towards down direction.

Summary of classified traffic volume count survey results is shown in **Table 3.5.**

Table 3.5: Summary of Classified Volume Count Survey at all count stations

Sr. No.	Location	Fast Moving AADT Vehicles (PCU)	Slow Moving AADT Vehicles (PCU)	Total AADT (PCU)	ADT (PCU)	Directional Distribution (%)		Peak Traffic (vol)	Peak Hour	Peak Traffic (%)
						Up	Down			
1	At Brakpora, (Km 263.550)	7988	71	8059	8856	52.11	47.88	1020	17:00-18:00	11.20

Location wise Average daily traffic (ADT) and Annual Average Daily Traffic is shown in **Annexure 3.1 and 3.2** respectively**.** Survey has been carried out for seven days 24 hours continuously; the traffic flow on all the days in the week will not be same. There will be variation of traffic for each day. The average vehicles per hour is presented graphically in **Figure 3.2 and Figure 3.3.**

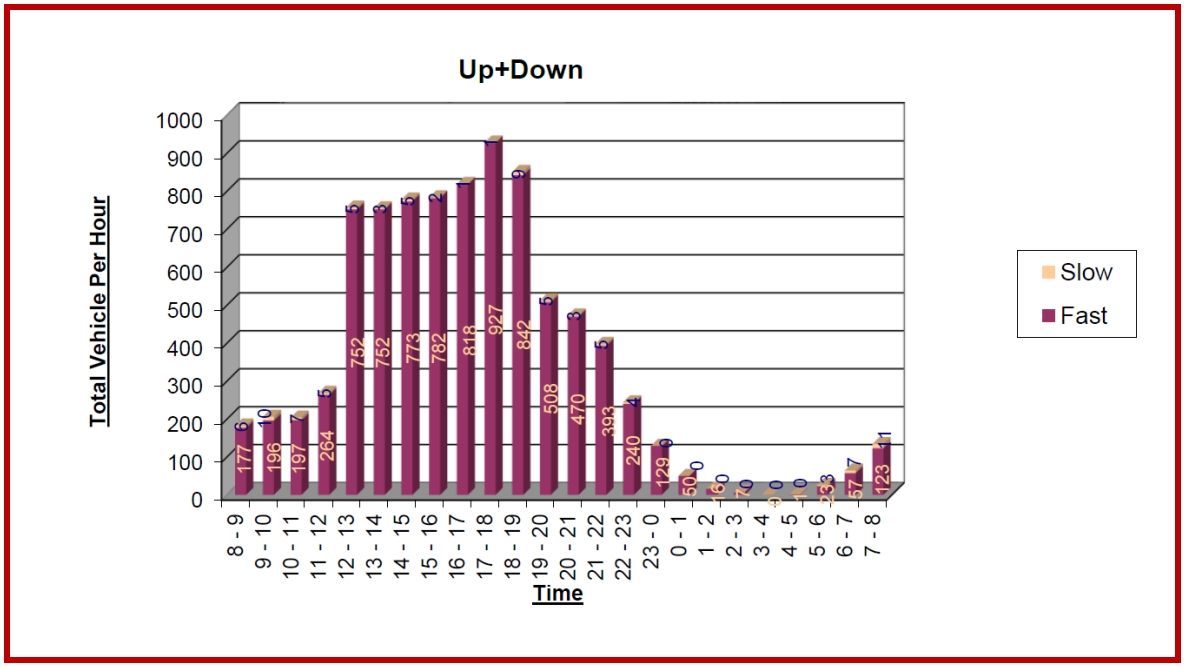


Figure 3.2: Daily Variation of Total traffic at Brakpora

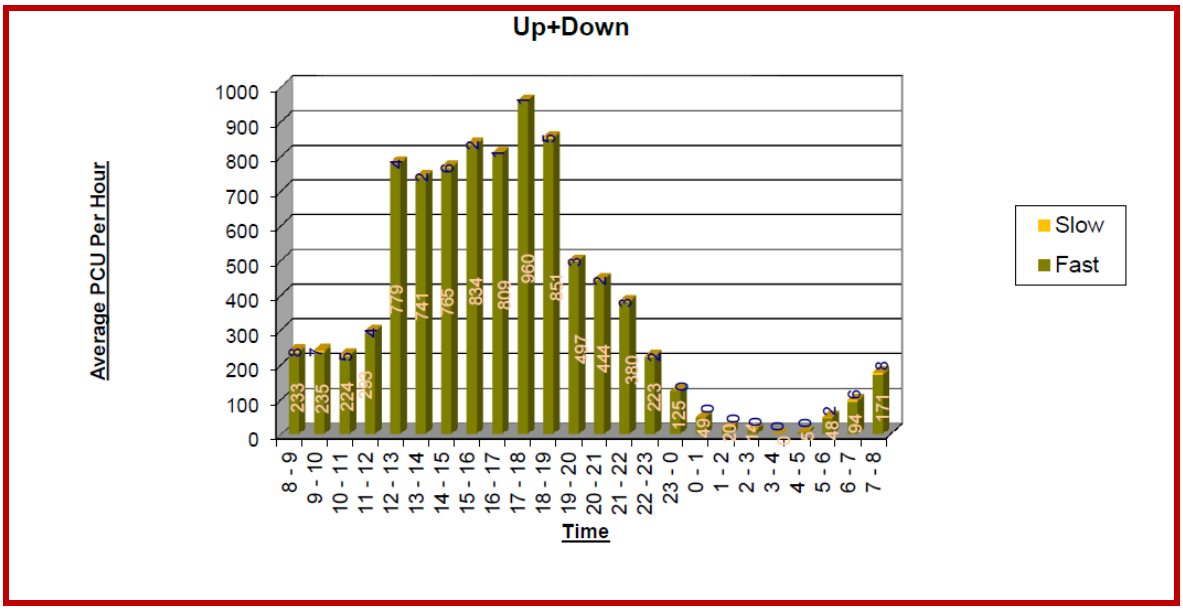


Figure 3.3: Hourly Variation of Traffic at Brakpora

3.8.2 Traffic Composition

The traffic compositions observed in survey locations are presented graphically in **Figure 3.4 and figure 3.5.**

At location Brakpora (Km 263+550) vehicle's compositions by type and percentage of volume are 2-wheelers (27.08%), Auto Rickshaw (5.43%), Car/Jeep/Van (55.24%), Mini Bus (0.17%), Bus (1.63%), LCV (4.28 %), 2-Axle Truck (4.24 %), Multi Axle (0.06%) and Agriculture Tractor (0.53%).

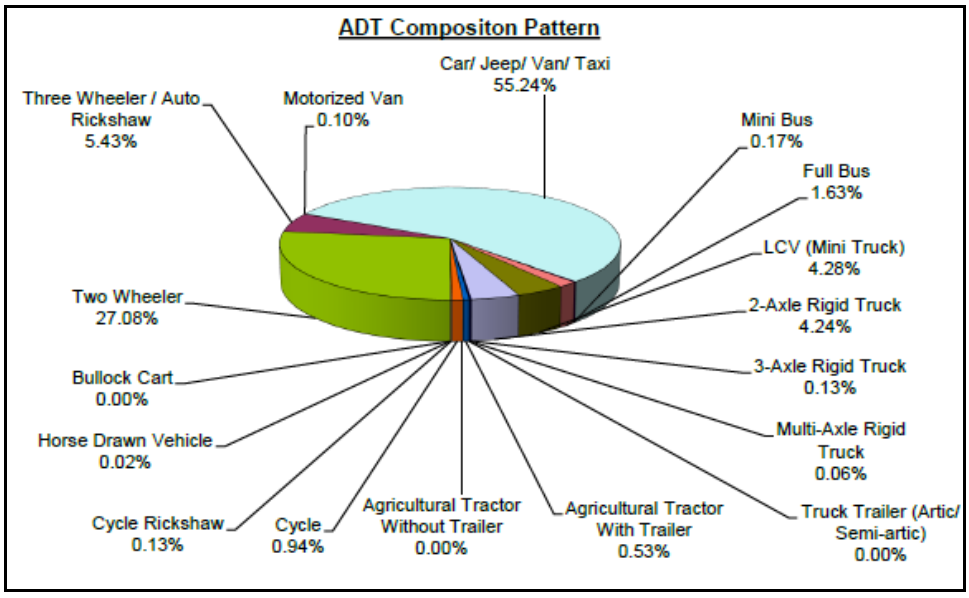


Figure 3.4: Composition of Traffic by Volume at Brakpora (Km 263+550)

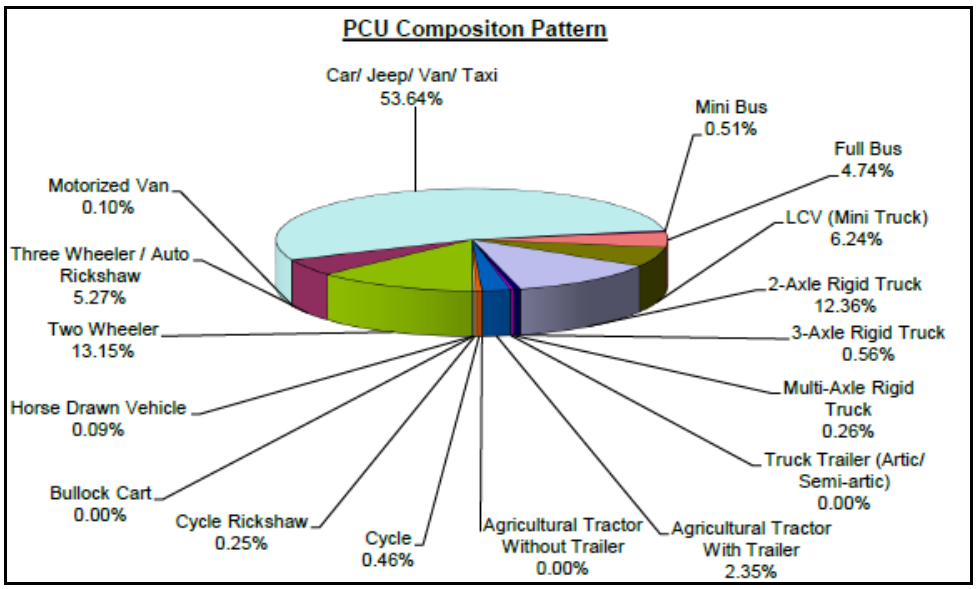


Figure 3.5: Composition of Traffic by PCU at Brakpora (Km 263+000)

3.9 Estimation of Seasonal Correction Factor

Seasonal Correction factors by vehicle types are required to account for variations in the pattern of traffic volume on the project road sections over different seasons of the year. Seasonal correction trends were assessed based on the sale of automobile fuels i.e. petrol and diesel data along the project road.

Seasonal correction factors were worked out to arrive at Annual Average Daily Traffic (AADT). The monthly petrol and diesel sales data were collected from fuel station on the project road. The SCF was calculated separately for petrol and diesel driven vehicles. The calculated SCF based on monthly fuel consumption are presented in the following **Table 3.6.**

Table 3.6: Seasonal Correction Factors (SCF) Based on Fuel Consumption

	Petrol	Diesel
For Whole Section	0.92	0.89

Since traffic volume count surveys were carried out in the month of July 2019, the computed seasonal variation factors of 0.89 for Diesel driven and 0.92 for Petrol driven vehicles have been adopted for estimation of AADT.

3.10 Annual Average Daily Traffic (AADT)

The seasonal correction factors presented above are used to convert Average

Daily Traffic (ADT) to Annual Average Daily Traffic (AADT). Location wise Annual Average daily traffic is shown in Annexure 3.2 and in **Table 3.7** below:

Table 3.7: Annual Average Daily Traffic

Type of Vehicle			ADT (Up+Dn)		Annual Average Daily Traffic (AADT)	
			No.	PCU	No.	PCU
Fast / Motorised Vehicles		Two Wheeler	2329	1165	**2096**	**1049**
		Three Wheeler / Auto Rickshaw	467	467	**430**	**430**
		Motorized Van	9	9	**8**	**8**
		Car/ Jeep/ Van/ Taxi	4750	4750	**4370**	**4370**
	Bus	Mini	15	45	**13**	**40**
	Bus	Full	140	420	**125**	**374**
		LCV (Mini Truck)	368	553	**328**	**492**
	Truck	2-Axle Rigid Truck	365	1095	**325**	**975**
	Truck	3-Axle Rigid Truck	11	50	**10**	**45**
	Truck	Multi-Axle Rigid Truck	5	23	**4**	**20**
	Truck	Truck Trailer (Artic/ Semi-artic)	0	0	**0**	**0**
		Tractor With Trailer	46	208	**41**	**185**
		Tractor Without Trailer	0	0	**0**	**0**
Slow / Non-motorisedVehicles		Cycle	81	41	**81**	**41**
		Cycle Rickshaw	11	22	**11**	**22**
		Bullock Cart	0	0	**0**	**0**
		Horse Drawn Vehicle	2	8	**2**	**8**

3.11 Axle Load Survey

To estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles, the axle load surveys have been carried out at Km 263+550 at Brakpora. The data collected from the Axle Load Survey has been compiled and analysed through "Fourth power" pavement damage rule to arrive at the vehicles damage factor (VDF). The survey is analysed to obtain Vehicle Damage Factor (VDF) and is presented below:

Table 3.8: Adopted VDF by Homogeneous Sections

VDF Summary		
Sr. No.	**Vehicle Type**	**VDF**
1	LCV	1.10444
2	2 Axle	2.94281
3	3 Axle	1.82046
4	MAV	4.38954
5	Bus	1.04853
Adopted VDF		**2.2612**

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the year 2023. VDF Details are provided in **Annexure 3.5.**

3.14 Analysis of Origin-Destination (O-D) & Commodity Movement Survey

3.13.1 General

Origin and Destination survey was conducted by roadside interview method at one location at Km 263+550 at Brakpora. This survey has been used to obtain the travel characteristics of goods and passenger vehicles and to determine the through and local traffic.

The purpose of the OD survey is to determine the existing travel pattern of the road user on the corridor & the project influence area. The road users were asked questions to determine their flow path along the project corridor, trip purpose, trip length, commodity type. Axle load survey was also carried along with the OD survey to analyse the loading pattern and Vehicle Damage Factor, VDF.

The survey has been carried out by deploying a group of enumerators under the supervision of engineers. The questionnaire prepared for the O-D survey was filled up by the enumerators by stopping the vehicles and interviewing the road users. Resentment to answer the questions was observed at both the locations.

3.13.2 Zoning System

To analyse O-D Data the entire study corridor has been divided into local traffic zones and rest of the locations had been divided into external zones.

The number of trips originating from and destined to any zone represents the influence of that zone in traffic generation/attraction. Based on the study of collected O-D data, project corridor was divided into 10 zones. Table below represents O-D Zoning system used for the analysis. **Table 3.10 and Table 3.11** represents the zone influence factor for the goods and passengers.

Table 3.9: Traffic Area Zoning System

Zone Code	Zone Name
1	Achabal
2	Anantnag
3	Vailoo
4	Kokernag
5	Rest of Anantnag District
6	Srinagar
7	Pulwama District
8	Ganderbal District
9	Kishtwar District
10	Rest of J&K State

Table 3.10 : Zone Influence Factor for Goods Vehicles

Zone Code	Name of Zone	Trip Production	Trip Attraction	ZIF (%)
1	Achabal	51	31	**21.8**
2	Anantnag	57	33	**23.9**
3	Vailoo	18	29	**12.5**
4	Kokernag	13	6	**5.1**
5	Rest of Anantnag District	35	56	**24.2**
6	Srinagar	8	6	**3.7**
7	Pulwama District	4	8	**3.2**
8	Ganderbal District	0	2	**0.5**
9	Kishtwar District	0	17	**4.5**
10	Rest of J&K State	2	0	**0.5**

Table 3.11 : Zone Influence Factor for Passenger Vehicles

Zone Code	Name of Zone	Trip Production	Trip Attraction	ZIF (%)
1	Achabal	294	343	**30.5**
2	Anantnag	245	168	**19.8**
3	Vailoo	126	147	**13.1**
4	Kokernag	84	49	**6.4**
5	Rest of Anantnag District	98	252	**16.8**
6	Srinagar	98	42	**6.7**
7	Pulwama District	49	42	**4.4**
8	Ganderbal District	49	0	**2.3**

Zone Code	Name of Zone	Trip Production	Trip Attraction	ZIF (%)
9	Kishtwar District	0	0	**0.0**
10	Rest of J&K State	0	0	**0.0**

3.13.2.1 Discussion

Internal to internal zones means trips origin and destination within the project corridor and immediate surroundings. Internal to External zones means trips originating from project corridor and destined to beyond the project corridor. External to Internal zones means trips originating from outside the project corridor and destined to within the project corridor, and External to External zones means trips originating and destined form outside the project corridor.

3.13.2.2 Development of Origin-Destination Matrices and travel Characteristics

It is important to analyse the trip characteristics with respect to the project road and its surroundings by development of vehicle category wise trip matrices and desire lines.

After coding of Origin and Destination from the raw data, expansion factors were calculated by comparing sample size of each vehicle type with the traffic classified volume count data of the same day at the same location of O-D Survey. These expansion factors were applied to O-D Data and vehicle wise O-D matrices were developed.

O-D matrices for different vehicle types for each survey station on the project road are presented in **Annexure 3.4.** Based on O-D matrices, travel pattern of the vehicles moving on the project road is discussed below.

3.14 Analysis of Intersection Volume Count Survey

The intersection volume count survey at major intersection have been carried out during identified peak periods for 24 hours. The category-wise traffic is counted for all direction in a 60 - minutes interval. The counts were recorded in the specified survey formats.

The survey data have been analysed to obtain the peak hours with flow of vehicles in each direction. The peak hour traffic flow diagrams are provided in

Annexure 3.3. The summary of peak hour traffic flow through intersections is given in **Table 3.12.**

Table 3.12: Peak Hour Traffic at Intersections

Sr. No	Location	Peak Hour	Traffic (in No.)	Traffic (PCU)
1	Nai Basti	8:00 to 9:00	3159	3323

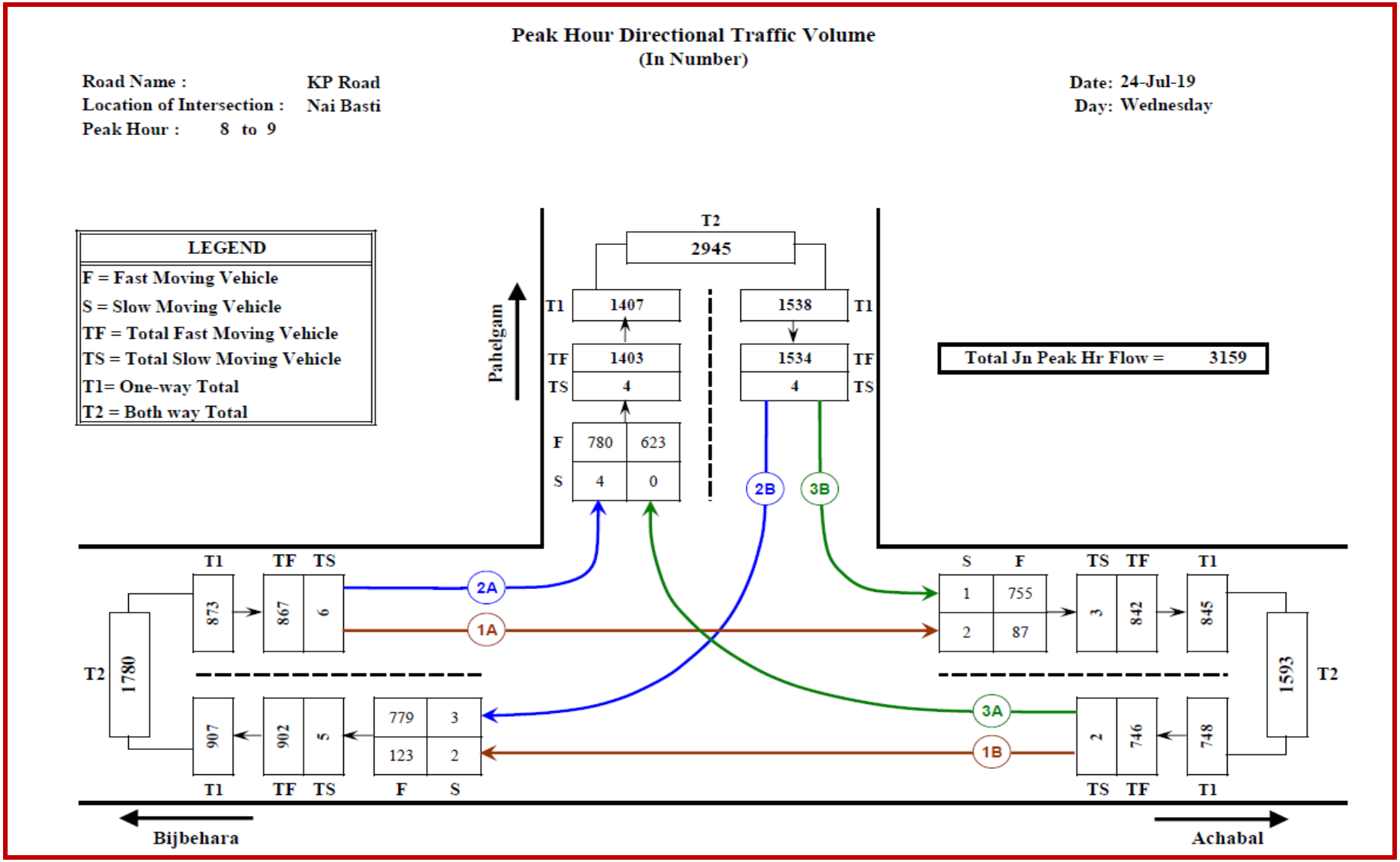


Figure 3.6 (a): Peak Hour Directional Traffic Volume (In Number)

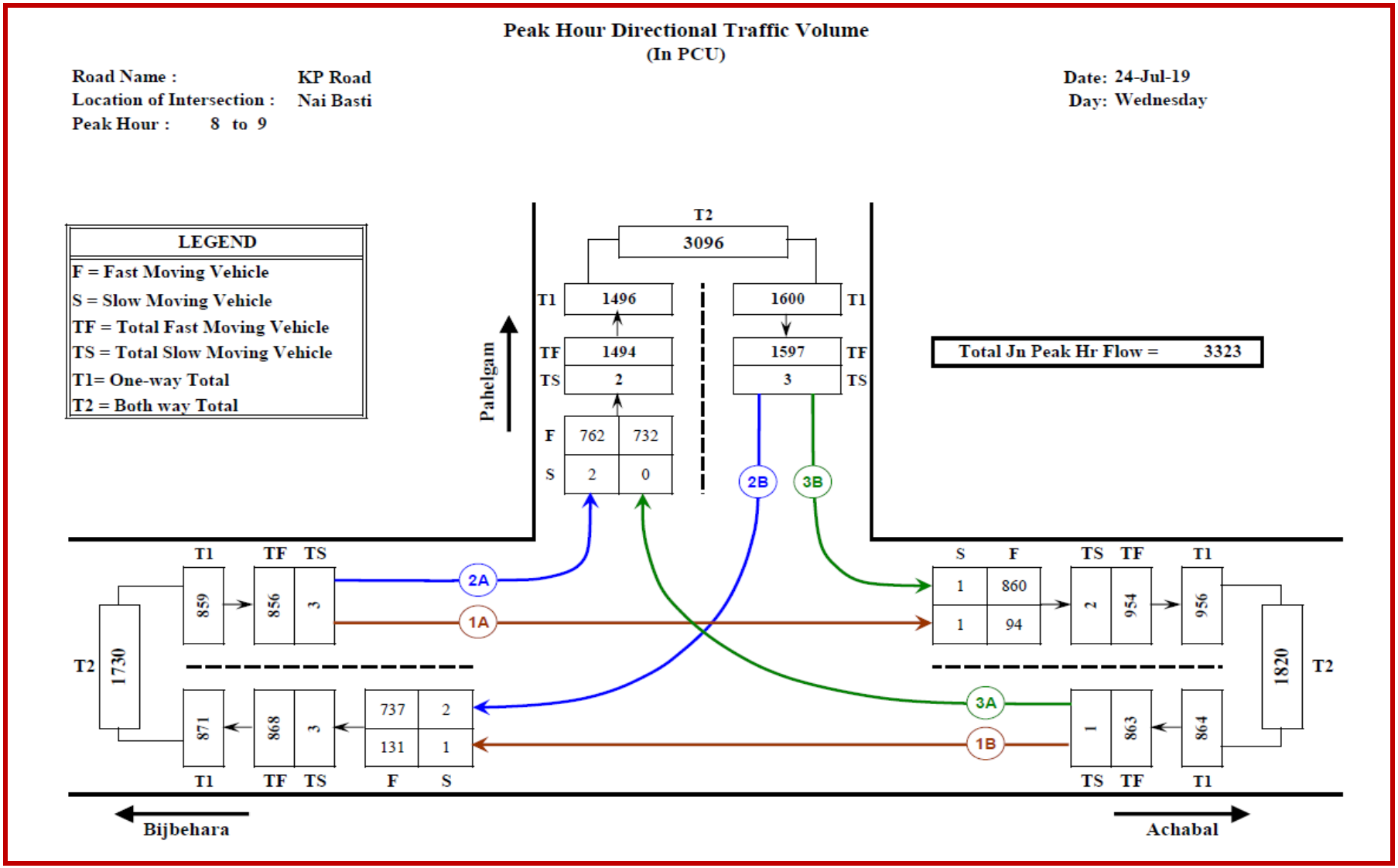


Figure 3.6 (b): Peak Hour Directional Traffic Volume (In PCU)

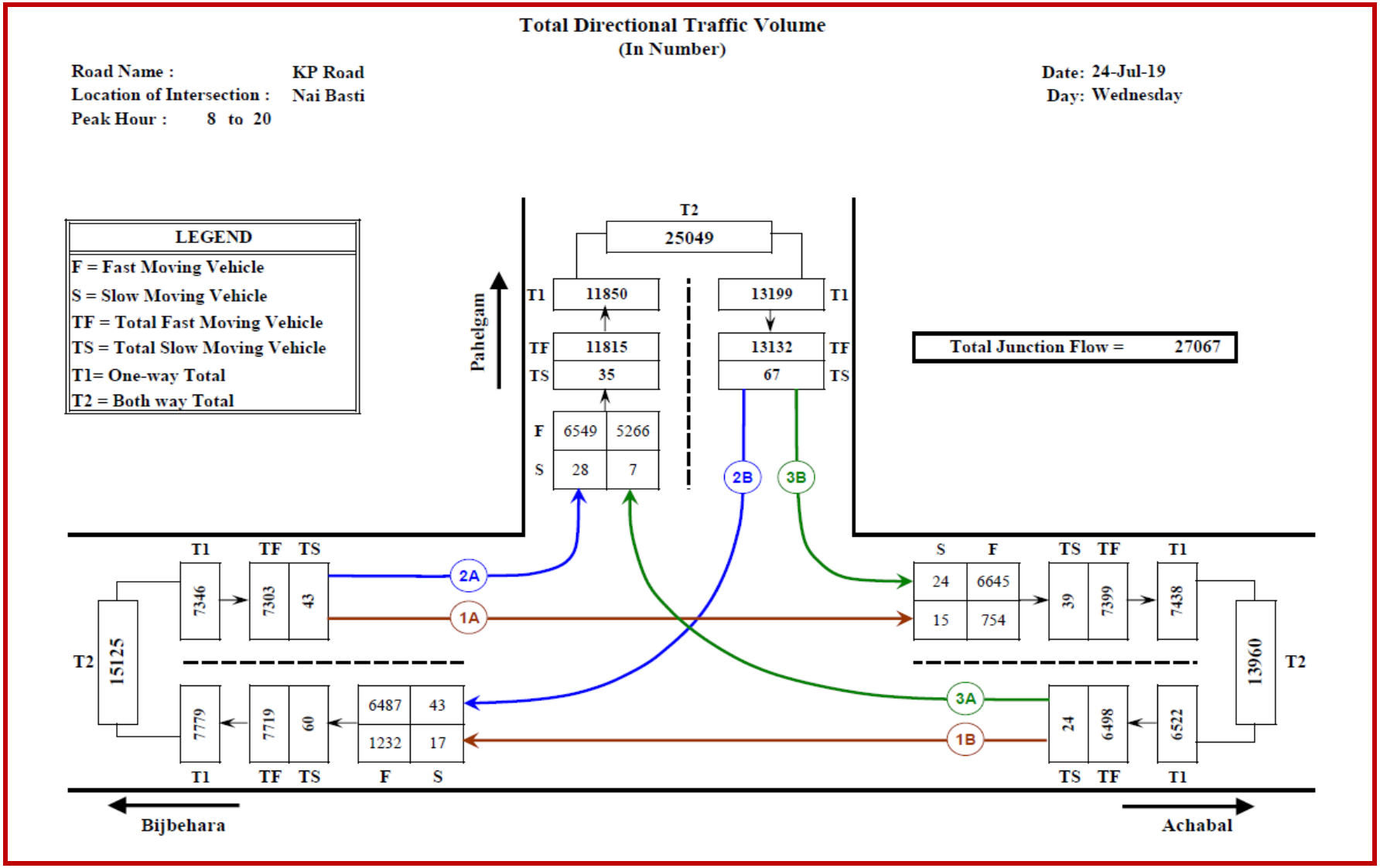


Figure 3.6 (c): Total Directional Traffic Volume (In Number)

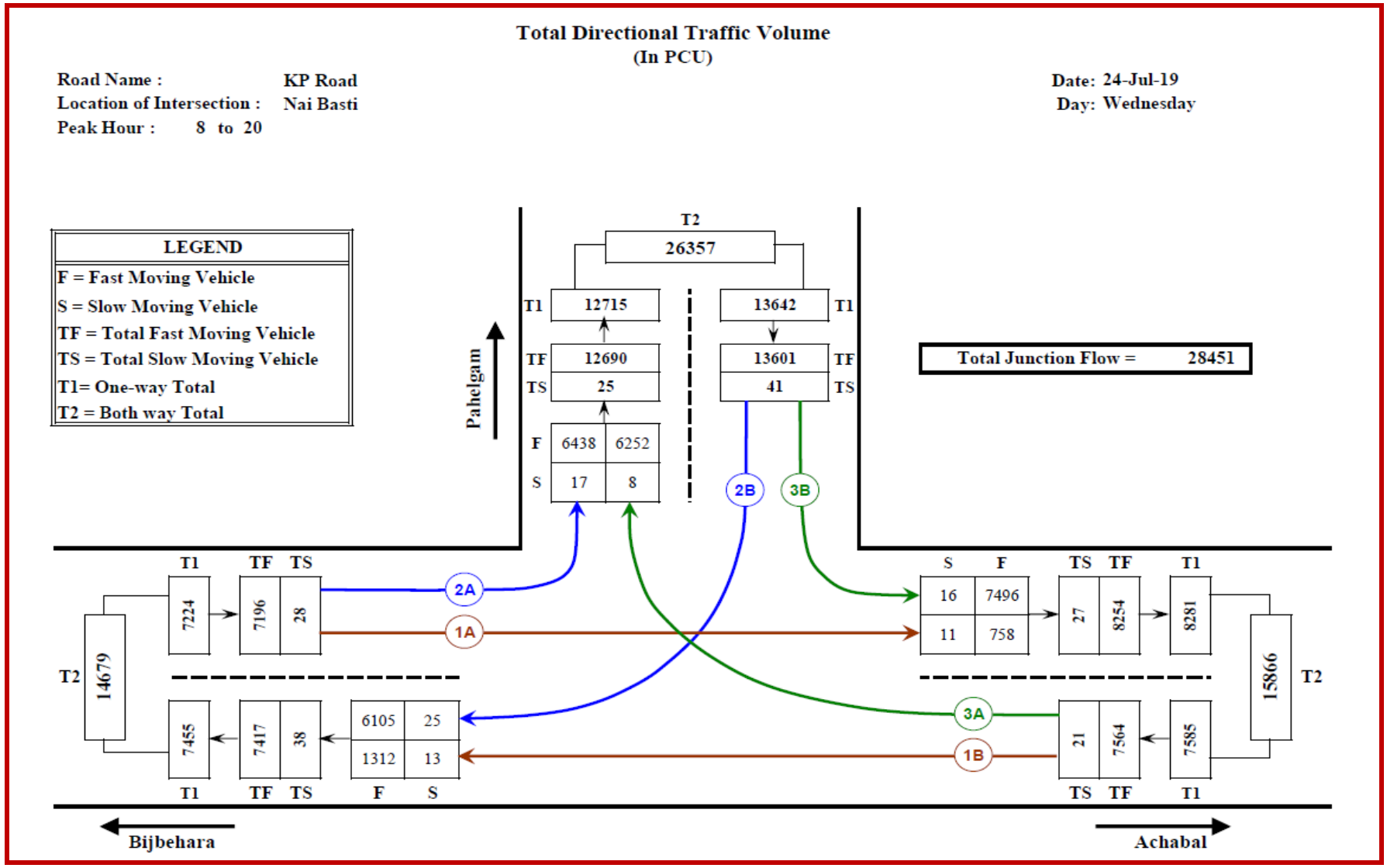


Figure 3.6 (d): Total Directional Traffic Volume (In PCU)

3.16 Analysis of Speed & Delay Survey

The vehicle operation cost and the time taken for a trip will depend mainly upon the journey speed and the type of surface on the road. Hence the journey speed data is needed to estimate the road user cost on the existing road and to compare the same with the road user cost on the improved facility. Speed and delay surveys by Moving car surveys were conducted to find the journey speeds on the existing project.

Round trip was made on entire project road during identified peak period using new technology vehicle. The survey vehicle was kept maintaining the speed of existing traffic flow. Start time, delay occurred, distance covered, and end time were recorded on the specified survey format. The data thus obtained is analysed and presented below **Table 3.13**.

Table 3.13 Summary of Speed-Delay Survey

Sr. No.	Section		Distance (Km)	Average travel Time during off-peak (minutes)	Average speed during off-peak (km/hr)	Travel Time during peak (minutes)	Average speed during peak hours (km/hr)	Delay (minutes)	Reason for delay
	From	To							
1.	Vailoo	Khanabal	34	60	34	80	25.5	20	Delay due to road condition & local traffic

The dominant reason for delay in Vailoo - Khanabal section is vehicular movements during peak hours along the project road. In the built-sup area like Achabal, Anantnag and others, it was observed during speed delay study that traffic was slow due to movement of vehicles. Also, due to absurd geometric condition of existing project road, traffic movement was found to be slower.

Chapter 4

Engineering Survey, Material Investigation & Pavement Design

4.0 ENGINEERING SURVEY, MATERIAL INVESTIGATION & PAVEMENT DESIGN

4.1 General

A sound engineering approach has been developed based on the requirement enumerated in Terms of Reference for conducting the required field surveys. Following data were collected from site and detailed desk study has been carried out to formulate a systematic and meticulous approach towards the present assignment. Following primary field surveys and investigations have been carried out on the project road:

- Inventory
  - *Road*
  - *Bridge and Cross Drainage Structures*
- Condition Surveys
  - *Pavement condition and Roughness survey*
  - *Bridges and Cross Drainage Structures*
- Topographic Survey
  - *Longitudinal alignment*
  - *Cross sections at 50m interval*
  - *Cross section of Bridges & Cross Drainage Structures*
- Pavement Investigations
  - *Trial Pit Investigation*
  - *Sub-grade Investigation*
  - *Axle load Survey*
- Material Survey
  - *Sand Sources*
  - *Source of Aggregates*
  - *Other construction Material like Cement, Bitumen etc.*

4.2 Inventory and Condition Survey of Road and Pavement

The scope of improvement measures and economic justification thereon depend on the condition of the existing road and its associated inventory. To collect the inventory of the existing road and allied features of road and structure, inventory surveys were carried out.

4.2.1 Road Inventory Survey

While conducting Inventory Survey of Road the existing physical features and surrounding condition of the project road was ascertained. The details collected are discussed in **Annexure 4.1.** Road Inventory of this report**.** Some of the salient features of the existing road has been described under following paragraphs.

The information collected, analysed and cross-checked, constitute the core database

for formulating improvement proposals for further validation and finalisation considering results of detailed topographical survey and investigations. The information has been utilised to decide the following:

- Decision on the widening of the carriageway is concentric for through the project road.
- Formulate the best-fit cross section with due consideration to terrain conditions, available land width and roadside features.
- Treatment to be given to congested built-up stretches.
- Number of tress to be affected by road improvement/construction works, the anticipated environmental impacts and extent of rehabilitation and resettlement.
- Provision of wayside amenities.
- Existing utility lines by type, location and extent that would require relocation.

4.2.1.1 Existing Carriageway

Project stretch is generally two-lane Carriageway and in some portion, it encounters four lane having 7.0 – 14.0 m width throughout the project road. The existing road has earthen shoulder of about 1.0 m to 2.0 m on either side of the project road. Median is not present for the major portion of the stretch, however in the end of the road stretch in the city region, median of varying width from 0.5m to 1.5m is found.

Table 4.1: Existing Carriageway Width

Existing Chainage		Road Type	Carriageway width	Earthen Shoulder		Median Width	Roadway Width	Pavement Condition
Start	End			Left	Right			
235+000	245+300	BT	7	1	1	-	9	Good
245+300	246+500	BT	7	2	2	-	11	Good
246+500	248+000	BT	7	1.5	2	-	10.5	Good
248+000	251+200	BT	7	2	2	-	11	Good
251+200	265+500	BT	7	1	1	-	9	Good
265+500	266+200	BT	14	-	-	1.5	15.5	Good
266+200	266+300	BT	14	-	-		14	Good
266+300	267+300	BT	14	-	-	1.5	15.5	Good
267+300	267+600	BT	14	-	-	1.2	15.2	Good
267+600	267+700	BT	14	-	-	-	14	Good
267+700	267+800	BT	14	-	-	-	14	Good
267+800	267+900	BT	14	-	-	1.2	15.2	Good
267+900	268+000	BT	14	-	-	1.2	15.2	Good
268+000	268+100	BT	14	-	-	-	14	Good
268+100	268+200	BT	14	-	-	-	14	Good
268+200	269+000	BT	14	-	-	1.2	15.2	Good

4.2.1.2 Alignment and Geometry

The horizontal alignment of the existing road has stretches with sub-standard

horizontal curves. The horizontal curves for most of the stretches allow a negotiable speed of 40 – 50 km/h but also at some stretches in built up areas such as Achabal, Khanabal, Anantnag etc. where the vehicle speed is as low as 20 – 30 km/h requires geometric improvements

The vertical geometry appears to be substandard at many places resulting in slow down of vehicle movement and inadequate sight distance. This would require improvement of vertical curves

Figure 4.1: Start Point at Vailoo village at junction with proposed Vailoo tunnel road

Figure 4.2: Pavement condition of the project road

4.2.1.3 Terrain and Land Use

Project road passes mainly through rolling terrain, but a very small portion also encounters mountainous terrain. The land-use pattern for the major part of the project road is habitational area.

Figure 4.3 : Built up location Achabal

Figure 4.4 : End point at Khanabal

4.2.1.4 Existing Major Intersections

The existing project stretch starts from Vailoo village at the junction of the road which heads towards proposed Vailoo tunnel and ends at the junction of NH-44 at Khanabal. The project road passes through many minor junctions along the project stretch.

There are 4 major intersections and 25 minor intersections sighted on the road. List of minor and major intersections is given in **Table 4.2(a) and Table 4.2(b)** respectively

below.

In general, no safety arrangements viz. road signs, markings, etc. are provided at many of these intersections. Junction development has been observed only at very few intersections.

Table 4.2 (a): Existing Minor Intersections

Sr. No.	Existing Chainage (Km)	Link		Type
		LHS	RHS	
1	235+060	Halpora		Y
2	237+800	Maagam		Y
3	242+620		Bidder Hayat Pora	Y
4	242+810	Naroo Pora		Y
5	243+490	Naroo Pora		Y
6	243+500		Nagum	Y
7	245+950		Booch	Y
8	246+835	Tangpawa		Y
9	248+260	Lissar Muqam		Y
10	248+800	Lissar Muqam		Y
11	249+125	Ghee Boom		Y
12	250+860	Paragpora		Y
13	251+150	Goripoora		Y
14	251+600		Hillar Arhama	Y
15	254+785	Umar Khar		Y
16	256+170	Achabal Bypass Road		Y
17	259+940	Sandoo		Y
18	262+055		Karewa Kangan Haal	Y
19	262+330	Bul Bul Nowgam		Y
20	262+712		Upper Barakpore	Y
21	264+890			Y
22	265+525	Ashajipora	Sheerpora	+
23	266+040	Danter		Y
24	266+600	Stadium Road	Court Road	+
25	267+731	Naid Khun		Y

Table 4.2(b): Existing Major Intersections

Sr. No.	Chainage	Location	Link	Side
1	235+000	Vailoo village	To proposed Vailoo Tunnel	Left
2	257+200	Achabal	Right – Shangus	+
			Left - Fatehpora	
3	267+825	Anantnag	Pahalgam	Right
4	269+000	Khanabal	Right – Srinagar	X
			Left - Jammu	

4.2.1.5 Embankment and Surface Drainage

The embankment height varies from 0.0 m to 2.0 m. The facilities such as roadside drainage are generally available at built-up locations. According to local inquiries it has been found that the road has no submergence stretches.

4.2.1.6 Existing Railway Crossings/ROB

There is no existing Railway Level crossings in the project road.

4.2.2 Pavement Condition Survey

4.2.2.1 Condition Survey of Pavement

It is the most important data needed for deciding upon the maintenance. The basic measurement of pavement condition is existing distresses. The information required is on the type, severity and amount of distress. The most commonly occurring distress forms are:

Sl. No.	Details	Sl. No.	Details
1	Bleeding	6	Patch deterioration
2	Block cracking	7	Polishing of aggregate
3	Corrugation	8	Ravelling
4	Depressions	9	Rutting
5	Pot-hole		

Pavement condition survey consists of observing and recording the various distresses like cracks, pothole, rutting, ravelling etc. of the existing carriageway, pavement shoulders and embankment. The details collected from pavement condition survey form the basis to decide strategy for adequate strengthening / rehabilitation measure of Existing pavement.

4.2.2.2 Pavement Condition Survey by Visual Inspection

a) General observation

Pavement condition of the Project stretch can be summarized as given below. The detail is given in **Annexure 4.2.**

Table 4.3: Percentage wise distribution of Good Fair and Poor Road

Sr. No.	Condition	Length (Km)	% Condition
1	Good	12	35.29
2	Fair	22	64.70

According to Maintenance Manual of Primary, Secondary and Urban Roads, Published by MoRT&H, pavement condition data can be analysed in terms of Good, Fair and Poor with the following criteria.

Table 4.4: Criteria wise distribution of Good Fair and Poor Road

Defects	Range of Distress, Percent				
Cracking (%)	> 30%	21 to 30	11 to 20	5 to 10	<5
Ravelling (%)	>30%	11 to 30	6 to 10	1 to 5	0
Potholes (%)	>1%	0.6 to 1.0	0.1 to 0.5	0.10%	0
Shoving (%)	>1%	0.6 to 1.0	0.1 to 0.5	0.10%	0
Patch (%)	>30%	16 to 30	6 to 15	2 to 5	<2
Settlement & deprn. (%)	>5%	3 to 5	Up to 2	Up to 1	<0
Rutting (mm)	>50	21 to 50	11 to 20	5 to 10	<5
Rating scale	1	2	3	4	5
Condition Description	V. poor	Poor	Fair	Good	V.good

4.3 Topographic Survey

Topographical surveys have been carried out as per IRC: SP 19-2001, "Manual for Survey, Investigation and Preparation of Road Project" and as per TOR, for the preparation of alignment plans, strip plans, longitudinal sections, cross sections and other details like drainage works, earth retaining structures, control points and reference pillars required in view of consideration of vertical and horizontal alignments. The DGPS and TBM points are enclosed as **Annexure 4.10.**

Table 4.5 (a): DGPS Points

Sr. No.	Station	Offset	Easting	Northing	Elevation	DGPS Point Name
1	0+000	0	511642.397	3733850.119	1597.451	GPS1APL
2	0+069.765	5.405	511747.08	3733739.06	1597.441	GPS1PL
3	2+162.578	6.047	513418.882	3732725.115	1599.659	GPS2PL
4	2+299.154	50.6872	513461.38	3732599.04	1598.254	GPS2APL
5	4+077.554	-5.941	514777.15	3731674.905	1608.279	GPS2APL
6	4+155.382	3.654	514833.173	3731617.387	1609.425	GPS2CPL
7	5+807.314	7.372	516175.714	3730776.519	1613.855	GPS3APL
8	5+873.105	4.377	516231.862	3730738.423	1614.114	GPS3PL
9	8+779.669	-5.656	518761.493	3729510.317	1634.702	GPS4PL
10	8+930.307	-5.165	518854.313	3729389.241	1634.483	GPS4APL
11	12+403.689	-7.768	520484.495	3726453.034	1675.785	GPS5PL
12	12+521.772	-6.259	520487.639	3726333.142	1679.578	GPS5APL
13	15+275.766	-5.942	521665.863	3724045.111	1720.727	GPS6PL
14	15+416.713	-5.52	521716.813	3723915.526	1725.102	GPS6APL
15	18+219.476	-14.113	521689.233	3721215.839	1754.711	GPS7PL
16	18+395.410	-5.278	521672.854	3721040.201	1758.864	GPS7APL
17	21+528.342	-6.103	522972.326	3719354.325	1797.841	GPS8PL
18	21+651.575	5.252	523052.868	3719259.519	1800.985	GPS8APL
19	24+458.228	6.139	525379.302	3718061.225	1843.795	GPS9PL
20	24+621.875	-4.771	525540.22	3718030.582	1848.186	GPS9APL

Sr. No.	Station	Offset	Easting	Northing	Elevation	DGPS Point Name
21	27+550.248	-10.24	527898.739	3716421.38	1921.059	GPS10PL
22	27+792.720	-6.357	528116.21	3716312.382	1930.963	GPS10APL
23	30+566.592	-5.662	530316.362	3714830.646	1979.208	GPS11PL
24	30+702.460	-5.835	530446.51	3714790.542	1981.098	GPS11APL
25	33+797.121	-8.21	533239.922	3714044.6	2021.486	GPS12APL
26	33+887.7381	11.9248	533235.115	3713945.381	2018.701	GPS12PL

Table 4.5 (b): TBM List

Sr. No.	Station	Offset	Easting	Northing	Elevation	Description
1	6+119.332	-8.251	516464.246	3730656.975	1611.417	TBM1
2	6+355.157	7.416	516666.19	3730534.875	1612.968	TBM2
3	6+589.525	5.001	516840.806	3730385.067	1615.258	TBM3
4	6+870.043	5.937	517066.185	3730221.089	1617.822	TBM4
5	7+103.158	10.463	517285.14	3730137.31	1619.559	TBM5
6	7+280.755	-4.345	517462.178	3730128.418	1621.103	TBM6
7	7+441.227	-5.358	517593.039	3730034.837	1624.21	TBM7
8	7+673.518	7.095	517758.684	3729872.462	1626.457	TBM8
9	7+894.649	-4.748	517962.34	3729787.986	1628.919	TBM9
10	8+190.285	5.259	518210.759	3729628.939	1629.044	TBM10
11	8+403.020	9.585	518392.717	3729516.94	1630.002	TBM11
12	8+558.892	7.534	518549.358	3729512.832	1630.544	TBM12
13	8+678.822	-4.395	518664.117	3729540.338	1633.115	TBM13
14	9+018.937	-6.167	518878.173	3729310.324	1633.185	TBM14
15	9+160.044	-6.862	518996.183	3729231.32	1632.653	TBM15
16	9+311.459	6.728	519063.217	3729094.365	1635.249	TBM16
17	9+459.233	-5.033	519152.353	3728977.267	1637.01	TBM17
18	9+594.682	6.083	519220.21	3728861.102	1639.35	TBM18
19	9+750.460	-4.313	519309.387	3728754.218	1641.204	TBM19
20	9+949.410	5.402	519341.839	3728558.276	1642.825	TBM20
21	10+188.013	5.909	519475.829	3728360.559	1644.342	TBM21
22	10+410.551	-4	519621.695	3728192.027	1646.812	TBM22
23	10+716.940	7.469	519759.889	3727918.093	1650.813	TBM23
24	10+977.195	-7.743	519887.802	3727693.204	1654.327	TBM24
25	11+188.008	5.772	519994.1	3727511.158	1657.574	TBM25
26	11+403.410	-6.658	520131.109	3727343.399	1658.575	TBM26
27	11+541.900	-4.632	520198.907	3727225.25	1659.216	TBM27
28	12+237.194	-6.477	520423.059	3726607.728	1670.691	TBM28
29	12+739.950	-4.027	520367.712	3726150.874	1680.423	TBM29
30	12+917.880	-3.832	520449.543	3726006.933	1683.941	TBM30
31	13+183.770	-4.814	520614.884	3725798.833	1686.951	TBM31
32	13+343.350	-4.597	520717.8696	3725678.457	1691.391	TBM32
33	13+617.732	-4.511	520916.8346	3725489.553	1698.08	TBM33
34	13+856.867	-4.622	521075.2921	3725310.315	1701.947	TBM34
35	14+022.415	11.257	521138.213	3725162.74	1701.496	TBM35

Sr. No.	Station	Offset	Easting	Northing	Elevation	Description
36	14+137.971	13.385	521175.828	3725047.562	1700.281	TBM36
37	14+400.256	0.305	521340.345	3724846.558	1706.872	TBM37
38	14+532.654	15.256	521404.047	3724729.288	1711.255	TBM38
39	14+716.471	3.975	521508.784	3724580.55	1713.63	TBM39
40	14+993.727	16.949	521564.58	3724310.742	1716.952	TBM40
41	15+689.481	-7.089	521839.367	3723670.428	1730.2	TBM41
42	15+963.592	-6.202	521883.646	3723399.38	1733.388	TBM42
43	16+271.349	6.029	521933.022	3723098.92	1735.682	TBM43
44	16+567.105	-10.22	522011.21	3722813.499	1749.392	TBM44
45	16+781.609	5.349	521993.954	3722598.755	1755.401	TBM45
46	17+033.608	-11.054	521993.608	3722345.575	1756.42	TBM46
47	17+205.564	-6.729	521956.11	3722176.584	1759.147	TBM47
48	17+459.209	-4.468	521908.101	3721930.866	1758.925	TBM48
49	17+751.823	5.522	521781.447	3721669.024	1756.931	TBM49
50	18+037.595	-21.662	521718.312	3721390.192	1753.777	TBM50
51	18+591.809	-6.896	521651.661	3720844.567	1758.704	TBM51
52	18+777.807	8.479	521586.191	3720668.549	1757.547	TBM52
53	18+990.927	-12.498	521604.212	3720450.764	1758.333	TBM53
54	19+180.118	-12.385	521483.467	3720301.25	1757.884	TBM54
55	19+355.870	13.207	521340.078	3720196.647	1758.328	TBM55
56	19+593.246	8.139	521384.36	3719959.145	1765.507	TBM56
57	19+828.678	5.12	521498.172	3719753.125	1770.245	TBM57
58	20+088.854	4.197	521700.014	3719588.552	1775.216	TBM58
59	20+314.123	-7.522	521895.601	3719476.135	1779.779	TBM59
60	20+561.912	-6.93	522081.606	3719324.904	1784.205	TBM60
61	20+800.115	9.793	522308.66	3719349.696	1785.95	TBM61
62	20+989.806	-7.537	522467.947	3719456.262	1787.528	TBM62
63	21+199.3642	-8.4437	522673.831	3719496.533	1788.343	TBM63
64	21+818.547	6.072	523209.447	3719200.171	1802.448	TBM64
65	22+061.223	-7.215	523443.533	3719137.103	1806.44	TBM65
66	22+215.842	11.553	523585.307	3719069.198	1807.228	TBM66
67	22+477.711	-9.082	523841.272	3719139.934	1806.611	TBM67
68	22+619.074	-6.297	523976.271	3719092.914	1810.767	TBM68
69	22+818.751	-5.738	524169.988	3719053.161	1810.627	TBM69
70	23+318.055	-8.839	524539.802	3718827.994	1819.308	TBM70
71	23+537.440	5.959	524675.335	3718651.973	1826.617	TBM71
72	23+833.780	-5.601	524910.897	3718473.519	1837.236	TBM72
73	24+003.546	5.747	525039.813	3718362.159	1841.949	TBM73
74	24+324.021	5.231	525282.601	3718156.395	1843.12	TBM74
75	24+808.526	5.196	525713.592	3717962.455	1854.146	TBM75
76	25+043.422	-12.889	525939.877	3717890.989	1861.562	TBM76
77	25+294.951	-10.412	526125.649	3717718.779	1865.278	TBM77
78	25+606.530	-5.627	526363.792	3717531.639	1872.38	TBM78
79	25+852.568	-4.763	526563.252	3717387.634	1874.779	TBM79

Sr. No.	Station	Offset	Easting	Northing	Elevation	Description
80	26+131.938	8.127	526748.512	3717177.374	1884.863	TBM80
81	26+445.653	-5.95	527037.216	3717061.466	1881.483	TBM81
82	26+762.170	5.433	527261.175	3716837.491	1889.002	TBM82
83	26+961.284	8.661	527421.792	3716723.027	1897.668	TBM83
84	27+424.856	-7.962	527778.268	3716458.999	1914.742	TBM84
85	27+927.365	-4.484	528215.521	3716220.263	1937.255	TBM85
86	28+152.753	-5.495	528381.189	3716067.19	1937.768	TBM86
87	28+428.713	10.817	528492.355	3715811.689	1942.301	TBM87
88	28+637.968	11.644	528665.88	3715692.89	1944.032	TBM88
89	28+878.607	-4.581	528890.2	3715609.634	1949.356	TBM89
90	29+103.180	10.373	529111.235	3715570.998	1950.225	TBM90
91	29+210.898	-5.064	529219.077	3715575.523	1948.024	TBM91
92	29+498.676	4.946	529476.123	3715447.421	1947.273	TBM92
93	29+801.823	11.07	529685.804	3715230.078	1964.713	TBM93
94	30+005.436	-5.542	529847.884	3715107.749	1969.122	TBM94
95	30+250.458	4.916	530019.132	3714931.904	1972.106	TBM95
96	30+449.767	5.683	530200.262	3714848.867	1977.707	TBM96
97	30+914.206	-4.007	530647.348	3714724.489	1982.766	TBM97
98	31+096.587	8.418	530824.365	3714675.473	1984.67	TBM98
99	31+348.683	-5.335	531073.188	3714716.722	1977.181	TBM99
100	31+517.297	11.847	531224.718	3714773.284	1983.487	TBM100
101	31+825.591	-5.389	531521.279	3714838.855	1986.045	TBM101
102	32+009.487	-7.2	531705.999	3714843.215	1987.577	TBM102
103	32+265.533	-4.77	531959.756	3714826.893	1990.074	TBM103
104	32+526.742	-5.502	532195.705	3714715.2	1995.103	TBM104
105	32+708.768	8.441	532345.02	3714609.699	2004.926	TBM105
106	32+946.242	7.319	532562.021	3714515.19	2009.272	TBM106
107	33+232.994	10.653	532795.096	3714359.015	2015.373	TBM107
108	33+466.007	-4.298	533011.337	3714272.321	2020.811	TBM108

(a) Planimetric Control

The co-ordinates of basic plan control points were established by GPS in interval of 5km on RCC pillars as primary control station. Between two control points, benchmarks were fixed in interval of 250m on RCC pillars, which serve the purpose of starting and closing bearings for Total Station Traverse.

(b) Height Control

Double tertiary levelling was done along the entire stretch with precision automatic level connecting benchmarks and reference control points established near the project road. The misclosures were all seen to be below the tolerance limit of 0.12mm k, where k is the length of the levelling line in km in between the starting and closing benchmarks. The misclosures were adjusted and height available at, given to all benchmarks was connected to BMs established by contracting GTS Benchmark available near the project road.

(c) Detailed Survey

The detail of project influence area is up to minimum (building line) in case of urban area and 60m in case of realignments. The limit was extended further in case of anticipated junction improvement along the finalised centre line which were surveyed by running Total Station Traverse X, Y and Z coordinates of relevant points of survey to establish ground profile captured by this Total Station Traverse besides other details like electric/telephone poles, tree, building, well, visible property line etc.

(d) Creation of DTM

Data collected through topographical survey clubbed with the findings of inventory surveys have been used to develop a Digital Terrain Model (DTM) in Mx Roads Software. Supplemented with the silting of important cross drainage structures along with their desired deck levels, horizontal and vertical profile of each road has been finalised after the careful application of the relevant design standard.

Traverse and LS/CS surveys were fed into computer to carry out the followings:

(i) Sort out the geometric (horizontal) deficiencies in the existing alignment.

(ii) Design the best fit centre line of the existing alignment considering all obligatory/nodal points with relevant design standards.

(iii) Examine the feasibility of proposed laning requirement within existing available ROW or proposal of bypass if any.

(iv) As far as possible obviate existing buildings, functional infrastructure facilities within the proposed ROW to minimise utility relocation.

(v) Examine each existing junction for its usefulness and determine the improvement measures.

4.4 Pavement Investigation

4.4.1 General

Pavement Investigation comprise of carrying out Sub grade characteristics and strength, investigation of required Sub-grade and sub soil characteristics, Pavement composition by excavating trial pits, evaluate Sub-grade strength, Pavement condition Surveys.

4.4.2 Roughness Survey

Roughness survey has been carried out with "Towed Fifth Wheel Bump Integrator". The equipment was run on the entire road stretch under study for all the 2 lanes for each wheel path and the average value of Unevenness Index (UI) is expressed in terms of mm/ Km. The survey was conducted, in such a way that, vehicle runs along both lanes of the carriageway. Bump Integrator was towed at a constant speed of 32+/-0.5 Kmph. Readings are taken at every 200m interval. The values obtained were corrected by using the calibration equation.

Equipment used and Calibration: -

The survey was carried out by using bump integrator (Automatic Road Unevenness Recorder) No. STECO-320, duly calibrated by CRRI, New Delhi vide certificate dated March 2016 – March 2018.

The calibration equation for Automatic Road Unevenness Recorder (ARUR) given by CRRI, New Delhi:

Y= 1.061X+636.6

R^2 (Regression Coefficient) =0.992

Where, Y= Calibrated roughness value, mm/km

X= Observed roughness value by ARUR, mm/km

Recommended Standard for Roughness Values:

The maximum permissible value of surface roughness measured with bump integrator for different surfaces are given in Table-1 as per IRC- SP: 16:2004

Newly constructed surface is expected to give roughness value corresponding to 'Good' category while the values under 'Average' and 'Poor' category indicate level of service and intervention level for maintenance. Surfaces with very low roughness values loose skid resistance and are not desirable from safety considerations. Such surfacing should prompt attention for restoring frictional resistance. The roughness index values are given in **Annexure 4.3**.

Maximum Permissible Values of roughness (mm/km) for Road Surface

S. No.	Type of surface	Condition of Road Surface		
		Good	Average	Poor
1	Surface dressing	<3500	3500-4500	>4500
2	Open graded premix carpet	<3000	3000-4000	>4000
3	Mix seal surfacing	<3000	3000-4000	>4000
4	Semi-dense bituminous concrete	<2500	2500-3500	>3500
5	Bituminous concrete	<2000	2000-3000	>3000
6	Cement concrete	< 2200	2200-3000	>3000

Table 4.6: Roughness Index Values for Vailoo to Khanabal Section

Chainage, Km		Roughness Index (mm/Km)		Pavement Condition	
From	To	Left	Right	Left	Right
235+000	236+000	2389	2115	Fair	Fair
236+000	237+000	2386	2673	Fair	Fair
237+000	238+000	1529	1554	Good	Good
238+000	239+000	1763	1961	Good	Fair
239+000	240+000	1525	1914	Fair	Good
240+000	241+000	2147	2815	Fair	Fair
241+000	242+000	2679	2991	Fair	Fair
242+000	243+000	1847	1946	Good	Good
243+000	244+000	1933	1933	Good	Fair
244+000	245+000	2856	2636	Fair	Fair
245+000	246+000	1924	1869	Good	Good
246+000	247+000	2183	2128	Fair	Fair
247+000	248+000	2870	2895	Fair	Fair
248+000	249+000	1932	1729	Good	Good

Chainage, Km		Roughness Index (mm/Km)		Pavement Condition	
From	To	Left	Right	Left	Right
249+000	250+000	2182	2330	Good	Fair
250+000	251+000	2247	2885	Fair	Fair
251+000	252+000	2147	2087	Fair	Fair
252+000	253+000	2171	2059	Fair	Fair
253+000	254+000	2241	2350	Fair	Fair
254+000	255+000	2348	2097	Fair	Fair
255+000	256+000	1842	1875	Good	Good
256+000	257+000	2915	2438	Fair	Fair
257+000	258+000	2663	2017	Fair	Fair
258+000	259+000	2556	2073	Fair	Fair
259+000	260+000	2881	2163	Fair	Fair
260+000	261+000	2388	2332	Fair	Fair
261+000	262+000	1811	1928	Fair	Good
262+000	263+000	1500	1964	Good	Good
263+000	264+000	2611	2808	Fair	Fair
264+000	265+000	2015	2049	Fair	Fair
265+000	266+000	2082	2617	Fair	Fair
266+000	267+000	1896	1896	Good	Fair
267+000	268+000	1661	1528	Good	Good
268+000	269+000	1680	1806	Good	Good

4.5 Sub grade Investigations

The subgrade conditions of existing pavement structure have been investigated by means of test pits excavated at every 5 kilometres along the road. They have been carefully dug from the pavement surface up to sub-grade level. Samples of natural ground have also been collected and tested in lab for it's properties. Pavement structural composition of existing pavement at the chainage of every test pit is noted. Representative samples of subgrade soil have also been collected in bulk, in gunny bag for laboratory testing listed above. The laboratory test results for the existing subgrade is provided later in this chapter. The key observations are however given below:

The predominant soil used in existing subgrade construction is sand and silty sand with some pockets of clay at some discrete locations

Free swelling Index varies from 10.0 to 20.0.

4 days soaked CBR varies from 9.22 to 10.60 (%)

The following laboratory tests were conducted on the soil samples collected from each pit and borrow areas.

a. Grain Size Distribution (%age)

b. Maximum dry density (MDD) (gm/cc)

c. Optimum moisture content (OMC) (%age)

d. Atterberg's Limit (LL and PL) (%age)

e. Free swelling index (%age)

f. 4 days soaked CBR (%age)

4.5.1 Existing Pavement Composition

A total of 7 pits were dug all along the road and crust noted along with other field tests. Crust composition found at these pits is tabulated below. It can be seen from data that bituminous thickness varies from 40mm to 80mm with average of around 60 mm. Granular thickness varies from 280mm to 320mm and averaging around 300mm. Existing pavement composition data is presented in **Annexure 4.5**. Summary of crust thickness is given in **Table 4.7**.

Table 4.7: Summary of Existing Pavement Crust Thickness

Location	Granular in mm	BT in mm	Total thickness in mm
235+000	310	50	360
240+000	290	40	330
245+000	305	60	365
250+000	280	50	330
255+000	285	70	355
260+000	290	80	370
265+000	320	60	380

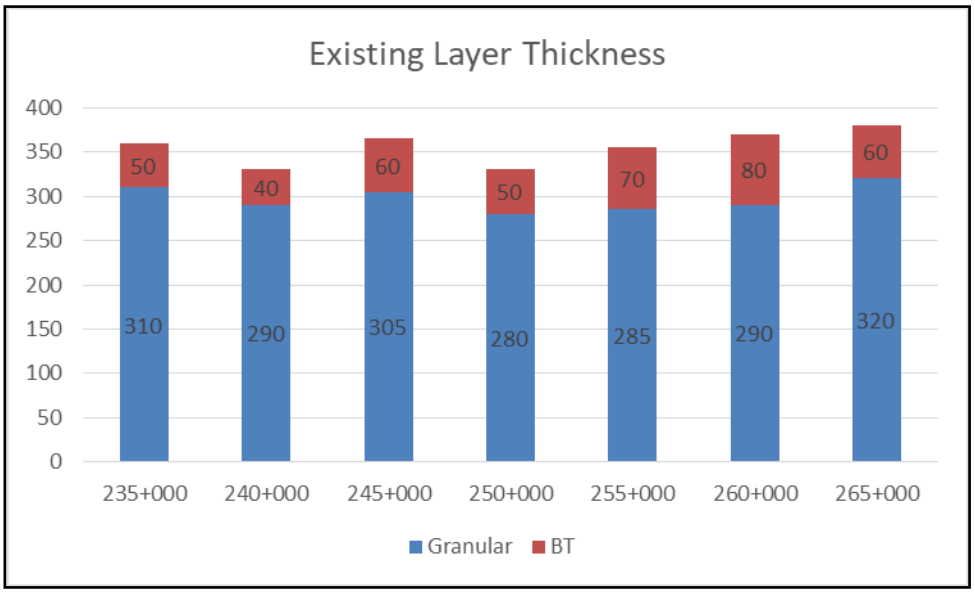


Figure 4.5: Existing Layer Thickness

4.5.1.1 Field Density of Existing Subgrade

Bulk filed density was found out at site by sand replacement method on soils of each pit and finally dry filed density was calculated by using field moisture content. Results are tabulated in **Annexure 4.4.**

The soil Lab Test Reports are also tabulated in **Annexure 4.6.**

4.5.1.2 Borrow Areas and its Evaluation

In initial assessment, **it is found that there will be the need of additional borrow**

areas which can fulfilled by borrowing earth from local area.

4.5.1.3 Aggregates (coarse and fine)

4 samples (coarse aggregates) and 4 crushed sand sample (fine aggregates) sample were collected and tested for following tests in laboratory. AIV, water absorption and specific gravity were carried out on coarse aggregates samples whereas grain size analysis, fineness modulus, water absorption and specific gravity were conducted on sand sample. The results obtained are tabulated below:

Table 4.8 : Test results Coarse Aggregates

Coarse Aggregate				
Sample ID	**AIV***	**Water absorption**	**Specific Gravity**	**FI & EI**
Agg-01/10 mm	21	1	2.724	74.4
Agg-01/20 mm	34	0.85	2.859	28.7
Agg-02/10 mm	23	0.95	2.702	16.1
Agg-02/20 mm	21	0.8	2.758	44.1
Agg-03/10 mm	25	0.5	2.982	44.9
Agg-03/20 mm	22	0.9	2.689	46.2
Agg-03/40 mm	24	0.6	2.652	67.4
Agg-04/10 mm	25	0.4	2.62	38.9
Agg-04/20 mm	28	1.05	2.658	51.8
Agg-04/40 mm	26	0.9	2.642	48.6

Table 4.9: Test Results for Fine Aggregates

Fine Aggregates											
Sample ID	**IS Sieve Size in mm (For Sand Gradation)**							**FM**	**Silt & Clay Content (%)**	**Water Absorption (%)**	**Specific Gravity**
	10	**4.75**	**2.36**	**1.18**	**0.6**	**0.3**	**0.15**				
Sand-01	100	97	89	76	62	32	9	2.3	8.5	1.25	2.64
Sand-02	99	95	87	79	56	13	3	3.4	2.5	1.02	2.7
Sand-03	100	94	88	76	51	27	9	2.5	9	1.21	2.64
Sand-04	100	99	90	73	63	34	10	2.2	10	1	2.68

4.6 Source of Material

4.6.1 Type of Materials

The various construction materials are listed below.

- Aggregate
- Sand
- Bitumen
- Steel
- Cement

4.7 Axle Load Survey

Axle Load Survey is required to know the existing loading characteristics of the

vehicles. The roadside direct interview method was adopted. A portable wheel load weighing pad, duly calibrated was used for measuring the axle loads. Axle Load measuring points were arranged on shoulder approaches with adequate sight distance to the on coming and going vehicles. These approaches were away from the main carriageway and wide enough to accommodate the lined up sampled vehicles for questioning and allow safe passage for un-sampled vehicles during the progress of the survey. The vehicles were stopped systematically at random based on their arrival with the help of police. These Vehicles were guided to mount on the axle load pad, axle-wise, in the order of front most axle to the rear most axles. Axle load of commercial vehicles, i.e. LCVs, 2-Axle, 3-Axle, Multi Axle Trucks and Buses were recorded in approved formats. Representative samples were captured uniformly over the entire period of survey for each category of goods vehicles.

4.7.1 Analysis of Axle Load Survey

To estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles, the axle load survey has been carried out at one location:

Km 263+550, Brakpora.

Design of Pavement is based on the cumulative number of 8.16 tonne equivalent standard axle (ESA) that will pass per lane during the analysis period. The categories of traffic which apply significant loads to the pavement are bus, minibus 2–Axle, 3–Axle and multi-axle vehicles. In calculating ESA, the standard axle loads taken are as under:

i) Single Axle dual type = 8.1 tonnes

ii) Tandem Axle dual type =15.1 Tonne

The ESA for each axle has been calculated using the fourth Power low, as under

$$ESA = \left[\frac{Actual\ Axle\ Load}{S\tan dard\ Axle\ Load} \right]^4$$

The Vehicle Damage Factor is a multiplier to convert the number of commercial vehicles of different axle loads and axle configuration to the number of standard axle load repetitions.

Table 4.10: Adopted VDF by Homogeneous Sections

VDF Summary		
Sr. No.	**Vehicle Type**	**VDF**
1	LCV	1.10444
2	2 Axle	2.94281
3	3 Axle	1.82046
4	MAV	4.38954
5	Bus	1.04853
Adopted VDF		**2.2612**

4.8 Inventory and Condition Survey of Bridges and Culverts

It is observed that the land along the existing alignment are open land passing through

many built up area and terrain is mostly hilly and rolling.

4.8.1 Minor and Major Bridges

There are 1 major bridges & 14 minor bridges which crosses either River, Nalla or small streams. Photographic representations are some of minor bridges are described as below.

Bridge at location Km 246+200

Bridge at location Km 251+225

Bridge at location Km 251+500

Figure 4.6 : Existing Bridge

Table 4.11: Existing Bridges

Sr. No	Existing Chainage	Type of Structure	Existing Span Arrangement	Carriageway Width (m)	Overall Width (m)	Remarks
1	237+525	Minor Bridge	1 X 18.2	4.3	5.1	Abandoned due to realignment.
2	239+278	Minor Bridge	1 X 7	7	12.2	Reconstruction (due to Masonry Substructure)
3	244+575	Minor Bridge	1 X 7.2	7	11.6	Reconstruction (due to Highway Realignment)

Sr. No	Existing Chainage	Type of Structure	Existing Span Arrangement	Carriageway Width (m)	Overall Width (m)	Remarks
4	245+567	Minor Bridge	1 X 7	7	12	Reconstruction (due to Highway Realignment)
5	246+200	Minor Bridge	1 X 7	7	12	Reconstruction (due to Masonry Substructure)
6	249+775	Minor Bridge	1 X 7.3	7	12	Reconstruction (due to Masonry Substructure)
7	250+255	Minor Bridge	1 X 7.3	7	14	Reconstruction (due to Masonry Substructure)
8	250+550	Major Bridge	3 X 35	7.5	12.5	Retained with repair and rehabilitation
9	250+610	Minor Bridge	1 X 6.6	7	12	Reconstruction (due to Masonry Substructure)
10	250+875	Minor Bridge	1 X 24.4	7.5	12	Retained with Widening
11	251+225	Minor Bridge	1 X 40.7	7.6	12.4	Retained without Widening
12	251+350	Minor Bridge	1 X 6.7	7	12	Reconstruction (due to Masonry Substructure)
13	251+400	Minor Bridge	1 X 21.5	7.5	12	Retained with additional 2-lane Bridge
14	251+500	Minor Bridge	1 X 22.2	7.5	12	Retained with additional 2-lane Bridge
15	256+950	Minor Bridge	1 X 7	7	12.7	Reconstruction (due to Masonry Substructure)

4.8.2 Inventory of Culverts

There are Slab Causeways, 1 Pipe culverts, 0 Arch Culvert, 105 Slab culverts on project road. Detailed inventory and condition survey of culverts are presented vide **Annexure 4.8** and in Table 4.12 below: -

Table 4.12: Existing Culverts

Sr. No.	Chainage (km)	Type of Culvert	Span /Opening with span length (m)		Width
			No	Clear Span	
1	235+130	Slab	1	2.00	16.20
2	235+337	Slab	1	2.00	10.30
3	235+822	Slab	1	2.00	12.00
4	236+105	Slab	1	2.00	12.00
5	236+475	Slab	1	2.00	12.00
6	236+675	Slab	1	2.00	12.00
7	236+776	Slab	1	2.00	12.00
8	236+922	Slab	1	2.00	12.00
9	237+232	Slab	1	2.00	12.00
10	237+345	Slab	1	4.70	12.00
11	237+773	Slab	1	1.20	12.00
12	238+015	Slab	1	3.00	12.00
13	238+426	Slab	1	3.00	12.00
14	238+755	Slab	1	2.00	12.00
15	239+376	Slab	1	2.00	12.00
16	239+534	Slab	1	0.80	12.00
17	239+700	Slab	1	3.00	12.00
18	239+860	Slab	1	3.20	12.00
19	240+045	Slab	1	3.00	12.00
20	240+295	Slab	1	3.00	12.00
21	240+841	Slab	1	2.00	12.00
22	240+877	Slab	1	1.00	12.00
23	241+779	Slab	1	0.30	12.00
24	242+090	Slab	1	0.80	12.00
25	242+332	Slab	1	2.00	12.00
26	242+468	Slab	1	2.00	12.00
27	242+615	Slab	1	2.00	12.00
28	242+696	Slab	1	2.00	12.00
29	243+420	Slab	1	2.00	12.00
30	243+665	Slab	1	2.00	12.00
31	243+993	Slab	1	2.00	12.00
32	244+017	Slab	1	2.00	12.00
33	244+597	Pipe	1	1.00	12.00
34	244+868	Slab	1	2.00	12.00
35	245+143	Slab	1	2.00	12.00
36	246+217	Slab	1	2.00	12.00
37	246+505	Slab	1	2.00	12.00
38	246+776	Slab	1	3.40	12.00
39	246+925	Slab	1	3.40	12.00
40	247+177	Slab	1	2.00	12.00
41	247+373	Slab	1	2.00	12.00
42	247+709	Slab	1	2.00	12.00

Sr. No.	Chainage (km)	Type of Culvert	Span /Opening with span length (m)		Width
			No	Clear Span	
43	247+859	Slab	1	1.40	12.00
44	248+005	Slab	1	1.80	12.00
45	248+080	Slab	1	2.00	12.00
46	248+268	Slab	1	3.00	12.00
47	248+330	Slab	1	1.40	12.00
48	248+605	Slab	1	2.00	12.00
49	248+882	Slab	1	2.00	12.00
50	249+460	Slab	1	1.00	12.00
51	249+615	Slab	1	2.00	12.00
52	249+813	Slab	1	2.00	12.00
53	249+844	Slab	1	3.00	12.00
54	249+907	Slab	1	2.00	12.00
55	249+960	Slab	1	2.00	12.00
56	250+025	Slab	1	2.00	12.00
57	250+293	Slab	1	2.00	12.00
58	250+614	Slab	1	2.00	12.00
59	250+739	Slab	1	2.00	12.00
60	250+810	Slab	1	2.00	12.00
61	251+001	Slab	1	2.40	12.00
62	251+096	Slab	1	2.00	12.00
63	251+378	Slab	1	3.00	12.00
64	251+561	Slab	1	2.00	12.00
65	251+713	Slab	1	2.00	12.00
66	251+880	Slab	1	2.00	12.00
67	252+284	Slab	1	2.00	12.00
68	252+718	Slab	1	2.00	12.00
69	252+803	Slab	1	2.00	12.00
70	253+090	Slab	1	2.00	12.00
71	253+219	Slab	1	2.00	12.00
72	253+260	Slab	1	2.00	12.00
73	253+580	Slab	1	2.00	12.00
74	253+788	Slab	1	2.00	12.00
75	254+270	Slab	1	2.00	12.00
76	254+629	Slab	1	2.00	12.00
77	254+780	Slab	1	2.00	12.00
78	254+975	Slab	1	2.00	12.00
79	255+273	Slab	1	2.00	12.00
80	255+745	Slab	1	2.00	12.00
81	256+115	Slab	1	2.00	12.00
82	257+020	Slab	1	2.00	12.00
83	257+076	Slab	1	2.00	12.00
84	257+375	Slab	1	1.00	12.00

Sr. No.	Chainage (km)	Type of Culvert	Span /Opening with span length (m)		Width
			No	Clear Span	
85	257+900	Slab	1	1.40	12.00
86	258+060	Slab	1	2.00	12.00
87	258+445	Slab	1	2.00	12.00
88	258+900	Slab	1	2.00	10.00
89	259+145	Slab	1	2.00	15.80
90	259+350	Slab	1	2.00	12.00
91	259+585	Slab	1	2.00	12.00
92	259+840	Slab	1	2.00	12.00
93	259+905	Slab	1	2.00	12.00
94	259+980	Slab	1	2.00	12.00
95	260+103	Slab	1	2.00	12.00
96	260+284	Slab	1	2.00	12.00
97	260+395	Slab	1	2.00	12.00
98	260+467	Slab	1	2.00	12.00
99	260+872	Slab	1	2.00	12.00
100	261+603	Slab	1	2.00	12.00
101	261+938	Slab	1	2.00	12.00
102	262+023	Slab	1	2.00	12.00
103	262+153	Slab	1	2.00	12.00
104	262+304	Slab	1	2.00	12.00
105	262+590	Slab	1	2.00	12.00
106	262+858	Slab	1	2.00	12.00

4.9 Exiting Right of Way

Sr. No.	Design Chainage in km		EROW in Meter	Remarks
	From	To		
1	148+589	155+600	27	
2	155+600	157+800	28	
3	157+800	159+200	29	
4	159+200	160+000	28	
5	160+000	160+400	25	
6	160+400	161+200	27	
7	161+200	166+800	26	
8	166+800	167+600	28	
9	167+600	169+800	26	
10	169+800	170+600	28	
11	170+600	170+750	22	Masjid
12	170+750	171+600	27	
13	171+600	173+200	28	
14	173+200	173+600	27	
15	173+600	176+589	28	

4.10 Manufactured Materials

Following are the manufactured materials use for the construction purpose listed below.

4.10.1 Cement

The Cement will be getting from Gurdaspur or Bathinda District of Punjab. Ordinary Portland Cement and with various grade of cement like 33, 43 & 53 type of Cement in various brand like Birla, Ambuja, J K etc are available.

4.10.2 Bitumen

Nearest source of Bitumen is **Panipat Refinery**. Different Viscosity grade of bitumen from above mentioned Refinery is available. As per study, BC and DBM layer with use of VG 10 grade bitumen resist rutting and top down cracking on high volume roads at low temperature, thus VG 10 Bitumen serve better. Hence use of VG 10 Bitumen is recommended. VG 10 Bitumen is equivalent to penetration grade of 89/100.

Bitumen Emulsion can be made available from Jammu.

4.10.3 Steel

The required type of Steel is to be procured from the (SAIL) Steel Plant in Srinagar.

4.10.4 Brick

Brick is one of the important manufactured materials to build structures for highway projects. There are numbers of brick manufacturing Kiln located in and around of the project road. Brick sample was collected from one of Kiln during material survey and tested in laboratory. The tests are carried out in accordance with the IS: 3495 (Part I): 1992.

Chapter 5

Traffic Demand Forecast

5.0 TRAFFIC DEMAND FORECAST

5.1 Approach

For evaluating the benefits as well as costs incurred by the project roads, it is obvious that a certain period must be considered for the overall project. Though project once implemented has a long life, if a proper maintenance is carried out from time to time, it is also understood that the project will continue to benefit the society even after the expiry of the project period. For the present project, as mentioned in the TOR, period of 30 years has been considered for traffic demand forecasting.

Traffic demand forecast was carried out up to horizon year 2049. To calculate the growth rate for traffic projections, comparative analysis has carried out for all the methods. The methods used for growth rate calculation are as follows:

1) Past trends in traffic growth (Vehicle registration Method)

2) Econometric Model Method: IRC-108:2015

5.2 Past Trends in Traffic growth

There is no permanent count station along the project road.

5.3 Past trend in growth of Registered vehicle

The vehicle registration growth also gives an indication of the traffic growth. Vehicle Registration data of Jammu and Kashmir has been taken for period 2004 – 2016 as available. A growth rate for the same has been derived and the same has been shown in the **Table 5.1** below.

Table 5.1: Growth Rate based on Vehicle Registration Method (Based on Road Transport Yearbook)

S.No	Year	Cars / Jeeps			Trucks			2 Wheelers			LCV & Mini LCV			Buses		
		Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)
1	2004-05	96590			31515			273265			13949			20735		
2	2005-06	109367	12777	13.23	33172	1657	5.26	297656	24391	8.93	16843	2894	20.75	21435	700	3.38
3	2006-07	123357	13990	12.79	35697	2525	7.61	320754	23098	7.76	20004	3161	18.77	22161	726	3.39
4	2007-08	139693	16336	13.24	38977	3280	9.19	341834	21080	6.57	22674	2670	13.35	23149	988	4.46
5	2008-09	156462	16769	12.00	41696	2719	6.98	363029	21195	6.20	24768	2094	9.24	24051	902	3.90
6	2009-10	183672	27210	17.39	35109	-6587	-15.80	407928	44899	12.37	43238	18470	74.57	23480	-571	-2.37
7	2010-11	316539	132867	72.34	35414	305	0.87	446791	38863	9.53	46792	3554	8.22	25858	2378	10.13
8	2011-12	255248	-61291	-19.36	38482	3068	8.66	480815	34024	7.62	51412	4620	9.87	25765	-93	-0.36
9	2012-13	290025	34777	13.62	40751	2269	5.90	530594	49779	10.35	56230	4818	9.37	26888	1123	4.36
10	2013-14	326990	36965	12.75	43132	2381	5.84	588207	57613	10.86	62047	5817	10.35	27947	1059	3.94
11	2014-15	364763	37773	11.55	45802	2670	6.19	644458	56251	9.56	67077	5030	8.11	29695	1748	6.25
12	2015-16	407236	42473	11.64	48124	2322	5.07	706746	62288	9.67	74598	7521	11.21	30646	951	3.20
Average yearly growth rate (%)				**15.56**			**4.16**			**9.04**			**17.62**			**3.66**

5.4 Econometric Model Method (IRC-108:2015)

The traffic forecast by vehicle type has been carried out by adopting the transport demand elasticity method, which is a well-established and proven technique and is referred in India.

Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to change in the corresponding indicator selected. Hence, to estimate the elasticity of traffic demand, it is necessary to establish the relationship between the growth in number of a given category of vehicle with one of the economic variables considered, such as NSDP, per capita income and population growth. Then the data can yield econometric model and the form of equation for estimation of traffic demand elasticity as recommended in IRC: 108-1996 of the following type:

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

Where,

P=Number of vehicles

EI= Economic indicator

Ao=Constant

A1= a coefficient (elasticity value)

5.5 Past Trends in Economy and Population

The economic indicators of Jammu and Kashmir, which are used for the regression analysis, are summed up in Table 5.2 below:

Table 5.2: Net State Domestic Products and Growth for Jammu and Kashmir (2004-16)

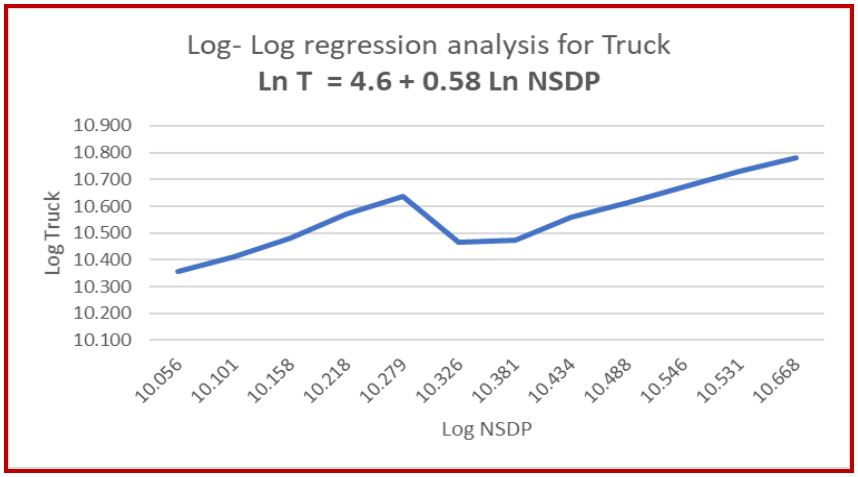
Sr. No	Year	Per Capita Income (PCI)			Population			NSDP			GSDP		
		Rs.	Growth	Gr. rate (%)	In 000's	Growth	Gr. rate (%)	Rs. (In crores)	Growth	Gr. rate (%)	Rs. (In crores)	Growth	Gr. rate (%)
1	2004-05	21734			10717			23292			27305		
2	2005-06	22406	672	3.09	10877	160	1.49	24371	1079	4.63	28883	1578	5.78
3	2006-07	23375	969	4.32	11035	158	1.45	25794	1423	5.84	30602	1719	5.95
4	2007-08	24470	1095	4.68	11192	157	1.42	27387	1593	6.18	32561	1959	6.40
5	2008-09	25641	1171	4.79	11350	158	1.41	29102	1715	6.26	34664	2103	6.46
6	2009-10	26518	877	3.42	11506	156	1.38	30512	1410	4.85	36225	1561	4.50
7	2010-11	27666	1148	4.33	11659	153	1.33	32256	1744	5.72	38270	2045	5.65
8	2011-12	28790	1124	4.06	11806	147	1.26	33990	1734	5.38	41203	2933	7.66
9	2012-13	30035	1245	4.32	11952	146	1.24	35898	1908	5.61	43402	2199	5.34
10	2013-14	31448	1413	4.70	12096	144	1.20	38039	2141	5.96	45847	2445	5.63
11	2014-15	30612	-836	-2.66	12235	139	1.15	37453	-586	-1.54	45126	-721	-1.57
12	2015-16	35034	4422	14.45	12261	26	0.21	42955	5502	14.69	51757	6631	14.69
Average yearly growth rate (%)				**4.50**			**1.23**			**5.78**			**6.05**

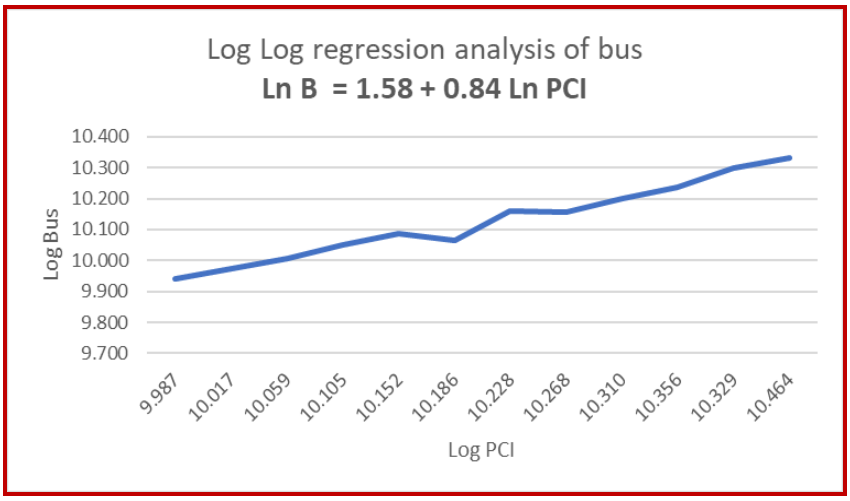
As mentioned above, to establish elasticity of traffic growth, we have regressed past vehicle registration data with past economic indicators of the Union Territory. The 'e' values for the selected economic variables with respect to different vehicle types are shown in the **Table 5.3** and are found with good fit, as reflected in their R^2 values.

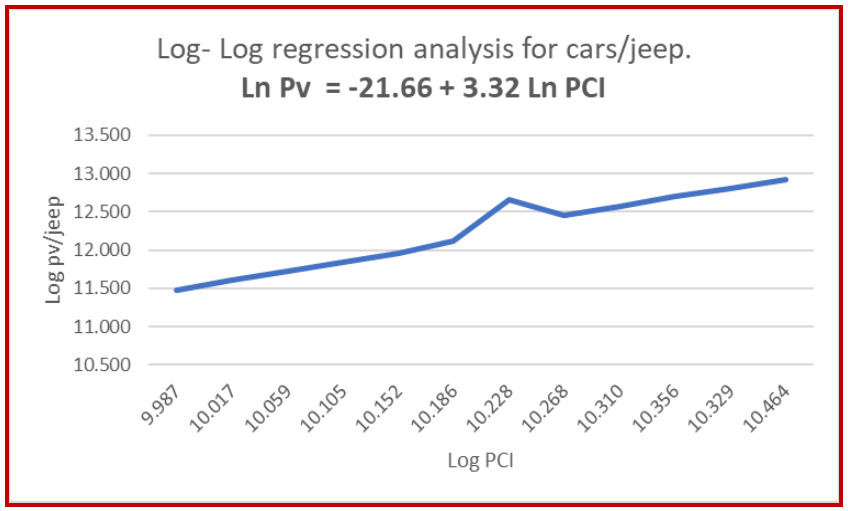
Table 5.3: Transport Demand Elasticity's

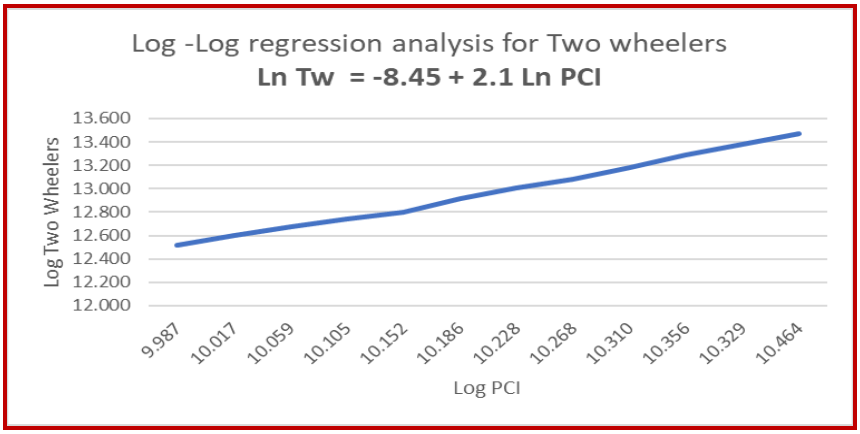
Vehicle Type	Independent variable	Elasticity Coefficient (e)	R2
2-Wheelers	Per Capita Income	2.10	0.97
LSV & Mini LSV	NSDP	2.98	0.95
Car/ Jeep /Van/Taxi	Per Capita Income	3.32	0.93
Bus	Population	2.69	0.98
Trucks /Trailer	NSDP	0.58	0.73

The relationship between different vehicle types and selected Per capita income (PCI) are presented in **Figure 5.1**.


Log- Log regression analysis for Truck
Ln T = 4.6 + 0.58 Ln NSDP
Log Truck
10.900
10.800
10.700
10.600
10.500
10.400
10.300
10.200
10.100
10.056
10.101
10.158
10.218
10.279
10.326
10.381
10.434
10.488
10.546
10.531
10.668
Log NSDP


Log Log regression analysis of bus
Ln B = 1.58 + 0.84 Ln PCI
Log Bus
10.400
10.300
10.200
10.100
10.000
9.900
9.800
9.700
9.987
10.017
10.059
10.105
10.152
10.186
10.228
10.268
10.310
10.356
10.329
10.464
Log PCI


Log- Log regression analysis for cars/jeep.
Ln Pv = -21.66 + 3.32 Ln PCI
Log pv/jeep
13.500
13.000
12.500
12.000
11.500
11.000
10.500
9.987
10.017
10.059
10.105
10.152
10.186
10.228
10.268
10.310
10.356
10.329
10.464
Log PCI



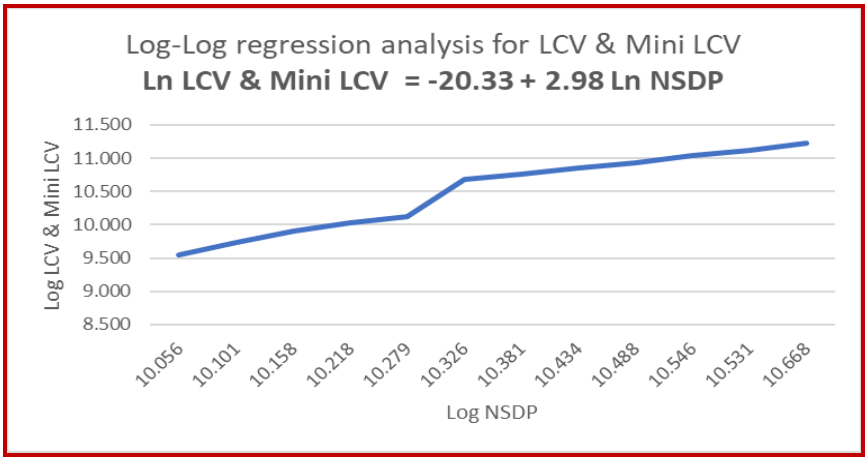


Figure 5.1: Relationship between Vehicle Types and Per capita Income (PCI)

The comparison of vehicle growth rates by vehicle registration and econometric model is as shown in **Table 5.4(a) and Table 5.4(b)**. It is appropriate to use the growth pattern that has emerged out of the economic model, which relates the economic growth with the growth in vehicle registration data.

Table 5.4(a) - Growth Rates of Vehicular Traffic for the state of Jammu and Kashmir

Sr. no.	Description	2 Wheelers	Cars/jeeps	Buses	Trucks	LCV and Mini LCV
1	Trend Growth of Vehicles	9.04	15.56	3.66	4.16	17.62
2	Growth from regression analysis	9.45	14.95	3.31	3.33	17.21
3	Considered for Revenue/Capacity	9.24	15.26	3.49	3.75	17.42

Table 5.4(b) – Adopted Growth Rates for Vehicular Traffic

S. no.	Period	2 Wheelers	Cars/jeeps	Buses	Trucks			LCV and Mini LCV
					2 Axle	3 Axle	M Axle	
1	Up to 2020	10.0	10.0	5.0	5.0	5.0	5.0	5.0
2	2021 -2025	9.0	9.0	5.0	5.0	5.0	5.0	5.0
3	2026 – 2030	8.0	8.0	5.0	5.0	5.0	5.0	5.0
4	2031 – 2035	7.0	7.0	5.0	5.0	5.0	5.0	5.0
5	Beyond 2035	6.0	6.0	5.0	5.0	5.0	5.0	5.0

5.6 Estimation of Corridor Traffic and Projection

Consultant has adopted growth rate of 5 % for buses, trucks and LCVs and for 2-wheelers, Cars it has adopted growth rate of 10% up to the year 2020, 9% from 2021-2025, 8% from 2026-2030, 7% from 2031-2035 and 6% beyond 2035 as per the analysis. Provided that annual rate of growth of commercial vehicles shall not be less than 5% for traffic projection and pavement design.

Traffic demand projections for the horizon year 2049 on homogeneous sections are shown in **Annexure 5.** The following **Table 5.5** shows the summary of projected traffic volume for homogeneous sections as per adopted realistic growth rates.

Table 5.5: Summary of Projected Total AADT Traffic PCU Volume/ day

Homogeneous Section	Year 2019	Year 2022	Year 2029	Year 2039	Year 2049
Vailoo To Khanabal	8055	10158	16810	30923	55249

5.7 Capacity Analysis and Level of Services

Capacity analysis is fundamental to the planning, design and operation of roads. It is a valuable tool for evaluation of the investment needed for the future improvements. The capacity figures used for determining the desired carriageway width in differing terrain w.r.t. traffic volume and composition are as per IRC: 64-1990. As per IRC 64:1990, it is recommended that on major arterial routes LOS-B should be adopted for the design purpose. On other roads under exceptional circumstances, LOS C could also be adopted for design. For LOS C, Design service volume can be taken as 40 % higher than those for LOS B.

For two lane highway, as per IRC: SP:73-2018 and MoRT&H circular dated 26th May 2016, the traffic at which the upgradation from two lane to four lane will trigger is shown in **Table 5.6**.

For four lane highway, as per IRC:SP:84-2019, the project highway shall be widened to six lane when total traffic including the traffic of service road, if any, reaches the design service volume corresponding to Level of Service 'C' of 4-lane highway shown in **Table 5.6.**

Table 5.6: Design Service Volume for Different Lane Configurations

Lane Configuration	Terrain	Design Service Volume (PCUs per day)
2-Lane with 2.5 m Paved Shoulder	Plain	10000
	Rolling	8500
	Mountainous/Steep	6000

Lane Configuration	Terrain	Design Service Volume (PCUs per day)	Design Service Volume (PCUs per day)
		Level of Service B	***Level of Service C***
4-Lane with 1.5m Paved Shoulder	Plain/Rolling	40000	60000
	Mountainous/Steep	20000	30000

5.8 Lane Requirements

Based on the assessment of the traffic demand on the various homogeneous sections of the Project Highway, the Consultant have carried out detailed option analysis for Two- laning with paved shoulders and Four Laning with paved shoulders. Based on the estimated Capacity & Design Service Volume, the number of lanes required for the project road is worked out for LOS B which is presented in **Table 5.7** below.

Table 5.7: Lanning Requirement for the Project Corridor

Homogeneous Sections	Terrain	2-Lane with Paved Shoulder	4-Lane with Paved Shoulder	4-Lane with Paved Shoulder
		Design Service Volume (PCUs per day)	LOS B	LOS C
Vailoo - Khanabal (Km. 235+000 to Km. 269+000)	Rolling/Hilly	Up to 2022	Up to 2044	Up to 2050

It is revealed from the capacity analysis results and considering future traffic growth, the project road in homogeneous section, will require four lane configurations since it reaches 10071 AADT Vehicles and 10158 AADT PCU in the year 2022.

5.9 Lane Improvement Proposals

Capacity analysis and lanning requirements have been carried out separately for the homogeneous section as per the traffic demand and travel characteristics.

For the project stretch, Lane capacity will exhaust for 2 lane with paved shoulder as per Design Service Volume (PCUs per day) for 2-lane in the year 2022.

It is revealed from the capacity analysis results and considering future growth, the project road requires four lane for capacity augmentation and efficient movement of traffic up to year 2044 of the project stretch.

As per traffic data, the maximum generated traffics are locally between Achabal to Anantnag/Srinagar during **April to September** at peak season of the tourist. Since, there are two major tourist places on the existing alignment i.e. **Korkernag & Achabal.** The **Korkernag** place is known for its gardens, pristine freshwater springs and rainbow trout farms. It is known for its trout streams and the largest freshwater spring in Kashmir, Trout hatchery department which has constructed pools in series where in trout is reared. The state's first rural mart has been set up in Kokernag, to promote and market the handicraft products manufactured by the local women self-help groups, by **NABARD. Achabal** is an important tourist place for an ancient spring surrounded by a garden terraced and developed by the Mughals.

The existing right of way are varying from 20m to 30m. as per above, we have proposed the 4-lane divide carriageway with 0.6m wide median & RCC covered drain at built-up area as per IRC: SP:73-2015 with in the existing right way based on current traffic scenario and local connectivity, which also discussed with NHIDCL, official HQ.

5.10 Intersection Improvement Proposals

Intersections are an important part of the highway because it controls the efficiency, the safety and the capacity. All intersections falling on the project corridor have been studied for the improvement to allow a safe connection to the corridor and minimum interference to the through traffic.

The traffic on the connected road for major intersections have been studied and projections have been made for its future development. Before recommending the improvement, all available options in order of their importance as enumerated ahead have been considered:

- At grade Intersections
- Grade separated Intersections
- Major junction with acceleration and deceleration lanes;
- Major junction with channelization of traffic or Rotary;
- Minor Junction as 'Left In & Left Out'

The intersection volume count survey at one major intersection has been carried out during identified peak periods. As per traffic projection for intersections will require at grade improvements. However as per latest Manual **Table 5.8.**

Table 5.8: Traffic Movement and Improvement Proposals at Major Intersection

Sr. No.	Location	Time	Peak Hour Volume	Peak Hour PCU	Total Volume	Total PCU
1	Nai Basti	8:00-9:00	3159	3323	27067	28451

With the increased traffic flow, it is anticipated that the saturation capacity of few intersections along the project road is going to impede smooth traffic flow.

As per IRC: SP 73-2018 and 2 laning manual, grade separation should be provided at intersection of junction with all the NH and SH.

5.11 Pedestrians Crossing Facilities

Pedestrian movement along any road is always expected near built up areas, bus bays and intersections. Safe crossing facilities for pedestrians are proposed at major intersections and bus bays. These facilities are planned in accordance with the relevant provisions contained in IRC-11, IRC-17 and IRC-103. At intersections, controlled form of crossing is achieved through provision of 3 m wide zebra crossing, accompanied by STOP line. Pedestrian guard rail has also been proposed at locations to safeguard the pedestrian movement at urban locations.

Chapter 6

Social Impact Assessment of the Project Influence Area

6.0 SOCIAL IMPACT ASSESSMENT OF THE PROJECT INFLUENCE AREA

6.1 Introduction

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to two/four laning with paved shoulder according to NH Configuration.

In pursuance of the above, **M/S Rodic Consultants Pvt. Ltd., New Delhi** in joint venture with **M/S Monarch Surveyors and Engineering consultant Pvt. Ltd**. have been appointed as Consultants to carry out the **"Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir**. The agreement was signed on 4th June 2019.

This project section deals with Vailoo- Khanabal section from ex. Km. 235.000 to Km. 269.000 (Proposed Chainage km 148.589 (Vailoo) to km 176.532 (Donipawa)).

6.2 Objectives

The main objectives of Social Analysis and Design are to improve decision making and to ensure that the highway improvement options under consideration are socially sound, sustainable and contribute to the development of social development goals. The main objectives of the Resettlement Action Plan are to provide for resettlement policy framework and includes comprehensive mitigation measures to ensure that the affected and displaced persons are appropriately resettled and rehabilitated i.e. to improve their livelihoods and standards of living or at least to restore them, in real terms. The Social Impact Assessment involves undertaking full baseline information, in such a manner as to ensure compliance with State, Govt. of Indian guidelines and regulations.

6.2.1 Scope of Work

The scope of work comprises the following main tasks, comprising main elements:

Carry out a preliminary social screening in coordination with other screening exercise (environment and Social) – desk review and field visit- of the highway to determine the magnitude of actual and potential impact and ensure that social considerations are given adequate weight in the selection and design of proposed highway improvements.

- Collect information – desk review and field visit – on existing baseline conditions (include all within the proposed width or Right of Way) and undertake a preliminary evaluation of the highway selected for improvement to define, the zone of impact of such component or activities, design and management studies.
- Explore viable alternative project designs and alignments to avoid, where

feasible, or minimize displacement and carry out public consultations on alternate alignments.

- Identify major and minor social impact issues and estimate the economic and social negative impacts on people and land of upgrading the highway and propose cost-effective measures to avoid and/or mitigate negative impacts.
- Carry out public consultation with the likely affected groups, NGOs, district administration and other stakeholders and document the outcomes.
- Provide a preliminary cost estimate for land acquisition, transfer and resettlement and rehabilitation and ensure inclusion in the overall project cost.
- Assets both within and outside of the right of way such structures and land will be recorded on strip maps; and
- Pre-testing of socio-economic questionnaires, checklist for focus group consultations on R&R with different social groups, administrative level and other stakeholders.

6.2.2 Project Road Appreciation

6.2.2.1 Introduction

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to two/four laning with paved shoulder according to NH Act.

In pursuance of the above, **M/S Rodic Consultants Pvt. Ltd., New Delhi** in joint venture with **M/S Monarch Surveyors and Engineering consultant Pvt. Ltd**. have been appointed as Consultants to carry out the "Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir". The agreement was signed on 4th June 2019.

This section of project deals with Vailoo- Khanabal section from ex. Km. 235.00 to Km. 269.000.

Project road section falls entirely in the Anantnag district of Jammu and Kashmir.

The Project Road starts from Existing Km 235+000 at Vailoo village and passes through Devalgam, , Bindoo Zalangam, Bidder Hayatpora, DanwathPora, Sagam, Buchoo, , Hillar Arhama, Akingam, Badoora, Achabal, Kull-gard, Thajiwara, Brakpora, Donipawa, Ulbugh Nowgam, Nunwani, Kadpora, Mohripora, Hakura Badasgam,Bahie,Chawalgam,Dandipora,Bitihar,DessuNowbugh and terminates at existing Km 269+000 at Khanabal (which has been revised **Vailoo to Donipawa**). The entire length of project road has a carriageway width varying from 7.0 m – 14.0 m but majority of portion traverses as carriageway of 7.0 m. Earthen shoulder of varying width from 1.0m - 2.0m exists along both sides of the road.

The roadside drainage network is not adequate. The project road traverses mainly

through habitational and agricultural land with apple farming in abundance. Encroachments are also found on the roads side at many places. The major settlements/Built up areas along the corridor are Vailoo, Gad wali, Kokernag, Bindoo, Bidder, Sagam, Buchoo, Hillar, Akingam, Achabal, Brakpora, Donipawa Anantnag and Khanbal. The building and commercial activity are close to road edge in the built-up area along the project road.

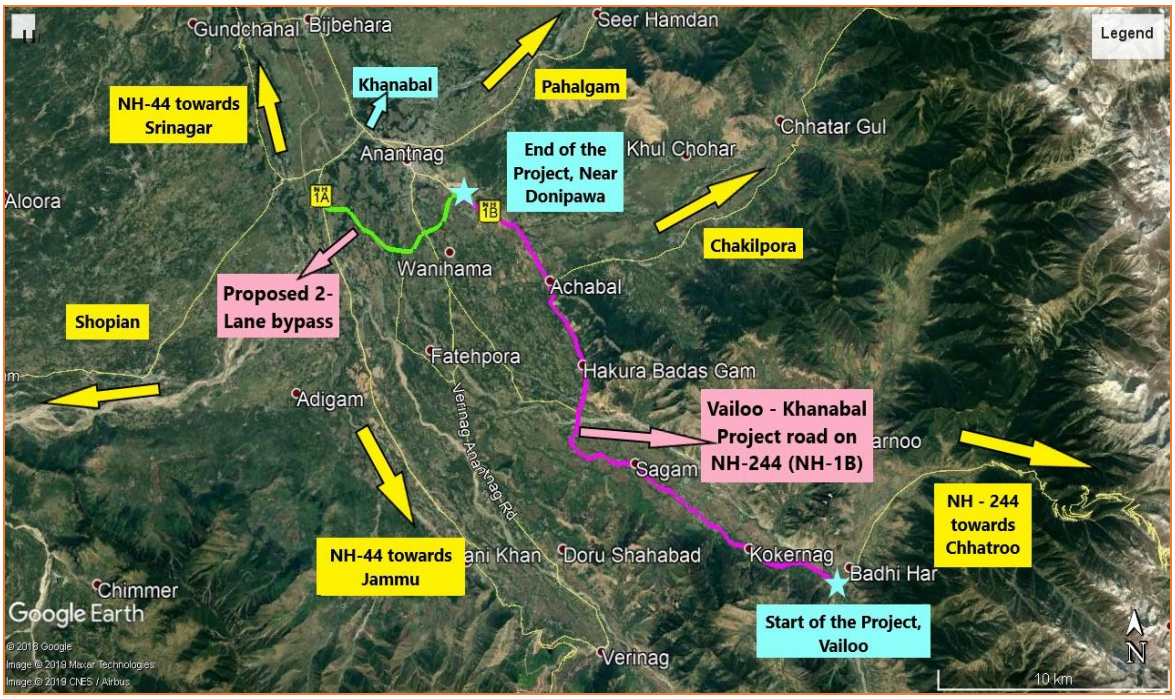


Fig 6.1: Key map of the project road

6.2.2.2 Villages and Districts under the project Road

The project road passing through some major settlements like Vailoo, Kokernag, Bindoo, Sagam, Buchoo, Hillar, Akingam, Achabal, Brakpora, Donipawa Anantnag and Khanbal.

Table 6.1: Major Villages and Tehsils under the Project Road

District	Tehsil-Village	Tehsil
ANANTNAG	1. Donipawa	Anantnag
	2. Ulbugh Nowgam	Anantnag
	3. Brakpora	Anantnag
	4. Nunwani	Anantnag
	5. Thajiwara	Anantnag
	6. Kadpora	Anantnag
	7. Kull-gard Achbal	Anantnag
Anantnag	1. Badoora 2. Akingam 3. MohriporaHillar Arhama 4. Bahie 5. Buchoo	Kokernag

District	Tehsil-Village	Tehsil
	6. Chawalgam 7. Sagam 8. Danwath Pora 9. Bidder Hayatpora 10. Bindoo Zalangam 11. Devalgam	
Anantnag	1. Hakura Badasgam	Dooru
Anantnag	1. Dandipora 2. Bitihar 3. Dessu Nowbugh	Larnoo

6.2.2.3 Road Width of the Project Road

Table 6.2: Road Width of the Project Road

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
235+000	235+100	H/R	BU	BU	9	BT	7	1	ES	1
235+100	235+200	H/R	BU	BU	9	BT	7	1	ES	1
235+200	235+300	H/R	BU	BU	9	BT	7	1	ES	1
235+300	235+400	H/R	BU	BU	9	BT	7	1	ES	1
235+400	235+500	H/R	BU	BU	9	BT	7	1	ES	1
235+500	235+600	H/R	Forest	BU	9	BT	7	1	ES	1
235+600	235+700	H/R	Forest	BU	9	BT	7	1	ES	1
235+700	235+800	H/R	Forest	Agri.	9	BT	7	1	ES	1
235+800	235+900	H/R	BU	BU	9	BT	7	1	ES	1
235+900	236+000	H/R	BU	BU	9	BT	7	1	ES	1
236+000	236+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+100	236+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+200	236+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+300	236+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+400	236+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+500	236+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+600	236+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+700	236+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+800	236+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
236+900	237+000	H/R	BU	BU	9	BT	7	1	ES	1
237+000	237+100	H/R	BU	BU	9	BT	7	1	ES	1
237+100	237+200	H/R	BU	BU	9	BT	7	1	ES	1
237+200	237+300	H/R	BU	BU	9	BT	7	1	ES	1
237+300	237+400	H/R	BU	BU	9	BT	7	1	ES	1
237+400	237+500	H/R	BU	BU	9	BT	7	1	ES	1
237+500	237+600	H/R	BU	BU	9	BT	7	1	ES	1
237+600	237+700	H/R	BU	BU	9	BT	7	1	ES	1
237+700	237+800	H/R	BU	BU	9	BT	7	1	ES	1

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
237+800	237+900	H/R	BU	BU	9	BT	7	1	ES	1
237+900	238+000	H/R	BU	BU	9	BT	7	1	ES	1
238+000	238+100	H/R	BU	BU	9	BT	7	1	ES	1
238+100	238+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+200	238+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+300	238+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+400	238+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+500	238+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+600	238+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+700	238+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
238+800	238+900	H/R	BU	Agri.	9	BT	7	1	ES	1
238+900	239+000	H/R	BU	Agri.	9	BT	7	1	ES	1
239+000	239+100	H/R	BU	Agri.	9	BT	7	1	ES	1
239+100	239+200	H/R	BU	Agri.	9	BT	7	1	ES	1
239+200	239+300	H/R	BU	BU	9	BT	7	1	ES	1
239+300	239+400	H/R	BU	BU	9	BT	7	1	ES	1
239+400	239+500	H/R	BU	BU	9	BT	7	1	ES	1
239+500	239+600	H/R	BU	BU	9	BT	7	1	ES	1
239+600	239+700	H/R	BU	BU	9	BT	7	1	ES	1
239+700	239+800	H/R	BU	BU	9	BT	7	1	ES	1
239+800	239+900	H/R	BU	BU	9	BT	7	1	ES	1
239+900	240+000	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+000	240+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+100	240+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+200	240+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+300	240+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+400	240+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+500	240+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+600	240+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
240+700	240+800	H/R	BU	BU	9	BT	7	1	ES	1
240+800	240+900	H/R	BU	BU	9	BT	7	1	ES	1
240+900	241+000	H/R	BU	BU	9	BT	7	1	ES	1
241+000	241+100	H/R	BU	BU	9	BT	7	1	ES	1
241+100	241+200	H/R	Open	BU	9	BT	7	1	ES	1
241+200	241+300	H/R	Open	BU	9	BT	7	1	ES	1
241+300	241+400	H/R	Open	BU	9	BT	7	1	ES	1
241+400	241+500	H/R	Open	BU	9	BT	7	1	ES	1
241+500	241+600	H/R	BU	BU	9	BT	7	1	ES	1
241+600	241+700	H/R	BU	BU	9	BT	7	1	ES	1
241+700	241+800	H/R	Agri.	BU	9	BT	7	1	ES	1
241+800	241+900	H/R	Agri.	BU	9	BT	7	1	ES	1
241+900	242+000	H/R	Agri.	BU	9	BT	7	1	ES	1

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
242+000	242+100	H/R	Agri.	BU	9	BT	7	1	ES	1
242+100	242+200	H/R	BU	BU	9	BT	7	1	ES	1
242+200	242+300	H/R	BU	BU	9	BT	7	1	ES	1
242+300	242+400	H/R	BU	BU	9	BT	7	1	ES	1
242+400	242+500	H/R	BU	BU	9	BT	7	1	ES	1
242+500	242+600	H/R	BU	BU	9	BT	7	1	ES	1
242+600	242+700	H/R	BU	BU	9	BT	7	1	ES	1
242+700	242+800	H/R	BU	BU	9	BT	7	1	ES	1
242+800	242+900	H/R	BU	BU	9	BT	7	1	ES	1
242+900	243+000	H/R	BU	BU	9	BT	7	1	ES	1
243+000	243+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+100	243+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+200	243+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+300	243+400	H/R	BU	Open	9	BT	7	1	ES	1
243+400	243+500	H/R	Agri.	BU	9	BT	7	1	ES	1
243+500	243+600	H/R	Agri.	BU	9	BT	7	1	ES	1
243+600	243+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+700	243+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+800	243+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
243+900	244+000	H/R	BU	BU	9	BT	7	1	ES	1
244+000	244+100	H/R	BU	BU	9	BT	7	1	ES	1
244+100	244+200	H/R	BU	BU	9	BT	7	1	ES	1
244+200	244+300	H/R	Agri.	BU	9	BT	7	1	ES	1
244+300	244+400	H/R	BU	Agri.	9	BT	7	1	ES	1
244+400	244+500	H/R	BU	Agri.	9	BT	7	1	ES	1
244+500	244+600	H/R	BU	Agri.	9	BT	7	1	ES	1
244+600	244+700	H/R	BU	Agri.	9	BT	7	1	ES	1
244+700	244+800	H/R	BU	Agri.	9	BT	7	1	ES	1
244+800	244+900	H/R	BU	Agri.	9	BT	7	1	ES	1
244+900	245+000	H/R	BU	Agri.	9	BT	7	1	ES	1
245+000	245+100	H/R	BU	Agri.	9	BT	7	1	ES	1
245+100	245+200	H/R	BU	Agri.	9	BT	7	1	ES	1
245+200	245+300	H/R	BU	Agri.	9	BT	7	1	ES	1
245+300	245+400	H/R	BU	BU	11	BT	7	2	ES	2
245+400	245+500	H/R	BU	BU	11	BT	7	2	ES	2
245+500	245+600	H/R	BU	BU	11	BT	7	2	ES	2
245+600	245+700	H/R	BU	BU	11	BT	7	2	ES	2
245+700	245+800	H/R	BU	BU	11	BT	7	2	ES	2
245+800	245+900	H/R	BU	BU	11	BT	7	2	ES	2
245+900	246+000	H/R	BU	BU	11	BT	7	2	ES	2
246+000	246+100	H/R	BU	BU	11	BT	7	2	ES	2
246+100	246+200	H/R	BU	BU	11	BT	7	2	ES	2

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
246+200	246+300	H/R	BU	BU	11	BT	7	2	ES	2
246+300	246+400	H/R	BU	BU	11	BT	7	2	ES	2
246+400	246+500	H/R	BU	BU	11	BT	7	2	ES	2
246+500	246+600	H/R	Agri.	BU	10.5	BT	7	1.5	ES	2
246+600	246+700	H/R	Agri.	BU	10.5	BT	7	1.5	ES	2
246+700	246+800	H/R	Agri.	BU	10.5	BT	7	1.5	ES	2
246+800	246+900	H/R	Agri.	BU	10.5	BT	7	1.5	ES	2
246+900	247+000	H/R	Agri.	BU	10.5	BT	7	1.5	ES	2
247+000	247+100	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+100	247+200	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+200	247+300	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+300	247+400	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+400	247+500	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+500	247+600	H/R	Agri.	Agri.	10.5	BT	7	1.5	ES	2
247+600	247+700	H/R	BU	BU	10.5	BT	7	1.5	ES	2
247+700	247+800	H/R	BU	BU	10.5	BT	7	1.5	ES	2
247+800	247+900	H/R	BU	BU	10.5	BT	7	1.5	ES	2
247+900	248+000	H/R	BU	BU	10.5	BT	7	1.5	ES	2
248+000	248+100	H/R	BU	BU	11	BT	7	2	ES	2
248+100	248+200	H/R	BU	BU	11	BT	7	2	ES	2
248+200	248+300	H/R	BU	BU	11	BT	7	2	ES	2
248+300	248+400	H/R	BU	BU	11	BT	7	2	ES	2
248+400	248+500	H/R	BU	BU	11	BT	7	2	ES	2
248+500	248+600	H/R	BU	BU	11	BT	7	2	ES	2
248+600	248+700	H/R	BU	Agri.	11	BT	7	2	ES	2
248+700	248+800	H/R	BU	Agri.	11	BT	7	2	ES	2
248+800	248+900	H/R	Agri.	Agri.	11	BT	7	2	ES	2
248+900	249+000	H/R	BU	BU	11	BT	7	2	ES	2
249+000	249+100	H/R	BU	BU	11	BT	7	2	ES	2
249+100	249+200	H/R	BU	BU	11	BT	7	2	ES	2
249+200	249+300	H/R	Agri.	Agri.	11	BT	7	2	ES	2
249+300	249+400	H/R	BU	Agri.	11	BT	7	2	ES	2
249+400	249+500	H/R	Agri.	BU	11	BT	7	2	ES	2
249+500	249+600	H/R	BU	BU	11	BT	7	2	ES	2
249+600	249+700	H/R	BU	BU	11	BT	7	2	ES	2
249+700	249+800	H/R	BU	BU	11	BT	7	2	ES	2
249+800	249+900	H/R	Agri.	BU	11	BT	7	2	ES	2
249+900	250+000	H/R	Agri.	BU	11	BT	7	2	ES	2
250+000	250+100	H/R	BU	BU	11	BT	7	2	ES	2
250+100	250+200	H/R	BU	BU	11	BT	7	2	ES	2
250+200	250+300	H/R	BU	BU	11	BT	7	2	ES	2
250+300	250+400	H/R	BU	BU	11	BT	7	2	ES	2

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
250+400	250+500	H/R	River		11	BT	7	2	ES	2
250+500	250+600	H/R	River		11	BT	7	2	ES	2
250+600	250+700	H/R	Agri.	Agri.	11	BT	7	2	ES	2
250+700	250+800	H/R	Agri.	Agri.	11	BT	7	2	ES	2
250+800	250+900	H/R	Agri.	Agri.	11	BT	7	2	ES	2
250+900	251+000	H/R	Agri.	Agri.	11	BT	7	2	ES	2
251+000	251+100	H/R	Agri.	Agri.	11	BT	7	2	ES	2
251+100	251+200	H/R	Agri.	Agri.	11	BT	7	2	ES	2
251+200	251+300	H/R	River		9	BT	7	1	ES	1
251+300	251+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
251+400	251+500	H/R	BU	BU	9	BT	7	1	ES	1
251+500	251+600	H/R	BU	BU	9	BT	7	1	ES	1
251+600	251+700	H/R	BU	BU	9	BT	7	1	ES	1
251+700	251+800	H/R	BU	BU	9	BT	7	1	ES	1
251+800	251+900	H/R	BU	BU	9	BT	7	1	ES	1
251+900	252+000	H/R	BU	BU	9	BT	7	1	ES	1
252+000	252+100	H/R	BU	BU	9	BT	7	1	ES	1
252+100	252+200	H/R	BU	BU	9	BT	7	1	ES	1
252+200	252+300	H/R	BU	BU	9	BT	7	1	ES	1
252+300	252+400	H/R	BU	BU	9	BT	7	1	ES	1
252+400	252+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
252+500	252+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
252+600	252+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
252+700	252+800	H/R	BU	BU	9	BT	7	1	ES	1
252+800	252+900	H/R	BU	BU	9	BT	7	1	ES	1
252+900	253+000	H/R	BU	BU	9	BT	7	1	ES	1
253+000	253+100	H/R	BU	BU	9	BT	7	1	ES	1
253+100	253+200	H/R	BU	BU	9	BT	7	1	ES	1
253+200	253+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+300	253+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+400	253+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+500	253+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+600	253+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+700	253+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+800	253+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
253+900	254+000	H/R	Agri.	Agri.	9	BT	7	1	ES	1
254+000	254+100	H/R	BU	BU	9	BT	7	1	ES	1
254+100	254+200	H/R	BU	BU	9	BT	7	1	ES	1
254+200	254+300	H/R	BU	BU	9	BT	7	1	ES	1
254+300	254+400	H/R	BU	BU	9	BT	7	1	ES	1
254+400	254+500	H/R	BU	BU	9	BT	7	1	ES	1
254+500	254+600	H/R	BU	BU	9	BT	7	1	ES	1

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
254+600	254+700	H/R	BU	BU	9	BT	7	1	ES	1
254+700	254+800	H/R	BU	BU	9	BT	7	1	ES	1
254+800	254+900	H/R	BU	BU	9	BT	7	1	ES	1
254+900	255+000	H/R	BU	BU	9	BT	7	1	ES	1
255+000	255+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+100	255+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+200	255+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+300	255+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+400	255+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+500	255+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+600	255+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+700	255+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+800	255+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
255+900	256+000	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+000	256+100	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+100	256+200	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+200	256+300	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+300	256+400	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+400	256+500	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+500	256+600	H/R	Agri.	Hill	9	BT	7	1	ES	1
256+600	256+700	H/R	BU	BU	9	BT	7	1	ES	1
256+700	256+800	H/R	BU	BU	9	BT	7	1	ES	1
256+800	256+900	H/R	BU	BU	9	BT	7	1	ES	1
256+900	257+000	H/R	BU	BU	9	BT	7	1	ES	1
257+000	257+100	H/R	BU	BU	9	BT	7	1	ES	1
257+100	257+200	H/R	BU	BU	9	BT	7	1	ES	1
257+200	257+300	H/R	BU	BU	9	BT	7	1	ES	1
257+300	257+400	H/R	BU	BU	9	BT	7	1	ES	1
257+400	257+500	H/R	BU	BU	9	BT	7	1	ES	1
257+500	257+600	H/R	BU	BU	9	BT	7	1	ES	1
257+600	257+700	H/R	BU	BU	9	BT	7	1	ES	1
257+700	257+800	H/R	Agri.	BU	9	BT	7	1	ES	1
257+800	257+900	H/R	Agri.	BU	9	BT	7	1	ES	1
257+900	258+000	H/R	Agri.	BU	9	BT	7	1	ES	1
258+000	258+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+100	258+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+200	258+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+300	258+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+400	258+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+500	258+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+600	258+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+700	258+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
258+800	258+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
258+900	259+000	H/R	Agri.	BU	9	BT	7	1	ES	1
259+000	259+100	H/R	Agri.	BU	9	BT	7	1	ES	1
259+100	259+200	H/R	Agri.	BU	9	BT	7	1	ES	1
259+200	259+300	H/R	Agri.	BU	9	BT	7	1	ES	1
259+300	259+400	H/R	BU	BU	9	BT	7	1	ES	1
259+400	259+500	H/R	BU	Agri.	9	BT	7	1	ES	1
259+500	259+600	H/R	BU	BU	9	BT	7	1	ES	1
259+600	259+700	H/R	BU	BU	9	BT	7	1	ES	1
259+700	259+800	H/R	BU	BU	9	BT	7	1	ES	1
259+800	259+900	H/R	BU	BU	9	BT	7	1	ES	1
259+900	260+000	H/R	BU	BU	9	BT	7	1	ES	1
260+000	260+100	H/R	BU	BU	9	BT	7	1	ES	1
260+100	260+200	H/R	BU	BU	9	BT	7	1	ES	1
260+200	260+300	H/R	BU	BU	9	BT	7	1	ES	1
260+300	260+400	H/R	BU	BU	9	BT	7	1	ES	1
260+400	260+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
260+500	260+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
260+600	260+700	H/R	Agri.	Agri.	9	BT	7	1	ES	1
260+700	260+800	H/R	Agri.	Agri.	9	BT	7	1	ES	1
260+800	260+900	H/R	Agri.	Agri.	9	BT	7	1	ES	1
260+900	261+000	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+000	261+100	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+100	261+200	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+200	261+300	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+300	261+400	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+400	261+500	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+500	261+600	H/R	Agri.	Agri.	9	BT	7	1	ES	1
261+600	261+700	H/R	BU	BU	9	BT	7	1	ES	1
261+700	261+800	H/R	BU	BU	9	BT	7	1	ES	1
261+800	261+900	H/R	BU	BU	9	BT	7	1	ES	1
261+900	262+000	H/R	Agri.	BU	9	BT	7	1	ES	1
262+000	262+100	H/R	Agri.	BU	9	BT	7	1	ES	1
262+100	262+200	H/R	BU	BU	9	BT	7	1	ES	1
262+200	262+300	H/R	BU	BU	9	BT	7	1	ES	1
262+300	262+400	H/R	BU	BU	9	BT	7	1	ES	1
262+400	262+500	H/R	BU	BU	9	BT	7	1	ES	1
262+500	262+600	H/R	Agri.	BU	9	BT	7	1	ES	1
262+600	262+700	H/R	Agri.	BU	9	BT	7	1	ES	1
262+700	262+800	H/R	Agri.	BU	9	BT	7	1	ES	1
262+800	262+900	H/R	Agri.	BU	9	BT	7	1	ES	1
262+900	263+000	H/R	BU	BU	9	BT	7	1	ES	1

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
263+000	263+100	H/R	BU	BU	9	BT	7	1	ES	1
263+100	263+200	H/R	Agri.	BU	9	BT	7	1	ES	1
263+200	263+300	H/R	Agri.	BU	9	BT	7	1	ES	1
263+300	263+400	H/R	Agri.	BU	9	BT	7	1	ES	1
263+400	263+500	H/R	BU	BU	9	BT	7	1	ES	1
263+500	263+600	H/R	BU	BU	9	BT	7	1	ES	1
263+600	263+700	H/R	BU	BU	9	BT	7	1	ES	1
263+700	263+800	H/R	River		9	BT	7	1	ES	1
263+800	263+900	H/R	BU	BU	9	BT	7	1	ES	1
263+900	264+000	H/R	BU	BU	9	BT	7	1	ES	1
264+000	264+100	H/R	BU	BU	9	BT	7	1	ES	1
264+100	264+200	H/R	BU	BU	9	BT	7	1	ES	1
264+200	264+300	H/R	BU	BU	9	BT	7	1	ES	1
264+300	264+400	H/R	BU	BU	9	BT	7	1	ES	1
264+400	264+500	H/R	BU	BU	9	BT	7	1	ES	1
264+500	264+600	H/R	BU	Hill	9	BT	7	1	ES	1
264+600	264+700	H/R	BU	Hill	9	BT	7	1	ES	1
264+700	264+800	H/R	BU	BU	9	BT	7	1	ES	1
264+800	264+900	H/R	BU	BU	9	BT	7	1	ES	1
264+900	265+000	H/R	BU	BU	9	BT	7	1	ES	1
265+000	265+100	H/R	BU	BU	9	BT	7	1	ES	1
265+100	265+200	H/R	BU	BU	9	BT	7	1	ES	1
265+200	265+300	H/R	BU	BU	9	BT	7	1	ES	1
265+300	265+400	H/R	BU	BU	9	BT	7	1	ES	1
265+400	265+500	H/R	BU	BU	9	BT	7	1	ES	1
265+500	265+600	H/R	BU	BU	15.5	BT	14	-	-	-
265+600	265+700	H/R	BU	BU	15.5	BT	14	-	-	-
265+700	265+800	H/R	BU	BU	15.5	BT	14	-	-	-
265+800	265+900	H/R	BU	BU	15.5	BT	14	-	-	-
265+900	266+000	H/R	BU	BU	15.5	BT	14	-	-	-
266+000	266+100	H/R	BU	BU	15.5	BT	14	-	-	-
266+100	266+200	H/R	BU	BU	15.5	BT	14	-	-	-
266+200	266+300	H/R	BU	BU	14	BT	14	-	-	-
266+300	266+400	H/R	BU	BU	15.5	BT	14	-	-	-
266+400	266+500	H/R	BU	BU	15.5	BT	14	-	-	-
266+500	266+600	H/R	BU	BU	14.5	BT	14	-	-	-
266+600	266+700	H/R	BU	BU	14.5	BT	14	-	-	-
266+700	266+800	H/R	BU	BU	14.5	BT	14	-	-	-
266+800	266+900	H/R	BU	BU	14.5	BT	14	-	-	-
266+900	267+000	H/R	BU	BU	14.5	BT	14	-	-	-
267+000	267+100	H/R	BU	BU	14.5	BT	14	-	-	-
267+100	267+200	H/R	BU	BU	14.5	BT	14	-	-	-

Chainage		Terrain	Adjacent Land use pattern		Roadway Width	Carriageway		Shoulder		
From	To		Left	Right		Surface Type	Width	Width(L)	Type	Width(R)
267+200	267+300	H/R	BU	BU	14.5	BT	14	-	-	-
267+300	267+400	H/R	BU	BU	15.2	BT	14	-	-	-
267+400	267+500	H/R	BU	BU	15.2	BT	14	-	-	-
267+500	267+600	H/R	BU	BU	15.2	BT	14	-	-	-
267+600	267+700	H/R	BU	BU	14	BT	14	-	-	-
267+700	267+800	H/R	BU	BU	14	BT	14	-	-	-
267+800	267+900	H/R	BU	BU	15.2	BT	14	-	-	-
267+900	268+000	H/R	BU	BU	15.2	BT	14	-	-	-
268+000	268+100	H/R	River		14	BT	14	-	-	-
268+100	268+200	H/R	BU	BU	14	BT	14	-	-	-
268+200	268+300	H/R	BU	BU	15.2	BT	14	-	-	-
268+300	268+400	H/R	BU	BU	15.2	BT	14	-	-	-
268+400	268+500	H/R	BU	BU	15.2	BT	14	-	-	-
268+500	268+600	H/R	BU	BU	15.2	BT	14	-	-	-
268+600	268+700	H/R	BU	BU	15.2	BT	14	-	-	-
268+700	268+800	H/R	BU	BU	15.2	BT	14	-	-	-
268+800	268+900	H/R	BU	BU	15.2	BT	14	-	-	-
268+900	269+000	H/R	BU	BU	15.2	BT	14	-	-	-

All major utilities follow the road alignment as the project road connects villages/Towns like : Bindoo, Bidder, Sagam, Buchoo, , Hillar Arhama, Akingam, Achabal, , Thajiwara, and the end location of the project Donipawa.

6.2.3 Benefits envisaged from the project road:

Following are the expected benefits due to the improvement in the project road:

- Better level of service in terms of improved riding quality and smooth traffic flow.
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc.
- With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
- Increased road landscaping and safety features.
- Enhanced connectivity between rural & urban population which will benefit the all sections of the society like general population, small-medium-large scale industries, farmers, businessmen etc.
- Improved access to higher education facilities & modern health facilities.
- Strengthening of both rural & urban economies which in turn will improve economic scenario of the region and country.
- Improved road connectivity helps in better implementation and management

of government schemes.

- With improvement in economy, more generation of employment opportunities.
- Overall improvement of the region.

6.2.4 Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic generators and diversion locations along the project corridor. The passenger traffic has been observed to vary with respect to the influence of village/towns falling along the project corridor. The major traffic generators settlements and its connections (diversion) points are:

- Vailoo to Khanabal

Traffic surveys locations were selected to capture representative traffic volume on the homogeneous sections with a view to capture section wise traffic flow characteristics, the total stretch has been segmented in to two homogeneous sections, based upon the major intersections that act as main collectors or distributors (diversion) of traffic along the project road.

Table 6.4: Traffic Homogenous Section

Sr. No.	Homogeneous Section	Existing Chainage	
		From (Km)	To (km)
1	Vailoo - Khanabal	235+000	269+000

6.2.5 Analysis of Alternatives for social impacts:

Table 6.5: Analysis of alternatives

Sr. No.	Homogenous Sections	Key environmental issues	Key Social Issues	Best design option	Adverse environmental and social Impacts	Recommended design option to avoid/minimize impacts
1	With project: but without any bypass /realignment	Increased Environmental pollution/vehicle operating cost/fuel usage due to congestion.	Less safety, increased accidents, loss of lives	By the analysis of alternatives, the project scenario with bypass /realignment has less negative effect on social, environmental & safety platforms.	land acquisition, Loss of agricultural land.	The project scenario with bypasses at congested areas and realignment at critical sections is recommended because it has a smaller amount of negative impact due to the project.
2	With project: but with bypass /realignment.	Somewhat less pollution / fuel usage & less accident & tree cutting	Somewhat more safety at critical sections. Less land acquisitions.			

6.3 About the Project Influence Area

The entire project road is passing within the Anantnag district. Hence, for analysing the immediate influence area of the project road Anantnag District in Jammu and

Kashmir Union Territory has been considered.

Major socio-economic benefits of the improvement of highways would be in terms of:

Better transportation will ultimately lead to massive savings in vehicle operating costs (VOCs) which include savings in time, savings in cost of wear and tear, fuel etc. It will increase access to the villages and other small settlements with the urban areas, thus providing better connectivity to the urban infrastructure.

- Strengthening of rural economies as the rural sector/ economy is sure to get strengthened, though at a gradual pace.
- Education is one of the most dominant indicators towards the development of a region. Though primary schools are present in almost all villages, access to high schools, higher secondary schools and colleges is not so easy at present. Provision of easy access to higher education can be directly linked to the improved educational scenario.
- Indian villages are yet not well-equipped with all types of medical facilities and services like Public Health Centres (PHCs), dispensaries, hospitals. Due to inaccessibility, reaching even the nearest health centre sometimes becomes a colossal task.

  Other than this, there would be inevitable **Negative impacts** that the improvement of the concerned highway would lead to:

- **Land Acquisition:** Impacts leading to agricultural land being affected, either completely or partially. It is chiefly restricted to acquisition of agricultural land, revenue land, pastureland and other government lands.
- **Loss of roadside structures:** People will be affected by land acquisition, which possess title or other tenured status. Consequent to the land acquisition requirements, wells, houses (pucca, semi-pucca, and kutcha) and other structures like religious places (temples, mosques), community structures like bus stand, community sitting places, hand pumps, tube wells etc are likely to be affected.

  Loss of livelihood: Big and small shops, roadside restaurants and hotels, other small commercial developments etc. are also likely to be affected due to road improvement and widening. The people directly or indirectly dependent on these would experience an abrupt loss in their income.

6.3.1 Location and Districts involved

Location and Geography

Jammu and Kashmir

The Union Territory of Jammu and Kashmir covers an area of 42,241 sq.km. The state is very rich in natural heritage since it is located mostly in Himalayan Mountains. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border of Pakistan on the east, the Line of Control separates it from the Pakistan. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts. Jammu and Kashmir is home to several valleys such as the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley. The main Kashmir Valley is

100 km. The Indus, Tawi, Ravi and Chenab are the major rivers flowing through the region. Jammu and Kashmir is home to several Himalayan glaciers. With an average altitude of 5,753 metres (18,875 ft) above sea-level, the Siachen Glacier is 76 km (47 mi) long making it the longest Himalayan glacier. In the south around Jammu, the climate is typically monsoonal. In the hot season, Jammu city is very hot and can reach up to 40 °C whilst in July and August, very heavy though erratic rainfall occurs with monthly extremes of up to 650 millimetres.

Anantnag District

The project bypass stretch lies in the Anantnag district. It is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

Anantnag is located about 54 Km from Srinagar and about 254 Km from Jammu. The district is well connected with other districts and National Highway NH-1A (44) and NH-1B (244) pass through the district. The district has a good road network. District Anantnag is called the Gateway of Kashmir Valley. The nearest airport is located at Srinagar, which is about 65 Km away and the nearest Railhead is located at Jammu. The general approach to the whole of the District is through road and one can avail the transport facilities like Taxi, Deluxe Buses etc. both from Jammu and Srinagar. Geographically the district lies between 33-20' to 34 -15' north latitude and 74-30 to 75 -35 East Longitude bounded by north west by Srinagar and Pulwama districts and in the north east by Kargil district, in the southeast by district Doda, Kishtwar and in the south and south west by Ramban and Kulgam districts respectively

Anantnag features a moderate climate (Köppen climate classification). It's climate is largely defined by its geographic location, with the towering Karokaram to its east and the Pirpanjal range to the south. It can be generally described as cool in the spring and autumn, mild in the summer, and cold in the winter. As a large city with a significant difference in Geo location among various districts, the weather is often cooler in the hilly Areas of east as compared to the flat northern part of Anantnag. The hottest month is July having mean maximum temperature 32 °C, and the coldest are December–January (mean minimum temperature -15 °C)

6.3.2 Administrative Setup

Jammu and Kashmir consist of two divisions: Jammu and Kashmir Valley further divided into 22 districts. The major cities in Jammu and Kashmir are:

Table 6.6: Population of Major Cities of Jammu and Kashmir

Divisions	Districts	Area (Square-Km)	Population	Headquarters
Jammu	Kathua District	2651	616,435	Kathua
	Jammu District	2336	1,529,958	Jammu
	Samba District	1002	3,18,898	Samba
	Udhampur District	5550	554,985	Udhampur
	Reasi District	1719	314,667	Reasi
	Rajouri District	2630	642,415	Rajouri
	Poonch District	1674	476,835	Poonch

Divisions	Districts	Area (Square-Km)	Population	Headquarters
	Doda District	2625	409,936	Doda
	Ramban District	1329	283,713	Ramban
	Kishtwar District	7737	230,696	Kishtwar
Kashmir	Anantnag District	2917	1,078,692	Anantnag
	Kulgam District	1067	424,483	Kulgam
	Pulwama District	1398	560,440	Pulwama
	Shopian District	612.9	266,215	Shopian
	Budgam District	1370	753,745	Budgam
	Srinagar District	1979	1,236,829	Srinagar
	Ganderbal District	1979	297,446	Ganderbal
	Bandipora District	345	392,232	Bandipora
	Baramulla District	3353	1,008,039	Baramulla
	Kupwara District	2379	870,354	Kupwara

6.3.3 Demographic features of the Union Territory

According to the 2011 census of India, the total population of Jammu and Kashmir is 12258433. The official language of the UT is Urdu among other languages such as Kashmiri, Dogri, Hindi, Punjabi, Pahari, Balti, Ladakhi, Gojri, Shina and Pashto are also spoken in other parts of Jammu and Kashmir. It has a rich literary heritage with roots that lie deep in the sociological and historical movements of the region. Its literature reflects the regional consciousness and the evolution of an identity distinct from others in Northern India. The literacy is about 68.74%.

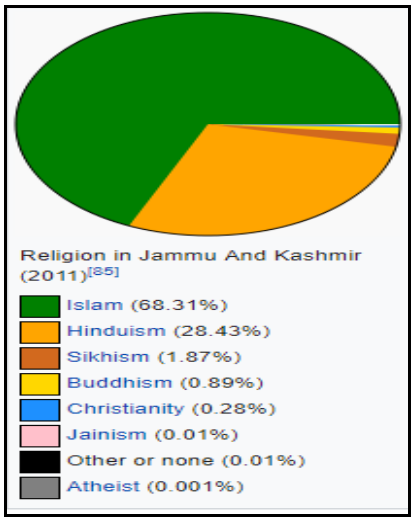


Fig 6.2: Religion Wise break up of Jammu and Kashmir

Table 6.7: District Wise Population of Jammu and Kashmir

		2001 Census	2011 Census					
Sr. No	District	Persons	Persons	Male	Female	Density	Rural	Urban
1)	Srinagar	1202447	1250173	665789	584384	1056	15928	1234245
2)	Ganderbal	NA	297003	158900	138103	284	250203	46800
3)	Budgam	629309	755331	400583	354748	550	666620	88711
4)	Anantnag	1172434	1069749	552203	517546	366	791237	278512
5)	Kulgam	NA	423181	216873	206308	396	343739	79442
6)	Pulwama	652607	570060	297988	272072	525	491370	78690

		2001 Census	2011 Census					
Sr. No	**District**	**Persons**	**Persons**	**Male**	**Female**	**Density**	**Rural**	**Urban**
7)	Shopian	NA	265960	136302	129658	852	251010	14950
8)	Baramulla	1169780	1015503	542171	473332	242	40948	174555
9)	Bandipora	NA	385099	201531	183568	967	320070	65029
10)	Kupwara	650393	875564	475126	400438	368	776322	99242
11)	Leh (Ladakh)	117232	147104	92907	54197	3	83901	63203
12)	Kargil	119307	143388	80791	62597	10	130635	12753
13)	Jammu	1588772	1526406	815727	710679	653	768577	757829
14)	Samba	NA	318611	168948	149663	350	264990	53621
15)	Kathua	550084	615711	327953	287758	246	527176	88535
16)	Poonch	372613	476820	252240	224580	284	438176	38644
17)	Rajouri	483284	619266	332424	286842	235	575332	43934
18)	Udhampur	743509	555357	298094	257263	224	445850	109507
19)	Reasi	NA	314714	166392	148322	185	288010	26704
20)	Doda	691929	409576	213091	196485	137	377003	32573
21)	Kishtwar	NA	231037	120496	110541	29	216196	14841
22)	Ramban	NA	283313	149032	134281	210	271527	11786
	TOTAL	**10143700**	**12548926**	**6665561**	**5883365**	**124**	**9134820**	**3414106**

(Data Source: Digest of Statistics, 2011-12)

6.3.4 Economical Profile of Project Influence Area (PIA):

The economy of Jammu and Kashmir has suffered from disturbed conditions. It would be therefore necessary to put the economy back to the rails to enable an average person get employment opportunities. In this direction, the following 8 sectors of economy have been identified for generation of gainful employment opportunities in the region on sustainable basis:

1. Agriculture (including Horticulture, Floriculture, Food Processing and Animal Husbandry)
2. Handlooms and Handicrafts
3. Industries (including Small Scale industries and Rural industries)
4. Tourism & travels
5. Education & health
6. Large infrastructure projects (Roads & Railways)
7. Information Technology & Telecommunication
8. Construction Sector

Jammu and Kashmir's economy is predominantly dependent on agriculture and allied activities. The Kashmir Valley is known for its sericulture and cold-water fisheries. Wood from Kashmir is used to make high-quality cricket bats, popularly known as Kashmir Willow. Kashmiri saffron is very famous and brings the state a handsome amount of foreign exchange. Agricultural exports from Jammu and Kashmir include apples, barley, cherries, corn, millet, oranges, rice, peaches, pears, saffron, sorghum, vegetables, and wheat, while manufactured exports include handicrafts, rugs, and shawls.

Horticulture plays a vital role in the economic development of the state. With an annual turnover of over ₹3 billion (US$47 million), apart from foreign exchange of over ₹800 million (US$12 million), this sector is the next biggest source of income in the state's economy.

Economic centres:

Main industrial activity is concentrated in the Jammu and Kathua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of raw material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The State has set up two industrial growth centers - one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

- Horticulture
- Floriculture
- Handloom & Handicraft
- Tourism.
- Mineral based Industries.
- Gem & Jewellery
- Sericulture
- Information Technology
- Pharmaceuticals
- Insecticides
- Pesticides
- Electronics
- Hardware

GDP and Profile of the Sectors Contributing to the Regional Economy:

This is a chart of trend of gross state domestic product of Jammu and Kashmir at market prices estimated by Ministry of Statistics and Programme Implementation with figures in millions of Indian Rupees.

Table 6.8: Gross State Domestic Product

Sr. No.	Sector	2011-12 (Q)	2012-13 (Q)	2013-14 (A)
1	Agriculture including Livestock	743878	745110	756742
2	Forestry and Logging	130261	130059	131083
3	Fishing	18071	18160	18347
(A)	Agriculture & Allied (1+2+3)	892209	893330	906171
4	Mining and Quarrying	10446	44768	313638
(a)	Sub-total Primary (A+4)	902655	938098	50300

Sr. No.	Sector	2011-12 (Q)	2012-13 (Q)	2013-14 (A)
5	Manufacturing	290872	305100	956471
5.1	Manufacturing (Registered)	134062	138905	313638
5.2	Manufacturing (Un-registered)	163740	166195	142740
6	Construction	476989	489583	170898
7	Electricity, Gas, Water Supply	185792	188497	508922
(b)	Sub-total Secondary (5-7)	690583	983180	194022
(B)	Industry (b+4)	971029	1027949	1016582
8	Transport, Storage & Communication	326981	349799	233485
9	Trade, Hotels & Restaurants	290376	299924	379532
10	Banking & Insurance	232571	256991	286321
11	Real Estates, Ownership of Dwelling, Legal & Business Services	228437	238825	249603
12	Public Administration	684436	747025	823423
13	Other Services	519803	554075	594528
(C)	Sub-total Tertiary (Services Sector)	2200827	2366546	2566892
	(8-13)			
	Total GSDP (a + b + c)	4064065	4287825	4539945
	Population in Lakhs	118.06	119.52	120.96
	Per Capita GSDP (Rs.)	34424	35875	37533
	Growth Rate	6.19	5.51	5.88

Workforce Characteristics

After collection and verification of the data from time to time, state income division prepares estimates at factor cost usually in the month of January-February every year. These estimates are discussed and verified by CSO during comparable discussion generally in the month of April-May every year. Advance estimates prepared in the current year is finalized in the forthcoming third year after discussion with CSO. For instance, an Advance GSDP estimate for the year 2013-14 has been prepared in the month of January 2014. In January 2015, a Quick estimate will be prepared for the same year. Similarly, In January 2016, a provisional estimate will be prepared for the year 2013-14 and finally In July 2016, GSDP estimates for the year 2013-14 would be finalized after discussion with CSO.

6.4 Socio Economic Profile of Project Road

6.4.1 Demography Data of Area

The project bypass stretch lies in the Anantnag district. It is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

In the region most of the population depends upon agriculture which mainly composed of rice, maize, wheat and mustard. Apple orchards are also present in the area. People are also engaged in Tourism industry as it have a great potential in the region for the years to come.

Category	No
Area	2917 Sq. Kms.
No. of Revenue Villages	387
No. of Sub Divisions	04
No. of CD Blocks	16
No. of Tehsils	12
No. of Gram Panchayats	303
No. of Municipalities	10
No. of Municipal Corporations	2
No. of Patwar Halqas	99
Literacy Rate	62.69%
Total Population	1078692

If we talk about the religion, Muslim is the major religion in the area as it accounts for more than 98% of the population. The literacy rate is low as 62.69%. The development of project will help in upliftment of society in the region.

S. No.	Religion	Total	Male	Females
1	Muslims	1057005	542671	514334
2	Hindus	13180	12010	1170
3	Sikhs	6140	3660	2480
4	Christians	1449	845	604
5	Buddhist	55	35	20
6	Jains	7	4	3
7	Other	7	3	4
8	Not Stated	849	539	310
Total		1078692	559767	518925

6.4.2 Agriculture/ Irrigation in Project Influence Area

Impact on agricultural land

Jammu and Kashmir is essentially a mountainous region in which only about 30 per cent of the reporting area is under cultivation. Agriculture is the mainstay of the people as it provides employment, directly or indirectly to about 70 per cent of the workforce. It contributes about 65 per cent of the state revenue which explains the overdependence of the state on agriculture. Land is, however, limited and therefore, its judicious utilization is necessary to meet the growing need of the tremendously increasing population and for the sustainability of soils, ecosystems and environment. The total geographical area of the state is 2.23 lakh sq. km including those parts which are under the occupation of Pakistan and China. About 92 per cent of the geographical area of the state consists of high mountains rugged topography and only 5 per cent is available for cultivation.

Being, hilly, mountainous and snow covered, it is only the gentle slopes (below 15°) which may be developed as orchards and pastures after heavy investment. The proportion of old fallow and current fallow is 0.29 and 4.0 per cent respectively. About 12 per cent of the total reporting area is put to non-agricultural uses, e.g., settlement, roads, cemetery, guls (canals) and water bodies. In general, the Jammu plain has a high concentration of wheat, rice, maize, pulses, fodder and oilseeds, while the Valley of Kashmir is well known for its paddy, maize, orchards (apples, almond, walnut, peach, cherry, etc.) and saffron cultivation. In Ladakh, barley, wheat, maize, vegetables, barseem and fodder are the main crops. The Kashmir Valley has a large capacity of fruit production. Apples, walnuts, almonds, cherries and pears are imported by many foreign countries.

Over 70 percent of the Net Sown Area is under food crops and the area under fruits is a little over 13 percent. Viability of agriculture as a profession is presently affected capital inadequacy, lack of infrastructural support and controls on movement, storage and sale etc of agricultural produce. Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation.

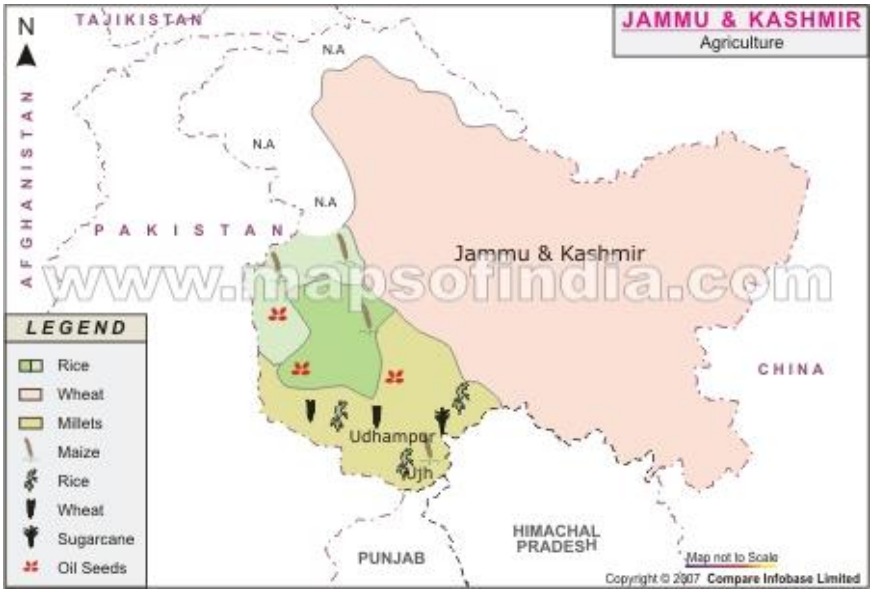


Fig 6.3: Agriculture in Jammu and Kashmir

The UT of J&K along with Ladakh is predominantly a mono cropped and rain fed with about 40% of the area in Jammu division and 60% in Kashmir Division having assured means of irrigation. Irrigation is crucial input for development of agriculture in the state. The major area in the state falls under the command of canal irrigation.

Rice, Maize and Wheat are the major crops in the state. While in Kashmir region Wheat, Oil Seeds and Fodder is being introduced as the secondary crop. In Jammu farmers are raising paddy as an additional crop. The production level of paddy adds about 40 quintals per hectare in Kashmir Valley and is highest in the country (Source: SoER, J&K 2012-13)

As per the figure for 2011-12 area not available for cultivation accounts for 574 thousand hectares. The category consists of 245 thousand hectares following under land put to non-agriculture use and 312 thousand hectares under barren and uncultivable land, 5 thousand hectares is under still water, marshy and water lodged

category which is negligible proportion.

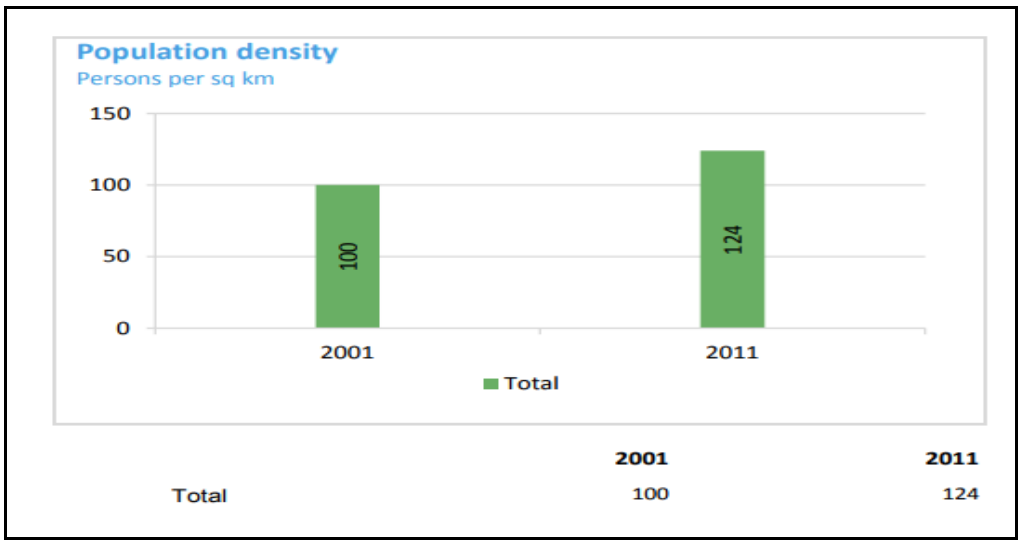
The crop yield for the year 2011-12 regarding principal agriculture crops was estimated to be 1.6 metric tonnes per annum for maize, 2.078 metric tonnes per annum for rice and 1.68 metric tonnes per annum for wheat, which are the major crops of the region.

S.No	District	Area Irrigated (Hectares)				
		Rice	Maize	Wheat	Barley	Other cereals Pulses & Millets
1)	Anantnag	25147	1335	-	-	538
2)	Kulgam	16812	530	-	-	68
3)	Pulwama	16567	849	-	-	110
4)	Shopian	556	162	-	-	48
5)	Srinagar	3709	-	-	-	17
6)	Ganderbal	7684	1290	-	-	104
7)	Budgam	24665	1428	6	-	536
8)	Baramulla	20236	5413	-	-	659
9)	Bandipora	9486	973	-	852	333
10)	Kupwara	15639	10122	-	-	-
11)	Leh	-	-	1092	4	3679
12)	Kargil	-	-	1324	-	5544
13)	Jammu	52338	118	49474	8	832
14)	Samba	7063	56	6350	29	171
15)	Udhampur	2926	4582	1654	169	96
16)	Reasi	1425	193	931	3	70
17)	Doda	1890	727	707	123	46
18)	Kishtwar	1202	836	253	227	801
19)	Ramban	1386	-	203	126	-
20)	Kathua	20000	297	15916	21	84
21)	Rajouri	453	118	3159	-	50
22)	Poonch	3621	98	2192	-	-
	Total	236888	29127	83261	1562	13786

Fig 6.4: Irrigated Land Distribution in Jammu and Kashmir

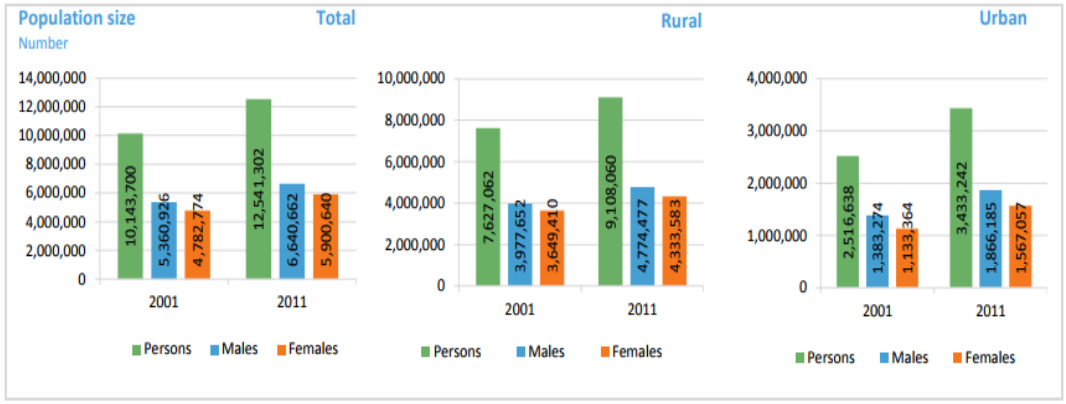
6.6.3 Population & Literacy

As per details from Census 2011, the following data is given by the Department of Ecology Environment and Remote Sensing. The **Population Density** of J&K is as below:



	2001	2011
Total	100	124

Population Size of Jammu and Kashmir



Total	2001	2011	Rural	2001	2011	Urban	2001	2011
Persons	10,143,700	12,541,302	Persons	7,627,062	9,108,060	Persons	2,516,638	3,433,242
Males	5,360,926	6,640,662	Males	3,977,652	4,774,477	Males	1,383,274	1,866,185
Females	4,782,774	5,900,640	Females	3,649,410	4,333,583	Females	1,133,364	1,567,057

Culture

The culture of Kashmir is a diverse blend and highly influenced by northern South Asian as well as Central Asian culture. Along with its scenic beauty, Kashmir is famous for its cultural heritage; it amalgamates Muslim, Hindu, Sikh and Buddhist philosophies and has involved composite culture based on the values of humanism and tolerance which is collectively known as Kashmiriyat.

The culture of Jammu and Kashmir is a comprehensive mingling of customs and practices of its three distinct regions, Kashmir, Jammu and Ladakh. Apart from its demographical variations, specific cultural diversions of its elements are what make the culture of Jammu and Kashmir remarkable. Music, dance, cuisine, lifestyle, festivals all these only highlight the diversities prevalent in these provinces. Unity is restored when a common thread of cultural tradition binds them together thus making it a part of Jammu and Kashmir as a whole. Culture of Jammu and Kashmir is therefore an interesting reflection of color, zest, harmony and concord which makes Jammu and Kashmir to stand apart with its distinct features of age-old tradition and deep ethnicity. The paradise on earth, Jammu and Kashmir is home to a rich cultural heritage, besides a panoramic landscape that leaves many a visitor spellbound. This culture and tradition is reflected in the several fairs and festivals in Jammu and Kashmir that are widely celebrated across the state with much zeal and gaiety. We at Indian Holiday take you on tours to Jammu and Kashmir that provide you with an exclusive opportunity to be a part of these memorable celebrations.

Almost all the major Hindu festivals in India are celebrated with equal enthusiasm in the state of Jammu and Kashmir. Some of such prominent fairs and festivals in Jammu and Kashmir include Lohri, Holi, Navratri, Baisakhi or New Year Day, Guru Ravi Das's Birthday, Tihar and Samkrant. People from across Jammu and Kashmir gather in large numbers during the time of these festivals. Interestingly, all Hindu, Muslim or Sikh fairs and festivals are religiously observed in the entire state of Jammu and Kashmir.

6.6.4 Transportation Profile of the state

Roads

Jammu and Kashmir has a wide range of road network that connects all the cities. The major highways in Jammu and Kashmir are NH 1, NH 3, NH 44, NH 144, NH 244, NH 144-A, NH 301, NH 444, NH 501, NH 701, NH 701-A, Srinagar-Jammu National Highway, Udhampur -Jammu Highway and Skardu Kargil Road. A detail road network in the state is shown as below in the map.

National Highway 1

NH-1 is a national highway in the Indian state of Jammu & Kashmir. NH 1 comprises parts of old NH1A and NH1D. The number 1 indicates, under the new numbering system, that it is the northernmost East-West highway in India.

NH 1 passes from Uri to Baramulla, Srinagar, Sonamarg, Zoji La, Dras, Kargil and Leh. The route passes through high mountain passes and most of the road clings to mountainsides. The NH is the lifeline of the Ladakh region. An alternative route, the Leh-Manali Highway, exists but it climbs over even higher mountain passes. NH 1 passes near the India-Pakistan border.

National Highway 44

National Highway 44 is the longest-running major north–south National Highway in India. It begins from Srinagar and terminates in Kanyakumari; the highway passes through the states of Jammu and Kashmir, Punjab, Haryana, Delhi, Uttar-Pradesh, Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu.

National Highway 144

National Highway 144 is a national highway in state of Jammu and Kashmir in India. NH-144 is a branch of National Highway 44. It passes through Domel, Katra, Riasi, Pauni and Bamla.

National Highway 144-A

National Highway 144A is a national highway in State of Jammu and Kashmir in India. NH-144A is a spur road of National Highway 44 which passes through Jammu, Akhnur, Naoshera, Rajauri, Punch.

National Highway 244

National Highway 244 (NH 244) is a National Highway in India. It is located entirely within the state of Jammu and Kashmir. It was originally called National Highway 1B. NH 244 starts at NH44 near Khanabal, Achabal, Kokernag, Daksum, Sinthan pass (Elevation: 3748 m), Chatroo, Kishtwar, Doda and terminates at NH44 near Batote. Our project road lies in this stretch from Khellani to Chatroo having project length of 96.050 Km.

National Highway 301

NH 301 is a national highway in India. It is a spur road of National Highway 1.NH-301 traverses the state of Jammu and Kashmir in India. It provides route for Kargil to Padum.

National Highway 701

NH 701commonly referred to as NH 701 is a national highway in India.It is a spur road of National Highway 1.NH-701 traverses the state of Jammu and Kashmir in India. And it connects Baramulla - Rafiabad - Kupwara – Tangdhar.

National Highway 444

NH 444 is a national highway entirely in the state of Jammu and Kashmir in India. NH 444 is a branch of National Highway 44 which connects Srinagar - Badgam - Pulwama - Shupiyan - Kulgam – Quazigund.

National Highway 501

NH 501 is a national highway in India. It is a spur road of National Highway 1. And it traverses through Jammu and Kashmir connecting Panchtarni - Chandanwari - Pahalgam - Batakut - Martand – Khanabal.

Jammu-Srinagar National Highway

The Jammu-Srinagar National Highway is the northernmost segment of NH 44. It runs from Srinagar in the Kashmir Valley southward to the city of Jammu. It is one of the two road links that connects the Kashmir Valley with the rest of India. The traffic on the highway is controlled by two control rooms, one in Srinagar and the other in Jammu

Udhampur Jammu highway

Udhampur Jammu highway is the national highway and the road in Jammu and Kashmir that connects municipal committee of Udhampur with Jammu City. The highway is 64 kilometres long passing through lofty mountain terrains. The highway also provides road link which connects Katra with rest of India. The highway is the small part of Srinagar Jammu National Highway.

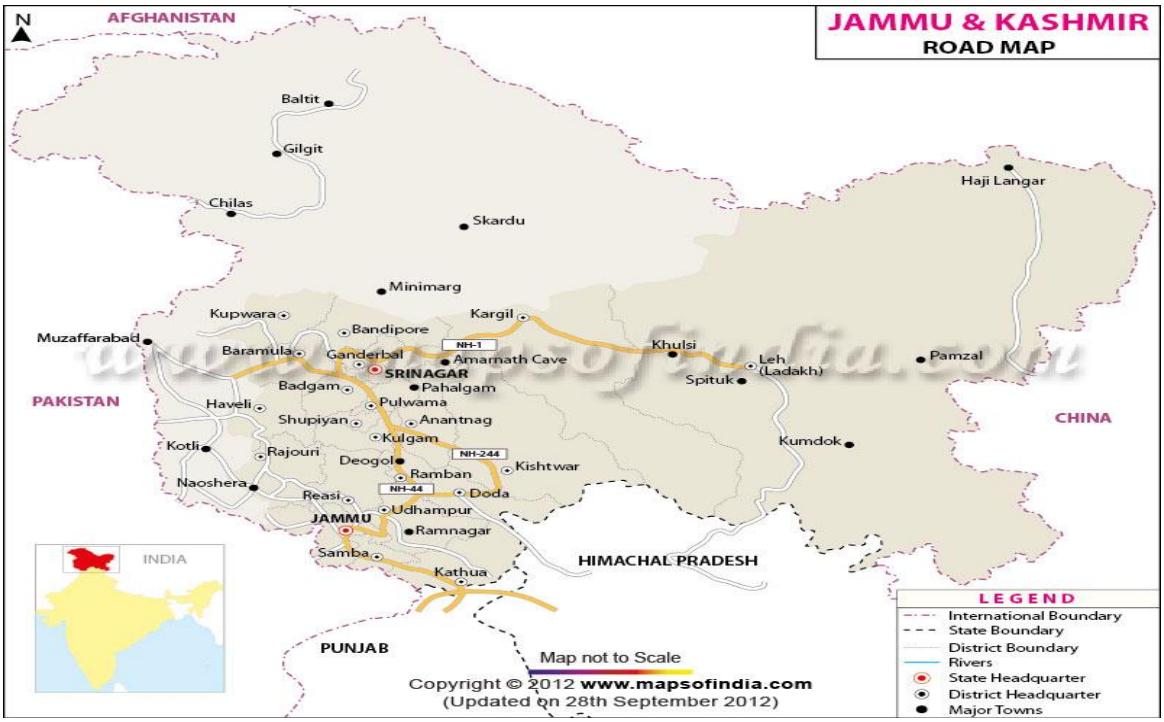


Fig 6.5: Jammu and Kashmir Road Map

Railways

Jammu & Kashmir have railway network of only 238.77 kms. The state government has recognised the crucial role of railways in the process of economic development and in response to that the government of India has also extended full cooperation in all respects by providing technical and financial support for developing railways links in the state at a very fast speed.

The Jammu–Srinagar–Baramulla railway line is a railway track being laid to connect the Kashmir Valley in the Indian state of Jammu and Kashmir with Jammu railway station and hence to the rest of the country. This railway line will connect the state with mainstream of country and will lead to boost in trade, economy and tourism in the state.

The list of railway stations in J&K and Ladakh can be divided into 3 parts:-

- Railway stations in Jammu Region
- Railway stations in Kashmir Region
- Railway stations in Ladakh Region

A detail Railway network in the state is shown as below in the map.

Fig 6.6: Jammu and Kashmir Railway Map

6.6.5 Trade and Tourism:

Jammu & Kashmir with its vast potential and growing economy has immense potential for the sustenance of the tourism industry. Tourism has historically remained an instrument of economic growth in the State of Jammu & Kashmir and has contributed a lot in developing the economy, particularly in Kashmir Valley and Ladakh. This sector has given jobs to many people and generated economic activities especially in the tertiary sectors. Its impact is visible in-service industry sectors of the State such as transport, hospitality, horticulture and small-scale industry. The tourism activities at a particular place are directly related to the arrival of tourists at that place. The more the arrival, the more economic activities get generated and make impact on the related sectors accordingly. Tourist expenditure generates multiple effects on the service sector such as agriculture, horticulture, poultry and handicrafts.

Jammu & Kashmir is an important tourist destination and has been a place of attraction for tourists since centuries. The lush green forests, sweet springs, perennial rivers, picturesque alpine scenery and pleasant climate of Kashmir valley has remained an internationally acclaimed tourist destination, whereas Jammu region is attracting many pilgrim tourists and the important destination has been Shri Mata Vaishno Devi Shrine at Katra.

6.6.6 Industrialization in Project Influence Area:

Main industrial activity is concentrated in the Jammu and Kathua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of raw material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The Industry sector has been declared as the main vehicle for accelerating economic activity besides providing employment opportunities to the unemployed educated youth in the State. To attract investment, the State government has come up with a new eco-friendly industrial policy in 2004, which is valid until 2015. The industrial policy is designated to promote rapid industrialization and has evoked a great deal of interest in the private investment. The policy has slew of incentives in the form of subsidies for all sorts of industries, especially for small-scale industries to make them capable of competing in the present market. The policy also lays emphasis on promoting industries based on local raw materials and skills. The State has set up two industrial growth centers - one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

- Horticulture
- Floriculture
- Handloom & Handicraft
- Tourism.
- Mineral based Industries.
- Gem & Jewellery
- Sericulture
- Information Technology
- Pharmaceuticals
- Insecticides
- Pesticides
- Electronics
- Hardware

The key industrial clusters are located at:

- Industrial Complex Bari Brahmana, Jammu
- Industrial Estate, Gangyal, Jammu
- Industrial Growth Centre, Samba, Jammu
- Industrial Infrastructure Development Project (IIDP), Udhampur
- Expert Promotion Industrial Park (EPIP) Kartholi, Jammu
- Industrial Complex Rangreth, Srinagar
- Industrial Complex Lassipora, Pulwama, Kashmir
- Industrial Complex Khunmoh, Srinagar

- Industrial Complex, Zainkot, Srinagar
- Industrial Estate, Zakura, Srinagar
- Industrial Growth Centre, Ompora, Budgam

Infrastructure

Housing

As per the census 2001 there were 155768 households in the state. The average household size is 6.5%. In urban areas, the average household size is little less i.e., 6.4%, the corresponding household size in rural areas is 6.6%.

Census 2001 has revealed that 55% of the households occupy permanent house whereas 32.16% resided in semi-permanent houses and 12.68% of household in temporary and unclassifiable houses.

Airports

Jammu and Kashmir have a very large area under mountainous topography, in difficult terrains like high mountainous areas of Leh and Kargil when road connectivity is disrupted during winter months due to heavy snowfall, the airways are the only source of access to such places. Airways connect all the three regions of the state with other parts of the country and abroad.

Out of the three airports of the state, Srinagar airport has been upgraded as international airport named as Sheikh-ul-Alam airport, whereas the facilities at Jammu and Leh airports are also being upgraded. One more airport at Kargil headquarters has been connected by decota service. Although some areas have been covered by helipads, the difficult terrain and scattered area in the state need more airports and better connectivity. For promotion of tourism in the state starting of air taxi services between Katra-Bhaderwah is also under the consideration.

6.6.7 Sources of Employment:

J&K has agro-climatic conditions best suited for horticulture and floriculture. Horticulture is the mainstay of the rural economy, providing employment to large number of local inhabitants. The state's share in the overall apple production in India increased from 65.97 per cent in 2013-14 to 69.15 per cent in 2015-16, with the overall production of apple in the state reaching around 2.00 million metric tonnes (MT) in 2015-16. The state is also a major exporter of walnut & its international market share is about seven per cent.

At current prices, the gross state domestic product (GSDP) of Jammu & Kashmir was US$ 17.73 billion in 2015-16 and has expanded at a compound annual growth rate (CAGR) of 10.2 per cent from 2004-05 to 2015-16. As of November 2015, J&K had a total installed power generation capacity of 3,142.34 Megawatts (MW), comprising 1579.81 MW under central utilities, 1511.53 MW under state utilities and 51.00 MW under private utilities.

Key Sectors:

Food processing and agro-based industries (excluding conventional grinding and extraction units) thrive in the state due to an excellent climate for horticulture and

floriculture. Handicrafts has been receiving priority attention from the Government in view of its large employment base and exports potential. J&K is famous for its small-scale and cottage industries such as carpet weaving, silks, shawls, basketry, pottery, copper and silverware, papier-mâché and walnut wood. J&K SIDCO is the nodal agency for promotion and development of medium- and large-scale industries in the state. To boost infrastructure, J&K has approved funding of about US$ 1.8 billion. Additionally, US$ 120.07 million is earmarked under the Pradhan Mantri Gram Sadak Yojana during 2015-16.

6.7 Stakeholder Consultation

Definition of Stakeholder

Stakeholders are the individuals or groups that are likely to affect or be affected positively or negatively by a proposed project or activity. Stakeholders play a very important role in deciding the course of project implementation.

It is very much essential to address the interests of the stakeholders in implementation of the proposed project and to modify/accommodate their views in the project plan or programmed. It is crucial to develop the co-operation between stakeholders & the project team to ultimately achieve the successful completion of the project. Benefits of reaching out to stakeholders through surveys and one-on-one meetings consultations are:

- **Quality input leads to quality decision-making**. A broader perspective reduces "group think", helps to challenge traditional thinking, and sparks creativity in problem solving.
- **Greater stakeholder satisfaction with the final planning product** comes from their involvement in shaping it.
- **The chances of successful implementation increase** as more stakeholders feel committed to the plan or project's goals and take ownership of the plan's design.
- **Good governance, transparency and open communication** are served when we communicate and receive feedback from stakeholders, instead of being guided by personal agendas.

Types of Stakeholders Consulted for Feasibility / Screening Studies

In our present study, most important stake holders are the public living by or near the project road, Road development/construction department officials including project implementation unit, forest officials and NGOs working in the locality. These stakeholders hugely influence the process of project decision making.

Stakeholders were identified to ensure as wide coverage as possible of the project area as follows:

- Households in the project area including potential Project Affected Persons
- Local voluntary organizations / Non-government Organizations (NGOs)
- Government agencies / forest department
- Community leaders

Questionnaire survey/discussions were designed to obtain background information and details of general environmental issues that concern people in the project area. In addition, environmental issues were discussed with relevant government officials, beneficiaries and community leaders.

Details about the Consultations Carried Out

Rodic Consultants Private Limited has tried to consult for external input & tried to bring important new points of view to planning.

6.8 Existing Key socio-economic issues and Risks of the Project

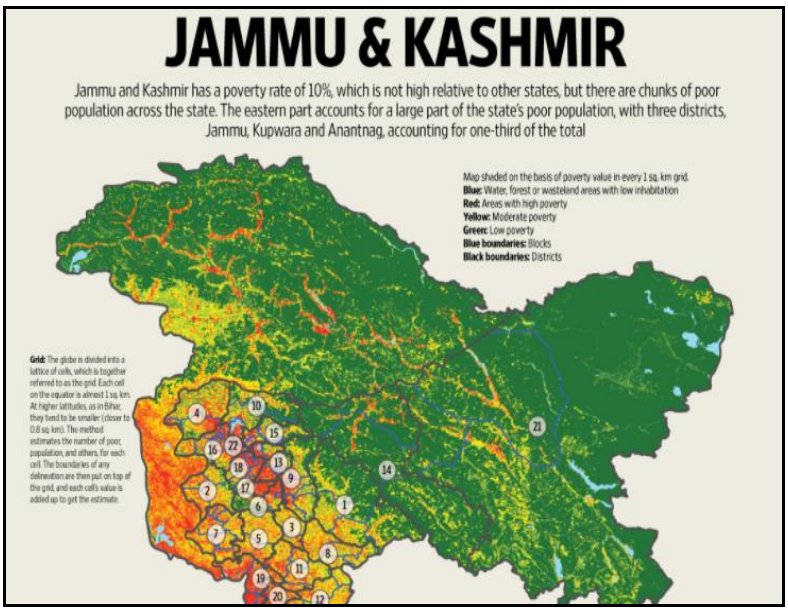
Poverty:

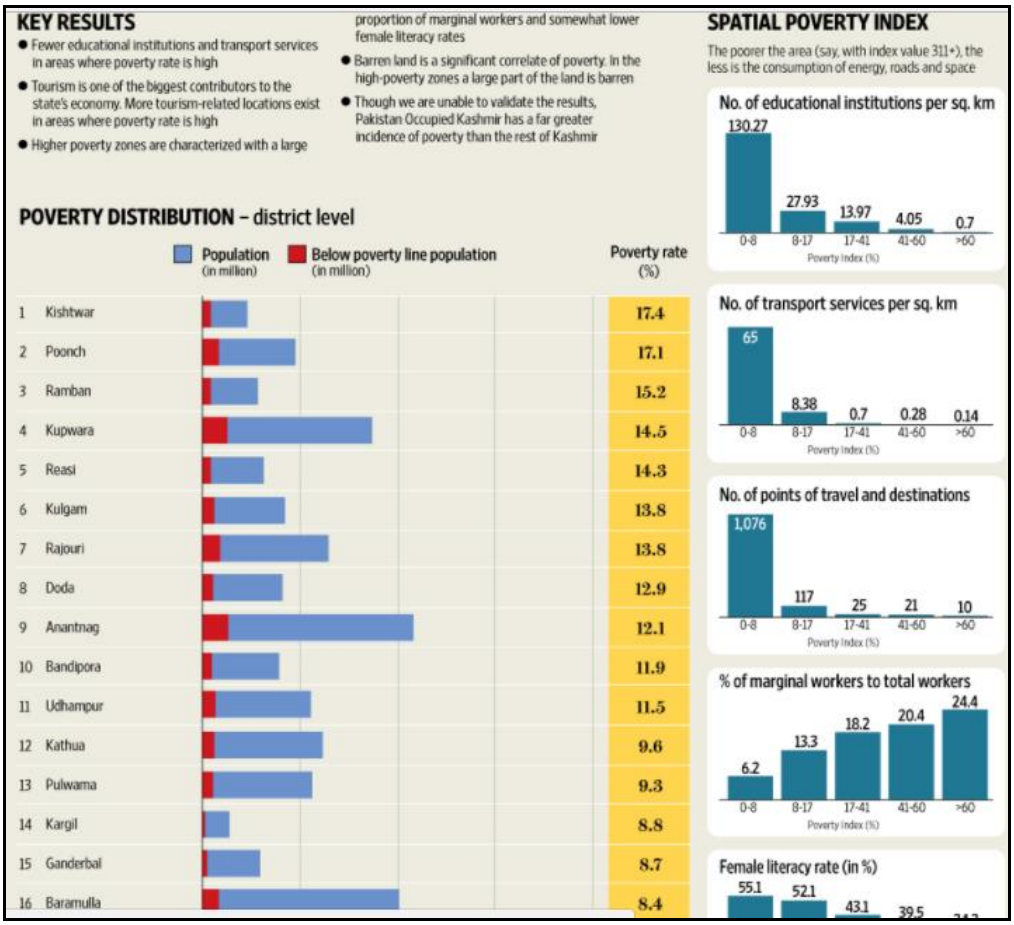
Since 1989, terrorist activity and violence have shattered peace and disrupted economic stability in Jammu and Kashmir. The constant threat to economic resources from rising militancy has led to its over-dependence on central government funding. Economic growth of the state measured in terms of per capita gross domestic product (GDP) from 2004-05 to 2013-14 was 12% per annum, at least 2 percentage points lowers than the national average.

With this slow growth, the state could do very little to reduce the poverty rate during this period. As per the Tendulkar Committee's poverty estimates, poverty reduction in the seven-year period since 2004-05 has been merely three percentage points, from 13% in 2004-05 to 10% in 2011-12, compared with an average decline of 15 percentage points at the national level.

Though the extent of poverty (10%) in the state is not high relative to other states, a telescopic view shows chunks of poor population across the state. The eastern part of the state accounts for a large part of its poor population. The three districts, Jammu, Kupwara and Anantnag together account for one-third of the total poor in the state.

Fig 6.7: Poverty Index of Jammu and Kashmir





Access to government programs:

The government response:

The enforcement authorities at the district such as department of labour and police and Department Women and Children, Department of Education, Department of Civil supplies hardly have any clue or data about the movement of people. In the process of human mobility, the migrants are left out from grassroots governance process and stay away from Gram Sabha, General Elections, poverty survey and the ongoing Census operations and UID (Unique Identification) is going to bypass lakhs of migrant unaccounted. In the past, thousands of hapless peoples include women, children and labourers were rescued in distress from various states are yet to be rehabilitated by the administration. Undoubtedly, the MNREGA and the array of food entitlement have the necessary element of reducing distress migration and poverty. While, the MNREGS can provide gainful employment and create livelihood assets, food security will be met from the food entitlements. However, it all depends whether the administration gears up the programme and target it to address the distress situations. Till today, most of the programmes are in state of despair and yet to fulfil its key objectives. The government of India under its National Disaster Management Authority clearly laid down guidelines for effective response and disaster management. All most every State today has a policy, plans and infrastructure towards mitigation and reduction of disasters and its effects. The disaster risk reduction (DRR) mandate of the government is a well-articulated step towards making the community disaster resilient. It is often observed that, due to

lack of preparedness and adequate relief and rehabilitation, poor people tend to move out to safer places and become vulnerable to migrate to far-flung areas. Hence, timely response and rehabilitation help the people to overcome the shocks of disasters. The impact of climate change on farmer, fishing communities and the forest dwelling communities will further alienate from their traditional livelihood and make them vulnerable to migrate to sustain their livelihood. Migration sometime regarded as alternative livelihood for the people. Due to rapid industrialisation and infrastructure building, there is a huge demand and need for skilled person power requirement in various sectors. And finally, the migrant who are outside of the realm of social security, food security and various labour welfare measurers should be adequately addressed. Both the sending states and the receiving states need to have a proper coordination to create win-win situation for the migrants.

6.8.1 Other social issues and Risks to be managed under the project.

Women Empowerment:

Jammu and Kashmir is considered as one of the poorest states in India. Apart from high incidence of poverty, social and human development indicators reveal persistent gender, caste and class disparity. Women fare worse than men with respect to most of the indicators. The gender disparity is too glaring for any further neglect in development strategy; Educational improvements in the overall sense have been modest, yet these are expectedly socially skewed with the backward sections being most deprived. This reality affects the nature of women's labour market participation quite adversely. The vulnerability of women is also reflected by their lower participation rate in the labour market.

Poverty in Jammu and Kashmir is predominantly rural. A large proportion of the population is landless and near landless, and therefore most of the rural poor tend to depend on agricultural wages or casual non-farm jobs for income. Over the years seasonal migration of mainly male workers in search of alternative income opportunities has substantially increased. There have been some positive developments about the empowerment of women in the state. A very important development is the provision of 50 per cent reservation for women in all three tiers of the local bodies. This is a recent introduction and its impact on the lives of women has not been systematically examined so far.

6.9 Resettlement policy and Framework

Resettlement and Rehabilitation Framework

- Verify the legal boundaries of the Right of Way according to the revenue records
- Establish the likely types of economic and social impact on people including on private land, traditional and customary rights, lease land, common property resources, different usage
- Establish the cut-off date for entitlements; d) Carry out market surveys to establish the likely monetary allowances for each
- Entitlement; e) Carry out meaningful public consultation with project affected people and other
- stakeholders on the types of R&R measures to ensure that the livelihood of the

affected people will be improved;

- Assess the capacity of Institutions to implement monitor and evaluate the R&R program

Prepare the draft R&R framework that is based on the following principles;

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons affected/displaced by the project to share in project benefits;
- Affected/displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs
- Affected/Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them in real terms, to pre- displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. This will be inclusive of full replacement cost for losses of assets attributable directly to the project, assistance during relocation, residential, commercial sites agriculture sites, transitional and subsistence allowance;
- Special provisions for the vulnerable to provide them with development opportunities

6.10 Land Acquisition and Budget

6.10.1 General

Land is the most vital resource of a region. It is a fixed asset and cannot be expanded to the need of an increasing population. Therefore, every effort is to be taken to achieve optimum land utilization. In a country like India where cropped land is at premium, land acquisition always has a negative impact on the population in general and agricultural population. Land acquisition is a major concern in a highway development project. In Indian situation, the settlements are normally compact and linear; if abetting a road, the land holdings are small and people have very close sentimental relationship with religious / worship places. Land acquisition for even a small width may have wider implications across the family. At the same time, development of infrastructure like highways is basic to the development of the regional and national economies and need to be developed even if some loss to properties and assets are involved. Generally, land acquisition in a highway project is done not only for the present requirement of road construction, but also considering the future requirement if land is available without eroding the social structure.

6.10.2 Social Management Framework and budget estimates.

Institutional Arrangements

Effective implementation of the RP will require joint efforts of the Collector of

Districts; district administration; Land Acquisition Officer, revenue department engaged NGOs and CBOs; and affected communities and PAPs. The RP includes actions and commitments by GoB to coordinate the work of the districts block and village level committees, along with NGOs contracted. District/block level R&R committees will be formed, consisting of the LAO, Tehsildar (Revenue Officer), Block Development Officer (BDO), Sub-Divisional Magistrate (SDM), Panchayats Samiti representative (Pradhan), NGO partners and CBO/PAP representatives with the District Collector as Chairperson.

Village/hamlet level R&R committees will also be formed to implement the RP activities in the field, consisting of Patwari, Gram Panchayats representatives/Sarpanch, PAPs/CBOs, NGOs and other stakeholders. All officers and staff appointed by the appropriate Government under this policy shall be subordinate to the Administrator for Resettlement & Rehabilitation. The State Government shall appoint an officer of the rank of Commissioner / Secretary of that Government for resettlement and rehabilitation in respect of such projects to which this policy applies to be called the Commissioner for Resettlement & Rehabilitation. For this Policy, the Administrator for Resettlement & Rehabilitation and other officers and employees appointed for the purposes of resettlement and rehabilitation of PAPs shall be subordinate to the Commissioner for Resettlement and Rehabilitation.

The Commissioner shall be responsible for supervising the formulation of resettlement and rehabilitation plans / schemes, proper implementation of such plans / schemes and redressal of grievances R &R Policy. Wherever tribal PAPs are involved, Commissioner, TW shall also be involved in above responsibilities and functions.

Entitlement: R&R Benefits for project affected families

The resettlement and rehabilitation (R&R) benefits shall be extended to all the Project Affected Families and Project Displaced Families (PAF) whether belonging to below poverty line (BPL) or non-BPL except to the extent where specifically restrictions mentioned in the policy.

Budget for RAP

To assess the budget for implementation of RAP, the cost estimate has been sub-divided into costs of Private land, Private buildings, Transitional allowance, relocation of Community assets, development of Resettlement sites and Training & Administrative measures. The budget has been prepared based on the market rates as well as the official rates..

6.11 Environmental and Social Management & Capacity Building Consultant

Public Works Department, J&K appointed consultant at implementation stage for Environment Management & Capacity Building (EMCB). The consultant shall be responsible for

- Review institutional capacity of PWD, J&K and PIAs vis-à-vis environmental management in general and addressing environmental issues
- Identify organizational needs in terms of structure, resources (facilities, and

staff), roles and responsibilities in PWD / PIAs.

- Develop and plan training programmer including:
- Identification of different training modules covering various courses at different levels (initial and recurring)
- Identification of trainers
- Development of training programs for each module
- Development of training material for each module (slides, videos and information support material)
- Planning a training schedule
- Development of a mechanism for training feedback assessment
- Conduct or organise training program according to the above program and provide feedback on the effectiveness of the training.
- Helping to develop uniform codes of practice for construction management for all PIAs that integrate all relevant environmental concerns upstream in subprojects (based on a review of what currently exists within the PIA's)
- Assisting in supervision of studies to be undertaken under the project, for example study on noise levels along the project road to be undertaken to map the noise levels with respect to sensitive receptors with a view to recommending adequate mitigation measures.

6.12 Recommendation and Conclusion

6.12.1 Recommendations

Keeping in view the general scope for socio-economical parameters and most importantly sustainable environment and economic development, the following conclusions and recommendations have been drawn:

- Present road needs improvement as it needs to accommodate ever growing traffic.
- Road safety is a critical issue in the present scenario as there is a possibility of high rate of accidents. Also, critical sections identified are to be developed as "speed restriction zone".
- In addition, local slow moving traffic adds to the fast moving traffic on NH, thus causing reduction in traffic speed and increased travel time. If existing national highway can be developed without considering the proposal of bypasses, then major R&R issues and conflict between pedestrian, non-motorized traffic, local traffic and through traffic will be the issue of concern both at present and future stage. Also plenty of trees, sensitive receptors, religious properties and community properties are expected to have adverse effect.
- One of the major issues that surfaced during the public consultation was drainage of carriage way & drainage facility along the road side. This need to be developed to prevent houses/shops getting inundated during heavy rains.

Summary of Key Benefits from the sub-project / Project Intervention

Availability of adequate and quality infrastructure is a pre-requisite for rapid development of any economy. Region of the project road being one of the emerging economic & densely populated areas of Jammu and Kashmir, it has quite high traffic intensity on roads due to considerably increased growth. The existing road is not capable to cater to increasing traffic demand due to rapid development in project influence area.

Improvement in the project road will result in the following benefits:

- Providing better level of service in terms of **improved riding quality** and **smooth traffic flow.**
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc. Mostly people of two the Anantnag district will get benefitted by this.
- Local people will get more benefit for all the point
- With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
- Introduction of additional safety measures like crash barrier, road illumination, retro-reflective boards, delineators etc. will result in lesser accidents.
- **Increased passenger comfort** due to good road condition shall be an added benefit.
- It will increase access of the villages and other small settlements to urban areas, thus **providing connectivity** of rural produce to urban markets, thereby enhancing the reach and export of perishable farm-goods, leading to better remuneration for the producer.
- The reach and export of perishable farm-goods will have quite a positive impact and this will prove to be a boon for the rural agricultural sector.
- Providing connectivity to the urban infrastructure.
- **Rural industrial produce**, whether from cottage industries, small-scale industries or medium-scale industries will have easy access to the urban markets. Especially silk industries in Bhagalpur are sure to get benefitted.
- **Strengthening of rural economies:** The rural sector / economy is sure to get strengthened, though at a gradual pace.
- **Higher education**: Education is one of the most dominant indicators towards the development of a region. Though primary education facilities are present along the project road, access to high schools, higher secondary schools and colleges is not so easy at present. Provision of easy access to higher education can be directly linked to the improved educational scenario.
- **Access to medical facilities:** Villages in the project region are not yet well-equipped with all types of medical facilities and services like Public Health Centres (PHCs), dispensaries, hospitals. Due to inaccessibility, reaching even

the nearest health centre sometimes becomes a colossal task. Even the doctor's reluctance will be converted into willingness to visit these areas after widening and improvement of the project road.

- By reducing the transportation costs, it will be more feasible to transfer construction materials which are important for many economic activities (house building, school building, small hydro-electric, projects etc) to hinterland. This will in turn, lead to direct as well as indirect strengthening of local economies.
- During the execution of the project, i.e. during the construction period, employment will be provided to workers from the local communities.

  The educated as well as uneducated people from villages will obtain access to new employment centres**.**
- The improvement of the road will reduce the number & frequency of collisions. This would be very beneficial from the safety point of view and will thus, reduce accident rate.
- Overall improved quality of life for the lesser developed areas in the neighbourhood.

Value Addition

- Aesthetic enhancement: Landscaping & road side plantation.
- Wayside facilities: Truck-lay byes, footpaths etc.
- Bypasses, under/over bridges, raised carriageway.
- Better road safety, signage and improved road surface.

Key Recommendations from Stakeholder Consultation Exercise

Based on the stakeholder consultation, the following recommendations are made:

- Drainage of carriage way & drainage facility along the roadside need to be developed to prevent houses/shops getting inundated during heavy rains.
- Road safety features need to be upgraded to reduce/bring down the frequency and number of accidents.

Summary Opportunities and Constraints at the sub-project Level

Opportunities:

With this project taking place, following opportunities are anticipated for the public:

- Improved road will indeed result in increased productivity, lesser transportation costs, lesser vehicle operating cost, increased access to urban markets for rural agricultural/non-agricultural products.
- Better connectivity to urban infrastructure for rural industrial products, there by strengthening rural economy.
- Better access to Health and educational facilities will lead to improved health and educational scenario in the project region. Also, this would be followed by many economic activities.

Constraints:

- There are many encroachments in the project road, so the process of widening the road at required sections may pose some opposition, as it will result in the loss of livelihood of some persons.
- Cost of land acquisition of non-forest land (Agri/non-agri) will be involved, to avoid huge R&R costs if the road is aligned in the existing densely populated settlements. This would further involve compensation amount given for displacement.

Chapter 7

Environmental Impact Assessment of the Project Influence Area

7.0 ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROJECT INFLUENCE AREA

7.1 Introduction

7.1.1 Project Description

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to two/four laning with paved shoulder according to NH Configuration.

In pursuance of the above, **M/S Rodic Consultants Pvt. Ltd**., New Delhi in joint venture with **M/S Monarch Surveyors and Engineering consultant Pvt. Ltd.** have been appointed as Consultants to carry out the "Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir. The agreement was signed on 4th June 2019.

This project section deals with Vailoo- Khanabal section from ex. Km. 235.000 to Km. 269.000 [Proposed Chainage km 148.589 {Vailoo} to km 176.532 {Donipawa}].

7.1.2 Project Proponent

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India

7.1.3 Description of the Project

The entire proposed project road is in the union territory of Jammu and Kashmir. The UT occupies a total area of 42,241 square kilometres. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south and Ladkah to the east. Jammu and Kashmir has an international border with Pakistan on the east.

The Vailoo-Khanabal road section situated in west part of Jammu and Kashmir is having total Existing length of about 34 Kilometres. The consultants have proposed road stretch from Vailoo to Donipawa with design chainage km 148.589 to km 176.532 having total design length of 27.943 km. The project road has significant influence on Jammu and Kashmir, specifically on the Anantnag district since it lies entirely in that district. Jammu and Kashmir is located around 33.7782° N, 76.5762° E.

The Project Road starts from Existing Km 235+000 at Vailoo village and passes through Gad Wali, Wandevalgam, Zalangam, Bindoo, Bidder, Hangalgund, Dan Veth Pora, Sagam, Takia Ahamad Shah, Buchoo, Peertakia, Hiller, Hillar Arhama, Akingam, Badoora, Achabal, Koleh Garh, Thajiwara, Barakpora, Donipawa, Chitti Singh Pora, Sheerpora, Janglat Mandi, Lal Chowk, Bangidhar, Mehman Muhalla, Nai Basti and terminates at existing Km 263+107 at Donipawa. The entire length of project road has a carriageway width varying from 7.0 m – 14 m but majority of portion traverses

as carriageway of 7.0 m. Earthen shoulder of varying width from 1.0m - 2.0m exists along both sides of the road. Terrain of the project road is rolling and hilly.

The project road Vailoo – Donipawa has a very significant role since it starts near such point where the Vailoo Tunnel project ends. Thus, the project road is expected to carry the load of traffic movement coming from the Vailoo tunnel side and to transfer it directly towards the Anantnag side and eventually transferring this traffic load to NH-44 (NH-1A) at Khanabal. This proposed section will lead benefits to many built up section falling on the stretch.

The surroundings of existing road stretch consist of vegetation, orchards and even built ups.

Table 7.1: Project Road Characteristics

Existing Chainage		Road Type	Carriageway width	Earthen Shoulder		Median Width	Road way Width	Pavement Condition
Start	End			Left	Right			
235+000	245+300	Bitumen	7	1	1	-	9	Good
245+300	246+500	Bitumen	7	2	2	-	11	Good
246+500	248+000	Bitumen	7	1.5	2	-	10.5	Good
248+000	251+200	Bitumen	7	2	2	-	11	Good
251+200	265+500	Bitumen	7	1	1	-	9	Good
265+500	266+200	Bitumen	14	-	-	1.5	15.5	Good
266+200	266+300	Bitumen	14	-	-		14	Good
266+300	267+300	Bitumen	14	-	-	1.5	15.5	Good
267+300	267+600	Bitumen	14	-	-	1.2	15.2	Good
267+600	267+700	Bitumen	14	-	-	-	14	Good
267+700	267+800	Bitumen	14	-	-	-	14	Good
267+800	267+900	Bitumen	14	-	-	1.2	15.2	Good
267+900	268+000	Bitumen	14	-	-	1.2	15.2	Good
268+000	268+100	Bitumen	14	-	-	-	14	Good
268+100	268+200	Bitumen	14	-	-	-	14	Good
268+200	269+000	Bitumen	14	-	-	1.2	15.2	Good

7.1.4 Over – View of Major Key Project Activities

The following major activities are involved for the design and construction of proposed project road:

a) Widening

b) Geometric Improvement

c) Proposed Pavement & Overlay

d) Traffic Control and Safety Measures

e) Bridge and Cross Drainage Structures

7.1.5 Need for the Project Activities

Widening:

The whole section of the road is being reconstructed.

Requirement of realignment

The concept of alignment design is to upgrade the project highway within the existing right of way avoiding land acquisition, except for locations having inadequate width and where provision of short bypass, service roads, alignment corrections, improvement of intersection are considered necessary, practicable and cost effective. These are based on the findings from various engineering features carried out on the project roads such as Reconnaissance Survey, future traffic requirement, Inventory Data and Pavement Investigations.

Proposed Pavement

The Flexible pavement is adopted for proposed new carriageway, and reconstruction. Design period of 20 years considered for new carriageway.

➢**Traffic Control and Safety Measures**

Road Marking & Traffic Signs:

Pavement markings are proposed as per IRC: 35-2015, "Code of Practice for Road Marking" with centreline, edge line, continuity line, stop line, give way lines, diagonal/chevron markings and zebra crossings. The pavement marking shall be of hot applied thermoplastic paint with glass beads as per the MoRT&H specification for Road and Bridge Works, 2013(5th Revision, latest reprint).

Appropriate road safety measures are provided with stop signs, give-way signs, traffic merging and diverging signs, lane closure signs, compulsory keep left/right signs or any other signs as per IRC-67. Advance cautionary signs are proposed for sharp curves along with chevron signs at the outer edge of the curves.

Proposal for Truck Lay byes/Parking cum Rest Area

As per the detailed field surveys and reconnaissance, truck lay bay/ Parking cum rest areas are not proposed in this stretch.

Toll Plazas and Weighing Stations

No Toll Plaza is proposed for the entire length of the project road.

Bridge and Cross Drainage Structures

There are 14 numbers of existing minor bridges and 01 existing Major bridges exists along the project road.

Culverts

There are 01 Pipe culverts and 105 Slab culverts on existing project road.

Proposed design standards:

Table 7.2: Summary of Recommended Design Standard

Design Standards			
	Design Speed (Km/hr.) as per IRC SP:73-2018		
(i)	Plain/Rolling Terrain	:	100 (Ruling), 80(Minimum)
(ii)	Level of Service	:	B
(iii)	Roadway Widths (m) as per IRC SP:73-2018 (modified as per Circular RW/NH-33044/22/2020-S&R(P&B) dtd.-17th July 2020)	:	7 m for 2-lanes carriageway , Paved shoulder and earthen shoulders of 1.5 m and 1.5 m respectively on either side.
	Plain/Rolling Terrain		
	Mountainous Terrain		11 m for 2-lane carriageway, with paved shoulders of 1.5m on either sides and earthen shoulder of 1.0m on valley side.
(iv)	Roadway Elements as per IRC SP: 73-2018, Plain/rolling Terrain with Paved and earthen shoulders either sides.	:	Carriageway 2-lane - 2X3.5m Paved Shoulder: 2x1.5 m Earthen Shoulder: 2x1.5 m
(v)	In built-up area roadway width as per IRC: SP-		2x7m carriageway with 0.6m wide

Design Standards			
	84:2019 (for 4-lane divide carriageway)		median and railing
(vi)	Camber as per IRC SP:73-2018	:	Carriageway Flexible- 2.50% Rigid - 2.00 % Paved Shoulder Flexible- 2.50% Rigid - 2.00 % Unpaved Shoulder Flexible- 3.50% Rigid - 3.00 %
(vii)	Right of Way	:	As per Plan and Profile
(viii)	Embankment/ Cutting Slope	:	
	Fill height, up to 3.0 m		In filling- 1V: 2 H
	Fill height from 3.0 m to 6.0 m		In filling- 1V: 1.5 H
			To be designed based on soil parameters, (IRC:75-2015)
	Fill height exceeding 6.0 m		In cutting- 1V:1H
(ix)	Minimum Sight Distance	:	90 m for design speed of 40 km/hr 180 m for design speed of 60 Km /hr 240 m for design speed of 80 km/hr 360 m for design speed of 100 km/hr
	Overtaking sight distance	:	165 m for design speed of 40 km/hr 340 m for design speed of 60 Km /hr 470 m for design speed of 80 km/hr 640 m for design speed of 100 km/hr
(x)	Super-elevation (As per IRC: SP:73-2018) Clause No-2.9.3	:	7%, if radius of curve is less than 400 m (Desirable Minimum) 5%, if radius of curve is more than 400 m (Absolute Minimum)
(xi)	Radii for Horizontal Curves as per IRC SP:73-2018 Plain/Rolling Terrain	:	Ruling (Desirable) Minimum Radius 400m, Absolute Minimum Radius 250 m
(xii)	**Gradient** (As per IRC: SP:73-2018) Clause 2.9.7.2		
	Plain/Rolling Terrain		
	Ruling	:	2.5%
	Limiting	:	3.3%
	Mountainous Terrain		
	Ruling	:	5.0%
	Limiting		6.0%
(xiii)	**Minimum k factor**		
	Summit Curve		
	Plain/Rolling Terrain	:	Desirable: 135
			Minimum: 60
	Valley Curve		
	Plain/Rolling Terrain	:	Desirable: 41.5
			Minimum: 25.3
(xiv)	**Bridge Clearance**		
	Vehicular underpass	:	5.5 m
	Light and Smaller Vehicular Underpass	:	4.0m
(xv)	Design Flood Frequency		
	Bridges	:	100 years
	Sewers and Ditches	:	60 years

7.1.6 Expected benefits from the projects:

Following are the expected benefits due to the improvement in the project road:

- Better level of service in terms of **improved riding quality** and **smooth traffic flow.**
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc.
- With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
- Increased road landscaping and safety features.
- Enhanced connectivity between rural & urban population which will benefit the all sections of the society like general population, small-medium-large scale industries, farmers, businessmen etc.
- Improved access to higher education facilities & modern health facilities.
- Strengthening of both rural & urban economies which in turn will improve economic scenario of the state and country.
- Improved road connectivity helps in better implementation and management of government schemes.
- With improvement in economy, more generation of employment opportunities.
- Overall improvement of the region.

Various studies/reports being prepared for the project and how the environment screening study relates to feeds into the overall project preparation.

- Various studies/reports being prepared for the project.
    - Inception Report
    - Feasibility Report which includes Environmental Screening
    - Environmental Impact assessment & Social Impact Assessment Reports.
    - Detailed Project Report.
- The environment screening study relates to feeds into the overall project preparation at various stages.

The various activities / components involved in the project include design process and construction activities. Some of the major activities likely to take place to implement the proposed up-gradation / improvement project are: Site clearing & grubbing, earthwork, pavement removal, granular sub-base, water bound macadam sub-base / base, bituminous pavement layers, pavement widening, drainage, safety measures, bridge & culvert improvement, waste material management, equipment staging & materials, aggregate and sand quarries etc. These major activities have been considered while finalizing the methodology for the impact assessment of the

project.

Table 7.3: Details of Environment Features

Project Component for Design	Details of Env. Features
Alignment	
Geometric Design & Cut / Fill Balance	Final alignment should be determined to minimize land take, air pollution, and the impact on people and animals and to avoid unfavourable geological condition and cultural relics. Unusable debris shall be disposed at nearest disposal sites as approved by engineer.
	The design should attempt to equalize cut and fill. The centreline should be aligned so that on all slopes below 60 degrees, half cut, and half fill can be achieved.
	The improvements to the road section may involve the cutting of some hill slopes. At few locations, amount of cut and fill work expected to be significant mainly at curves and bridge locations.
Ecology	
Roadside Plantation	Trees to be cut within the alignment shall be identified / marked with the help of forest department.
	Trees shall be removed as identified and with prior approval of the State Forest Department
Water	
Water Sources	Water resources shall be protected and enhanced by redesigning as per Enhancement measures plan
Road Drainage	Provision of adequate size and number of cross-drainage structures (culverts) as well as drains along the road
Quarries and borrow area	
Illegal and / or improper mining	Only approved and licensed Quarries and Borrow pits shall be permitted.
	Non-Productive, barren lands, raised lands, riverbeds are to be recommended for borrow material after approval of SEIAA or concern authority.
Location of Camps	
Site selection/ Location of Labour Camp/ Construction Camps	Labour Camp/ Construction camps should be located at least 500 m away from existing habitations
	All sites used for camps should be adequately drained and they should not be subjected to periodic flooding
	Camps should be located such that drainage from and through the camps will not endanger any domestic or public water supply.
	Living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer

Project Component for Design	Details of Env. Features
	Toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard
	Construction Camp should not be placed in ecologically sensitive areas
Utilities	
Relocation of utility lines / community utilities.	Affected utilities like electric poles, water pipelines, hand pumps, etc. shall be relocated with prior approval of the concerned agencies.
	All the cultural properties that have been identified as affected shall be relocated.
Road Safety	
Traffic control system	Temporary traffic arrangement during construction shall be planned in DPR.
	The concessionaire shall take all necessary measures for the traffic during demolition and site clearing activities.
Pedestrian safety	Special considerations shall be given in the local traffic management to the pedestrian safety Especially at congested locations
Environmental Quality	
Clearance/ permission for establishment of Hot mix plants/ Batching plants etc.	NOC from State Pollution Control Board / statutory authorities
	NOC for quarry sites
Noise Level - For Hot mix plant and construction machinery &At sensitive receptors.	Improved traffic speeds and riding conditions shall reduce noise levels
	Noise screening by trees plantation scheme proposed as noise barriers
	Provide noise attenuation at critical locations like Hospital, school etc.
Generation of Debris from Dismantling Structures and Road Surface	Vegetation will be removed from the RoW before the commencement of construction. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimized.
	Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval from the Environmental Expert, of Supervision consultant (SC). The concessionaire, under any circumstances will not damage trees (in addition to those already identified to be cut). Compensatory plantation will be provided for cutting of trees.

7.2 Methodology Adopted for Environment Screening Exercise

7.2.1 Purpose / Objectives of the Environment Screening Exercise:

Screening is the first stage of the EIA process. The screening procedure is necessary because of highway project (Development of Roads) and related activities that are potentially subject to EIA. It is intended to ensure that the form or level of impact on Environmental parameters review is commensurate with the importance of the issues raised by a proposal.

The conduct of screening thus involves making a preliminary determination of the expected impact of a proposed project of rehabilitation and widening of highway on the environment and of its relative significance. A certain level of basic information of the proposed project and its location is required for this purpose.

The screening process can have one of four outcomes:

- No further level of EIA is required.
- A full and comprehensive EIA is required.
- A more limited EIA is required (often called preliminary or initial assessment);
- Further study is necessary to determine the level of EIA required (often)

Screening establishes the basis for scoping, which identifies the key impacts to be studied and establishes terms of reference for an EIA. EIA systems have screening and scoping procedures. On occasion, the screening and scoping stages may overlap if a further study is undertaken to determine if the potential impacts are significant enough to warrant a full EIA.

7.2.2 Methodology (Step by Step Process) adopted for Environmental Screening Exercise:

The requirements for screening and the procedure to be followed are often defined in the applicable EIA law or regulations. PWD has appointed Rodic Consultants Private Limited, for designing along with the environmental screening. The screening is being done prior to development of the project so that the proponent and other participants are aware of the EIA obligations. It should be applied systematically and consistently so that the same decisions would be reached if others conducted the screening process.

Specific methods used in screening include:

- Legal (or policy) approach for the applicability of EIA ;
- Inclusion list of projects (with or without thresholds) for which an EIA is automatically required.
- exclusion list of activities which do not require EIA because they are insignificant or are exempt by law (e.g. national security or emergency activities); and
- Criteria for case-by-case screening of proposals to identify those requiring an EIA because of their potentially significant environmental effects.

  In this context, screening is a flexible process and can be extended into preliminary forms of EIA study. These 'extended screening' procedures include:

- Initial environmental examination – carried out in cases where the

environmental impacts of a proposal are uncertain or unknown (e.g. new technologies or undeveloped areas);

- Environmental overview – carried out as a rapid assessment of the environmental issues and impacts of a proposal; and
- Class screening – carried out for a family of small projects or repetitive activities, where the environmental effects and means of mitigation are known but there is potential for cumulative impacts (e.g. dredging, road realignment, bank stabilization).

Study Methodology:

The World Bank operational manual for piloting of the social and environmental safeguard policies procedures & practices and following Government of India's guidelines are reviewed.

- "Environmental Guidelines for Selected Infrastructure Projects".
- "Project Terms of Reference (TOR)".
- "Environmental guidelines for Road/Rail/Highway Projects", Government of India, 1989.
- "Handbook of environmental procedures and guidelines", 1994, Government of India.
- "Guidelines for Environmental Impact Assessment of Highway Projects" (IRC: 104-1988); and
- The Environmental (Protection) Act, 1986 and EIA Notification 2006 dated 14th September 2006.

The study is being carried out in following stages:

- The baseline environmental information in the study area viz., climate, physiographic features, drainage, geology, flora, fauna, ambient air, water and noise and socio-economic conditions.
- Reviews of literature, laws and guidelines and discussions with concerned agencies and organizations, National / State Authorities and on-site;
- Reconnaissance survey along with public consultation was undertaken (in the months of July-August 2015 and processes of public consultation continued till the completion of study) to inform the people about the project and collect the information / suggestions on environmental issues. The environmental data was collected within a corridor of 200 meters of centre of road. The vegetation analysis was done by counting the number of trees within corridor of direct impact and observing the vegetation density along the project road;
- Interaction with other members of the Project Team to ensure that environmental considerations were given adequate weight in project planning and design – data and other material from the Inception and Feasibility Reports have also been used for the preparation of this report; and
- The monitoring network regarding air, water and noise pollution.

- Assessment of the potential significant impacts and identification of the mitigative measures to address impacts adequately.
- The study of analysis of alternatives incorporating environmental concerns including 'Existing' and 'Proposed' project scenario and modification in the proposed project due to environmental considerations.
- The preparation of the "Environmental Screening" report.

Chapter 8

Improvement Proposals and Design

8.0 Improvement Proposals and Design

8.1 General

This chapter describes the various improvement proposals and their necessities to upgrade the existing carriageway facility of project road, if any, into two lane with paved shoulder, four lane carriageway and four lane divided carriageway or for new alignments/bypasses, in accordance to the Indian standard configuration and design standards proposed for the project road. These improvement proposals are based on the findings of various engineering features carried out on the project roads such as Traffic Survey and Analysis (Chapter-3), Inventory Data and Pavement Investigations (Chapter-4).

The improvement proposals for proposed widening include the provisions for the following major items:

a) Curvature Improvement

b) Realignment

c) Widening Proposal

d) Proposed Pavement Design

e) Bridge and Cross Drainage Structures

f) Traffic Control and Safety Measures

8.2 Design Standards

8.2.1 Summary

Following is a summary of the recommended design standards proposed to be adopted for the project road/bypass other than service road and intersections:

Design Standards			
	Design Speed (Km/hr.) as per IRC SP:73-2018		
(i)	Plain/Rolling Terrain	:	100 (Ruling), 80(Minimum)
(ii)	Level of Service	:	B
(iii)	Roadway Widths (m) as per IRC SP:73-2018 (modified as per Circular RW/NH-33044/22/2020-S&R(P&B) dtd.-17th July 2020)	:	7 m for 2-lanes carriageway , Paved shoulder and earthen shoulders of 1.5 m and 1.5 m respectively on either side.
	Plain/Rolling Terrain		
	Mountainous Terrain		11 m for 2-lane carriageway, with paved shoulders of 1.5m on either sides and earthen shoulder of 1.0m on valley side.
(iv)	Roadway Elements as per IRC SP: 73-2018, Plain/rolling Terrain with Paved and earthen	:	Carriageway 2-lane - 2X3.5m

Design Standards			
	shoulders either sides.		Paved Shoulder: 2x1.5 m Earthen Shoulder: 2x1.0 m
(v)	In built-up area roadway width as per IRC: SP-84:2019 (for 4-lane divide carriageway)		2x7m carriageway with 0.6m wide median and railing
(vi)	Camber as per IRC SP:73-2018	:	Carriageway Flexible- 2.50% Rigid - 2.00 % Paved Shoulder Flexible- 2.50% Rigid - 2.00 % Unpaved Shoulder Flexible- 3.50% Rigid - 3.00 %
(vii)	Right of Way	:	As per Plan and Profile
(viii)	Embankment/ Cutting Slope	:	
	Fill height, up to 3.0 m		In filling- 1V: 2 H
	Fill height from 3.0 m to 6.0 m		In filling- 1V: 1.5 H
			To be designed based on soil parameters, (IRC:75-2015)
	Fill height exceeding 6.0 m		In cutting- 1V:1H
(ix)	Minimum Sight Distance	:	90 m for design speed of 40 km/hr 180 m for design speed of 60 Km /hr 240 m for design speed of 80 km/hr 360 m for design speed of 100 km/hr
	Overtaking sight distance	:	165 m for design speed of 40 km/hr 340 m for design speed of 60 Km /hr 470 m for design speed of 80 km/hr 640 m for design speed of 100 km/hr
(x)	Super-elevation (As per IRC: SP:73-2018) Clause No-2.9.3	:	7%, if radius of curve is less than 400 m (Desirable Minimum) 5%, if radius of curve is more than 400 m (Absolute Minimum)
(xi)	Radii for Horizontal Curves as per IRC SP:73-2018 Plain/Rolling Terrain	:	Ruling (Desirable) Minimum Radius 400m, Absolute Minimum Radius 250 m
(xii)	**Gradient** (As per IRC: SP:73-2018) Clause 2.9.7.2		
	Plain/Rolling Terrain		
	Ruling	:	2.5%
	Limiting	:	3.3%
	Mountainous Terrain		
	Ruling	:	5.0%
	Limiting		6.0%
(xiii)	**Minimum k factor**		
	Summit Curve		
	Plain/Rolling Terrain	:	Desirable: 135
			Minimum: 60
	Valley Curve		
	Plain/Rolling Terrain	:	Desirable: 41.5

Design Standards			
			Minimum: 25.3
(xiv)	**Bridge Clearance**		
	Vehicular underpass	:	5.5 m
	Light and Smaller Vehicular Underpass	:	4.0m
(xv)	Design Flood Frequency		
	Bridges	:	100 years
	Sewers and Ditches	:	60 years

8.2.2 Road Functional Classification

"Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from (i) Km 44.500 to Km 142.000 of Chattroo Village & (ii) Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the state of Jammu and Kashmir. The agreement was signed on 4th June 2019.

This project section deals with Vailoo- Khanabal section from ex. Km. 235.000 to Km. 269.000 However, as per client's recommendation the proposed project stretch is from km 148.589 (Vailoo) to km 176.532 (Donipawa).

8.2.3 Geometric Design

8.2.3.1 General

Geometric design of a highway is the process whereby the layout of the road in specific terrain is designed to meet the needs of the road users keeping in view the road function, type and volume of traffic, potential traffic hazards and safety as well as convenience of the road users. The principal areas of control for fulfilment of this objective are- the horizontal alignment, vertical alignment and the road cross-section.

The Consultants have referred to the latest IRC publications and MORT&H circulars regarding design standards for National Highways in India. After careful review of all available data and requirements of the project road the proposed Design Standards for adoption on the project road have been recommended.

8.2.3.2 Design Speed

The project road passes mainly through plain terrain. For geometric design of the highway, design speed is used as an index which links road function, traffic flow and terrain. An appropriate design speed should correspond to general topography and adjacent land use. The speed selected for design should also cater to travel needs and behaviour of the road users.

The ruling design speed corresponding to the type of terrain as per IRC: SP: 73-2018.

Table 8.1: Design Speed Standards

Terrain Classification	Design Speed (km/h)	
	Desirable	Minimum
Plain & Rolling	100	80
Mountainous & Steep	60	40

8.2.3.3 Levels of Service (LOS)

The Level of Service (LOS) characterizes the operating conditions on the roadway in terms of traffic performance measures related to speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience. The levels of service range from level-of-service A (least congested) to level-of-service F (most congested). The Highways Capacity Manual (HCM) provides the following levels of service definitions:

Table 8.2: Standards for Level of Service

Level of Service (LOS)	General Operating Conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Considering the importance of the highway, whereas Level of Service (LOS) 'B' is desirable and level of service up to LOS- 'C' may be acceptable.

8.2.3.4 Cross Sectional Elements

Adequate roadway width will be provided for the requisite number of traffic lanes besides the shoulders and a central median dividing the traffic flow directions.

As specified in the IRC: SP-73-2018 in general, standard lane width shall be 3.5m for project highway. Based on a comparative review of international standards and safety, the values proposed to be adopted for the roadway elements by the Consultants for the project highway are as follows:

a) Roadway Width for Two Lane Highways

Table 8.3: Road Cross Section (Plain/Rolling terrain)

Item	Two-Lane with Paved Shoulder
Carriageways	2X3.5m
Paved shoulder	2X1.5 m
Earthen shoulder	2X1.0m

Item	Two-Lane with Paved Shoulder
Total Roadway width	**12 m**

b) Lane Width

Lane width has a significant influence on the safety and comfort of the road. The capacity of a roadway is marked by affected by the lane width. In general, safety increases with wider lanes up to a width of about 3.7 m. The lane width as per IRC: SP 73: 2018 is 3.5 m.

Experience shows that operating speed normally remains less than the design speed because of the partially access controlled facility and the other ambient conditions. Based on this assumption a 3.5 m lane width is proposed. This also concurs with other National Highways in India currently under construction.

c) Shoulders

Shoulders are a critical element of the roadway cross section. Shoulders provide recovery area for errant vehicles; a refuge for stopped or disabled vehicles; and access for emergency and maintenance vehicles. Shoulders can also provide an opportunity to improve sight distance through cut sections.

According to IRC: SP 73-2018 for two lane highways the normal shoulder width shall be 2.5 m paved shoulder on either side for plain terrain.

d) Pavement Camber (Cross fall)

IRC: SP: 73-2018 recommends the following camber for various surface types:

Table 8.4: Provision for Cross Fall

Category of surface	Annual Low rainfall (less than 1500 mm)	Annual High rainfall (more than 1500 mm)
Bituminous	2.5%	2.5%
Cement Concrete	2.0%	2.0%
Metal/Gravel	2.5%	3.0%
Earth	3.0%	4.0%

Considering of bituminous surfacing (bituminous concrete) the Consultants propose to provide a camber of 2.5 % for the main carriageway as well as paved shoulders and 3.5 % for the unpaved shoulder.

e) Land Width (Right of Way)

The IRC: SP:73-2018 has specified following land width values or Right-of Way for National Highways:

Table 8.5: Provision for ROW

Right of Way (m)	Plain/ Rolling Terrain	
	Range	Normal
Open Areas (Improvement)	30 - 40	30
Built-up Areas (Improvement)	30 - 40	30
New Bypasses	45 - 60	45

It may be noted that the provisions stipulated above corresponds to the carriageway configuration of Two-Lane Highway.

In built up areas the ROW will depend on the adjacent land strip available for development.

f) Embankment Slopes

The slope of embankment is linked with its height. In accordance with the Manual for Safety in Road Design (MoRT&H publication), the following are proposed to be adopted:

Ht. of embankment 4.5 m and above	2 H: 1V with crash barriers
Ht. of embankment 3 m to 4.5 m	2.5H: 1 V
Ht. of embankment 1.5 m to 3 m	3 H: 1 V
Ht. of embankment less than 1.5 m	4 H: 1 V

As per IRC: SP: 73-2018 the side slopes for embankment shall not be steeper than 2H: 1V unless soil is retained by suitable soil retaining structure. The side slopes of cutting shall be provided in accordance with the nature of soil encountered. The slope shall be stable for type of strata. Where required, benching including use of slope stability measures like pitching, etc. shall be adopted to make the slopes stable and safe.

The Consultants propose to provide slopes of 2H: 1V in Fill sections. Cut slopes are proposed as 1H: 1V in general however, these sections will be specifically analysed for stability before adopting this slope or steeper slopes.

8.2.3.5 Horizontal Alignment

a) General

For balance in highway design, all geometrical elements should be determined for consistent operation under the design speed in general. A horizontal alignment should be as smooth and consistent as possible with the surrounding topography. To achieve that, an appropriate blending with the natural contours is preferable to the one with long tangents through the terrain.

b) Sight Distances

Visibility is an important requirement for the safety of travel on roads. For this it is necessary that sight distance of adequate length is available in different situations, to permit drivers enough time and distance to control their vehicles so that chances of accidents are minimized. Sight distance is a direct function of the design speed. On divided highways, the design should correspond to Stopping Sight Distance, which is the clear distance ahead needed by a driver to bring his vehicle to a stop before meeting a stationary object in his path. On two-lane roads, normally intermediate sight distance should be available throughout for design purposed. In stretches where even intermediate sight distance is not available, safe stopping site distance should be provided with traffic signs depicting "Overhead Prohibited" at all such locations.

Sight distance corresponding to various design speeds are given below.

Table 8.6: Sight distance for various Speeds

Design Speed	IRC: SP: 73-2018	
Km/h	Minimum Sight Distance (m)	Overtaking Sight Distance (m)
40	90	165
60	180	340
80	240	470
100	360	640

It is desirable to design the highway for more liberal values for operational convenience. An appropriate allowance would be considered to take care of the effect of adverse incidents. The value recommended by IRC & guidelines are proposed to be adopted in design.

c) Horizontal Curve

The minimum horizontal curve radius is the limiting values of curvature for a given design speed and is determined based on from the maximum rate of super elevation and the side friction factor. As per the IRC: SP:73 – 2018 the minimum ruling radii of Horizontal curve for National Highways corresponding to different terrain conditions are as follows:

Table 8.7: Horizontal Radii Criteria

Type of Terrain	Minimum Radii of Horizontal Curve	
	Desirable Minimum	Absolute Minimum
Plain	400	250
Mountainous	150	75

Absolute minimum and ruling minimum radii correspond to the minimum design speed and the ruling design speed respectively.

On new roads, horizontal curves are designed with liberal radius provision that blends well the overall geometry and topography. However, for locations with constraints and to make

use of available roadway, it is proposed to keep minimum radius in accordance with the IRC recommendations. The horizontal curve detail is given in **Annexure 8.1.**

Table 8.8: Adopted Horizontal Radii

Speed (km/h)	Absolute Minimum Radius (m)
100	400
80	250
65	155
50	90

d) Transition (Spiral) Curves

The purpose of a transition (spiral) curve is to provide a smooth and aesthetically pleasing transition from a tangent and a circular curve. In addition, the transition curves provide the necessary length for attainment of super-elevation runoff.

The IRC: 73-2018 and IRC :38-1988 design standards suggest 115 m and 55 m transition curve lengths for circular curves of radii 400 m (design speeds of 100 km/hr, 80 km/) and 90 m and 50 m transition curve lengths for circular curves of radii 250 m (design speeds of 80 km/hr, 65 km/). The AASHTO (2001) design guidelines specify transition curve lengths of 72 m, 65 m and 50 m; and the TAC (1999) design guidelines recommend transition curve lengths of 80 m, 80 m and 50 m for curve radii of 440 m, 250 m, 90 m (design speeds of 100 km/hr, 80 km/hr and 50 km/hr) respectively.

e) Extra Width of Pavement and Roadways

Since the project road is of two-lane categories extra widening is necessary on curves having radius less than 300 m to counterbalance mechanical and psychological disorder of the vehicle. Extra widening is achieved by increasing the width at a uniform rate along the curve. On curve having no transition, widening is achieved in same way as super elevation i.e. two third is being attained on the straight section before start of the curve and one third on the curve. In hill roads and on curves without transitions extra widening is provided on inner side of the curve. As per IRC: SP: 73-2018, the extra widening shall be increased as follows:

Table 8.9: Extra width of Pavement and Roadway

Radius of Curve	Extra Width
75-100m	0.9m
101-300m	0.6m

The value and guidelines recommended by IRC are proposed to be adopted in design.

f) Super-elevation

7%, if radius of curve is less than 400 m (Desirable Minimum),5%, if radius of curve is more

than 400 m (Absolute Minimum) as per IRC: SP: 73 -2018.

g) Service Road Standards

There is No Service Road in the Project stretch.

8.2.3.6 Vertical Alignment

a) General

The vertical alignment should produce a smooth longitudinal profile consistent with standard of the road and of the terrain. Wherever possible horizontal and vertical curvature should be so combined that the safety and operational efficiency of the road is enhanced.

b) Gradients

The IRC: SP: 73-2018 proposes ruling vertical grades of 2.5% for plain/rolling terrains; however, for the project road, the following standard is proposed.

Table 8.10: Vertical Gradient

Terrain	Ruling (%)	Limiting (%)
Plain	2.5	3.3
Mountainous	5.0	6.0

c) Vertical Curves

As per IRC:SP: 73-2018 and IRC:SP:23-1993 design standards, the minimum lengths of vertical curves are 60 m and 50 m for design speeds of 100 km/h and 80 km/h respectively and are 40 m and 30 m for design speeds of 60 km/h and 50 km /h respectively. At complex locations such as interchanges and major intersections the minimum lengths of vertical curves should be designed for safe decision sight distance. The length of a vertical curve is calculated using the following equation:

L = K x A,

Where L = Length of vertical curve in metres;

K = Coefficient, a measure of the flatness of a vertical curve; and

A = Algebraic difference of grade lines (%)

Summit or Crest Curves

According to AASHTO (2001) design guidelines, the minimum K values for stopping sight distance requirements are 52, 26 and 7 for design speeds of 100 km/hr, 80 km/h and 50 km/hr respectively.

According to TAC (1999) design guidelines, the minimum K valves for stopping sight distance requirements are 45 to 80, 24 to 36 and 6 to 16 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively.

The Consultants propose minimum summit curve K values of 75, 35, 20 and 15 for design speeds of 100 km/hr, 80 km/hr, 65km/hr and 50 km/hr respectively.

Valley or Sag Curves

The minimum K values for valley or sag curves, in accordance with AASHTO (2001) design guidelines are 45, 30 and 13 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively. The minimum K values for valley or sag curves, in accordance with TAC (1999) design guidelines are 37 to 50, 25 to 32 and 7 to 16 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively.

The Consultants propose minimum sag curve K values of 42, 30, 20 and 15 for design speeds of 100 km/hr, 80 km/hr, 65km/hr and 50 km/hr respectively.

Table 8.11: K values for Summit and Valley Curves

Terrain Categories	K -Value of Summit Curves		K- Value of Valley Curves		Minimum Length of curve
	Desirable	Minimum	Desirable	Minimum	(m)
Plain	74	38	42	28	60
Rolling	38	18	28	18	50
Mountainous	8	5	10	7	30

8.2.4 Design Standards for Structures

The design of new structures shall be based on the following materials and loading-

8.2.4.1 Materials

Concrete Grade

The minimum Grade of concrete in various elements shall be as under for moderate conditions of exposure:

	Major Bridge	Minor Bridge/Culvert
All RCC	M 35	M 30
All PSC	M 45	-
All PCC	M 15	M 15

Reinforcement Steel

- High yield strength deformed bar/TMT shall be of grade Fe-500D

- Mild steel bar shall be of grade Fe-240

8.2.4.2 Seismic Zone

The project road is in a seismic zone V. It is proposed to design the bridges for seismic forces as mentioned in modified clause 219 of IRC: 6-2017.

8.2.4.3 Pre-Stressing System

Following pre -stressing system may be adopted as a general system.

S. No.	Components	Description
a	System (Post tensioning)	12T13/19T13 multi pull strand "Freyssinet" or "ISMALCCL" or equivalent
b	Cables (Post tensioning)	12T13/19T13 with strands of 12.7mm nominal dia.
c	High Tensile Steel	
d	Strands	Nominal 12.7 mm dia 7 ply low relaxation Strands conforming to class 2 of IS:14268-95
e	Area	98.7 sq.mm per strand (nominal cross section area)
f	Ultimate load	183.71 KN per strand
g	Modulus of Elasticity	1.95E05 Mpa
h	Sheathing (Post tensioning)	75mm OD/90mmOD Bright metal corrugated flexible sheathing for 12T13/19T13 cables respectively
i	Friction Coefficient (Post tensioning)	0.25/radian
j	Wobble Coefficient (Post tensioning)	0.0046/m
k	Anchorage Slip (Post tensioning)	6mm average
l	Loss of force due to relaxation	2.5% at 0.7 UTS after 1000 hrs. The final relaxation Values for design shall be 3.0 times the 1000hr. value as per cl 11.4 of IRC: 18-1985

8.2.4.4 Structural Steel

Composite construction consisting of structural steel girders with cast-in-situ deck slab may be proposed over deep valleys by keeping in view the seismic zone of the project roads. Superstructure weight shall be substantially reduced by using structural steel girders. Structural steel shall conform to IS: 226.

8.2.4.5 Bearings

Reinforced elastomeric bearings shall be proposed for short span simply supported superstructures. Elastomeric bearings shall be designed as per IRC: 83 (Part II) and shall conform to Cl.2005 of MoRT&H Specifications for Road & Bridges Works (5th Revision). RCC solid slab superstructures of culverts and minor bridges shall directly rest on pier/abutment

caps with a tar paper in bearing.

Pot fixed/Pot PTFE sliding/ metallic bearings shall be proposed for long span simply supported superstructures and continuous superstructures. The loads and forces on the bearings shall be calculated to enable the manufacturer to design these bearings and these shall conform to Cl. 2006 of MOR&TH Specifications for Road & Bridges Works (5th Revision).

8.2.4.6 Expansion Joints

The following types of Expansion Joints shall be adopted:

Filler type expansion joints shall be proposed for minor bridges with solid slab superstructures having span lengths not exceeding 10 meters. These types of joints shall conform to Cl. 2605 of MOST's Specifications for Road & Bridge Works (5th Revision).

Single Strip seal expansion joints shall be proposed for superstructures having movements up 80mm. (± 40mm).

The strip seal joints shall conform to Cl. 2607 of MOST's Specification for Road and ~Bridges works (5th Revision).

Concrete Clear Covers:

For all reinforcement - As per IRC: 112-2011 and 78-2014

For other covers and inter duct spacing - As per IRC: 112 -2011

8.2.4.7 Loads

Dead Loads

Following unit weights shall be assumed in the design as per IRC 6 Code.

Pre-stressed Concrete	:	2.5t/m3
Reinforced Concrete	:	2.5t/m3
Plain Cement Concrete	:	2.5 t/m3
Structural Steel	:	7.85t/m3
Dry Density of Soil	:	2.0t/m3
Saturated Density of Soil	:	2.2t/m3

Superimposed Dead Loads

Wearing coat	:	50mm SMA

In addition, Footpath / Kerb as well as Crash barriers, wherever feasible and provided are also considered as SIDL

Carriage way Live Load

Bridge Live load : One lane of Class 70R for every two lanes with one lane of Class A for the remaining lanes, if any, OR One lane of Class A for each lane.

The impact factor shall be as per Cl. 208 of IRC: 6 -2017 for the relevant load combinations.

Longitudinal Forces

The following effects shall be considered for calculating the longitudinal forces in the design-

Braking forces as per the provision of Cl. 211 of IRC: 6.-2017

Frictional resistance offered to the movement of free bearings due to change of temperature.

Distribution of longitudinal forces due to horizontal deformation of bearings/frictional resistance shall be carried out as per Cl. 211.5 of IRC: 6-2017 by assuming stiff supports.

Centrifugal Forces

Bridges on a horizontal curve shall be designed for centrifugal forces based on the following equation-

C = W*V^2/127R,

Where C = Centrifugal force acting normal to the traffic.

W = Carriageway Live Load

V = Design speed of the Vehicles using the bridge in km per hour.

R = Radius of curvature in metres.

The centrifugal force shall be considered to act at 1.20m above the formation level of the bridge in the transverse direction. No impact value on carriageway live load shall be considered for calculating the centrifugal force.

Water Current Forces

The effect of water current forces shall be calculated in accordance with clause number 210 of IRC: 6-2017 on sub structure and foundations. High flood level and Velocity shall be calculated based on the details received from relevant Government departments or Local inquiries.

Impact Forces

All the sub- structure and foundations in the river shall be designed for the impact due to

striking of rolling boulders on the sub-structure in mountainous terrain. The magnitude of force shall be decided based on field studies and in consultation with client.

Earth Pressure

Horizontal forces due to earth pressure shall be calculated as per the provision of Cl. 214 of IRC: 6-2017 assuming the following soil properties:

Type of soil assumed for backfilling : Dry Density of 2.07 t/cu.m and Submerged Density of : 1.2t/cu.m

Angle of Internal friction : $\phi = 30^0$

Angle of Wall Friction : $\delta = 20^0$

Coefficient of Friction μ at base: tan(2/3ø), where ø is the angle of internal friction of substrata immediately under the foundation.

Live Load surcharge shall be considered as equivalent to 1.2m height of earth fill in case of abutments and equivalent to 0.6m height of earth fill in case of return/wing walls.

Wind Forces

Structures shall be designed for wind effects as stipulated as Cl. 209 of the IRC: 6-2017. The Wind force shall be considered in the following two ways. The design shall be governed by the one producing the worst effect.

Full wind forces at right angle to the superstructure 65% of wind force as calculated in (i) above acting perpendicular to the superstructure and 35% acting in the traffic direction.

8.2.4.8 Seismic Effect

The project road falls under seismic zone V. Horizontal seismic force shall be calculated using the following formula-

Feq = Ah X (Dead Load + Appropriate Live Load)

Where, Ah = Horizontal seismic co-efficient = (Z/2) X (Sa/g)/(R/I)

Z = Zone factor

I = Important factor and is taken as 1.5 for important Bridges.

R = Response reduction factor and is equal to 2.5

Sa/g = Average response acceleration coefficient depending upon fundamental period of vibration T

T = Fundamental period of Bridge in seconds in horizontal vibrations.

The vertical seismic coefficient shall be considered in the case of structures built in seismic V. The vertical seismic coefficient shall be considered as half of the horizontal seismic force. Both horizontal and vertical seismic forces shall be assumed to act simultaneously for the design of bridge components.

8.2.4.9 Temperature Range

The bridge structure/components i.e. bearings and expansion joints shall be designed for a temperature variation of -7.5 º to 45º C considering extreme climate.

The super structure shall be designed for effects of distribution of temperature across the deck depth as per stipulations of BD 37/88 suitably modified for the surfacing thickness.

8.2.4.10 Differential Shrinkage Effects

A minimum reinforcement of 0.2% of cross-sectional area in the longitudinal direction of the cast-in-situ slab shall be provided to cater for different shrinkage stresses in superstructures with in-situ slab over pre-cast girders as per Cl.605.2 of IRC: 22-2015.

However, effects due to different shrinkage and/or different creep shall be duly accounted for in the design.

8.2.4.11 Differential Settlement Effects

Differential Settlement effects for continuous superstructure units shall be appropriately assessed for each structure. However, in any case of differential settlement of ± 12 mm shall be accounted for in the design.

The differential settlement effects in continuous superstructures shall be accounted for under following conditions:

A minimum of 12mm differential settlement of supports with half value of 'E'.

To simulate the bearing replacement conditions, a 12mm differential uplift with full value of 'E' shall be considered but without any live load on the superstructure.

8.2.4.12 Buoyancy

100% buoyancy shall be considered while checking stability of foundations irrespective of their resting on soil/weathered rock/or hard rock. However, maximum base pressure shall also be checked under an additional condition with 50% buoyancy in cases where foundations are embedded into hard rock. Pore pressure uplift limited to 15% shall be considered while checking stresses of the substructure elements.

In the design of abutment, the effects of buoyancy shall be considered assuming the fill behind abutment has been removed by scour.

8.2.4.13 Load Combination

All members shall be designed to safely sustain the most critical combination of various loads and forces that can coexist. Various load combinations as relevant with increase in permissible stresses considered in the design shall be as per Cl. 202 of IRC:6-2017 and Cl.706 of IRC:78-2014.

In addition, the stability of a bridge resting on neoprene/pot bearings shall be checked under one span dislodged condition. The load case shall be checked with seismic/wind load combinations.

8.2.4.14 Design Criteria of Culverts

The culverts shall be designed as per relevant IRC codes and special publications. The following IRC codes have been adopted for design of culverts:

IRC: 5-2015	General Features of Design;
IRC: 6-2017	Loads & Stresses;
IRC: 40-2002	Brick, Stone & Block Masonry;
IRC: SP: 13-2004	Guidelines for the Design of Small Bridges and Culverts;
IRC: SP: 48-1998	Hill Road Manual

8.2.4.15 Codes to be adopted for Design

Various codes of practices which shall be used for the design of culverts and bridges are mentioned below:

i) IRC:5-2015: Standard Specifications and Code of Practice for Road Bridges,

Section I- General Features of Design (Seventh Revision)

ii) IRC:6-2017: Standard Specifications and Code of Practice for Road Bridges,

Section II- Loads and Stresses (Fourth Revision)

iii) IRC:7-2017: Recommended Practice for Numbering Bridges and Culverts (First Revision)

iv) IRC:112-2011: Standard Specifications and Code of Practice for Road Bridges

v) IRC:22-2015: Standard Specifications and Code of Practice for composite steel Bridges

vi) IRC:24-2010: Standard Specifications and Code of Practice for steel Bridges

vii) IRC: 45-1972: Recommendations for Estimating the Resistance of Soil Below the maximum scour Level in the Design of Well Foundations of Bridges.

viii) IRC:78-2014: Standard Specifications for substructure and foundation for Road Bridges

ix) IRC: SP: 33-1989: Guidelines on Supplemental Measures for Design, Detailing & Durability of Important Bridge Structures.

x) IRC: SP:48-1998: Hill Road Manual

xi) IRC:83-2018: Standard Specifications and Code of Practice for Road Bridges

Part II: Elastomeric Bearings

Part III: POT/PTFE Bearings

xii) IRC:89-2019: Guidelines for Design and Construction of River Training & Control Works for Road Bridges (First Revision)

xiii) IS:2502-1963- Code of practice for bending and fixing of bars for concrete reinforcement

xiv) IRC: SP:13-2004: Guidelines for the Design of Small Bridges and Culverts (First Revision)

xv) IRC: SP: 35-1990: Guidelines for Inspection and Maintenance of Bridges.

xvi) IRC: SP: 40-2019: Guidelines on Techniques for Strengthening and Rehabilitation of Bridges

xvii) IRC: SP:112-2017: Guidelines on Quality Systems for Road Bridges (Plain, Reinforced, Prestressed and Composite Concrete)

xviii) IRC: SP: 51-2015: -Guidelines for Load Testing of Bridges.

MORTH Specifications

The specifications for road and bridges works of Ministry of Road Transport & Highways (latest editions) published by Indian Road congress shall be used for materials to be used for construction of bridge.

8.3 Widening Scheme

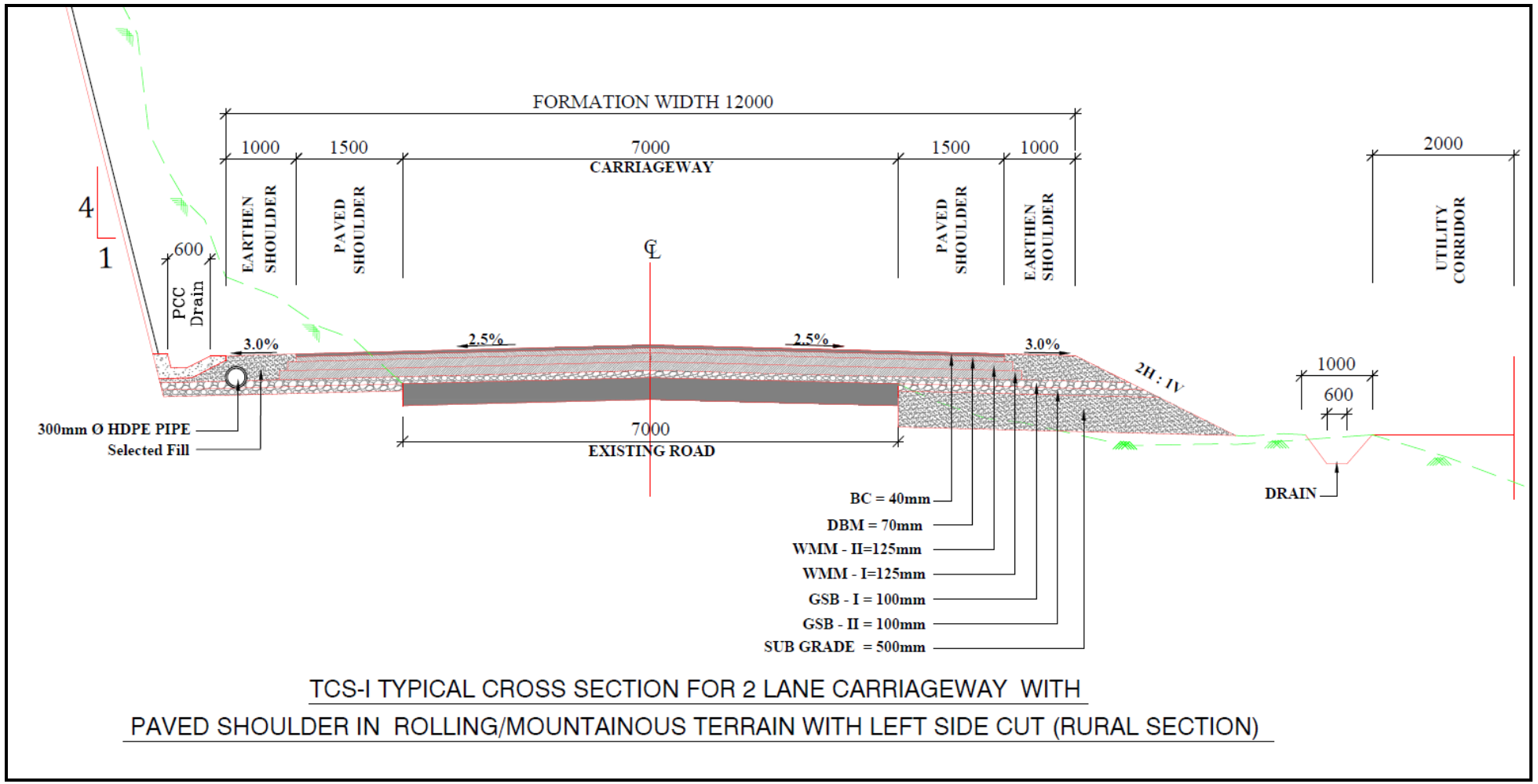
To meet future traffic requirement, the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety. Concentric widening scheme is followed to minimise land acquisition issues and to ensure maximum utilisation of existing carriageway.

8.3.1 Typical Cross-sections

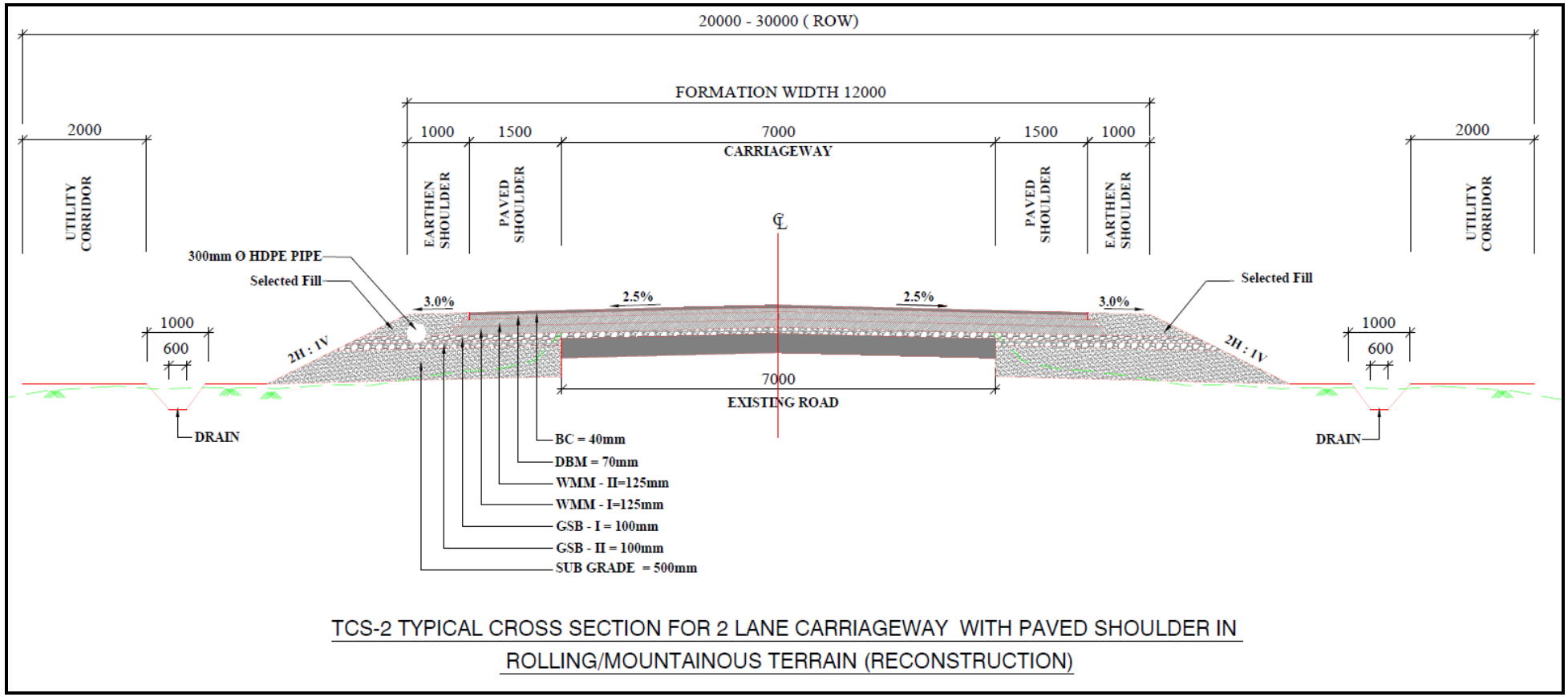
Proposed cross-sections summary is shown in **Table 8.12** below and **(Annexure-8.5).**

Table 8.12: Proposed Improvement Proposal

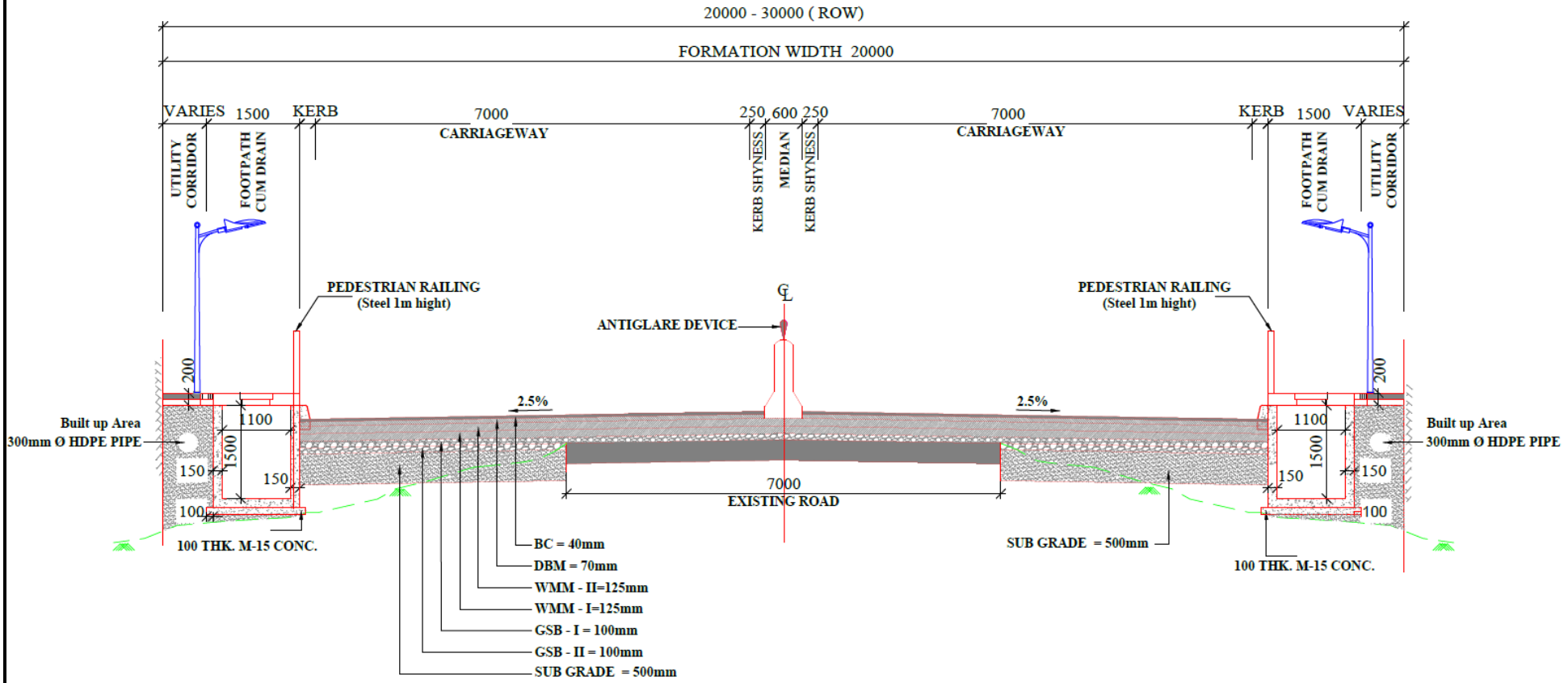
Summary of TCS				
Sr.No.	**Detail**	**TCS**	**Length**	
			(m)	**Kms**
1	2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN WITH LEFT SIDE CUT (RURAL SECTION)	TCS-1	201.46	0.201
2	2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN (RECONSTRUCTION)	TCS-2	8141.94	8.142
3	4 LANE CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN(URBAN SECTION FORMATION WIDTH-20M RECONSTRUCTION)	TCS-3	17510.00	17.510
4	(2x7 M CARRIAGEWAY INCLUDING LOADED DRAIN) DIVIDED CARRIAGEWAY IN ROLLING/MOUNTAINOUS TERRAIN (URBAN SECTION WITHOUT FOOTPATH FORMATION WIDTH. 15.10M RECONSTRUCTION)	TCS-4	1750.00	1.750
5	MAJOR BRIDGE	MAJOR BRIDGE	105.00	0.105
6	MINOR BRIDGE	MINOR BRIDGE	235.10	0.235
TOTAL DESIGN LENGTH			***27943.499***	***27.943***



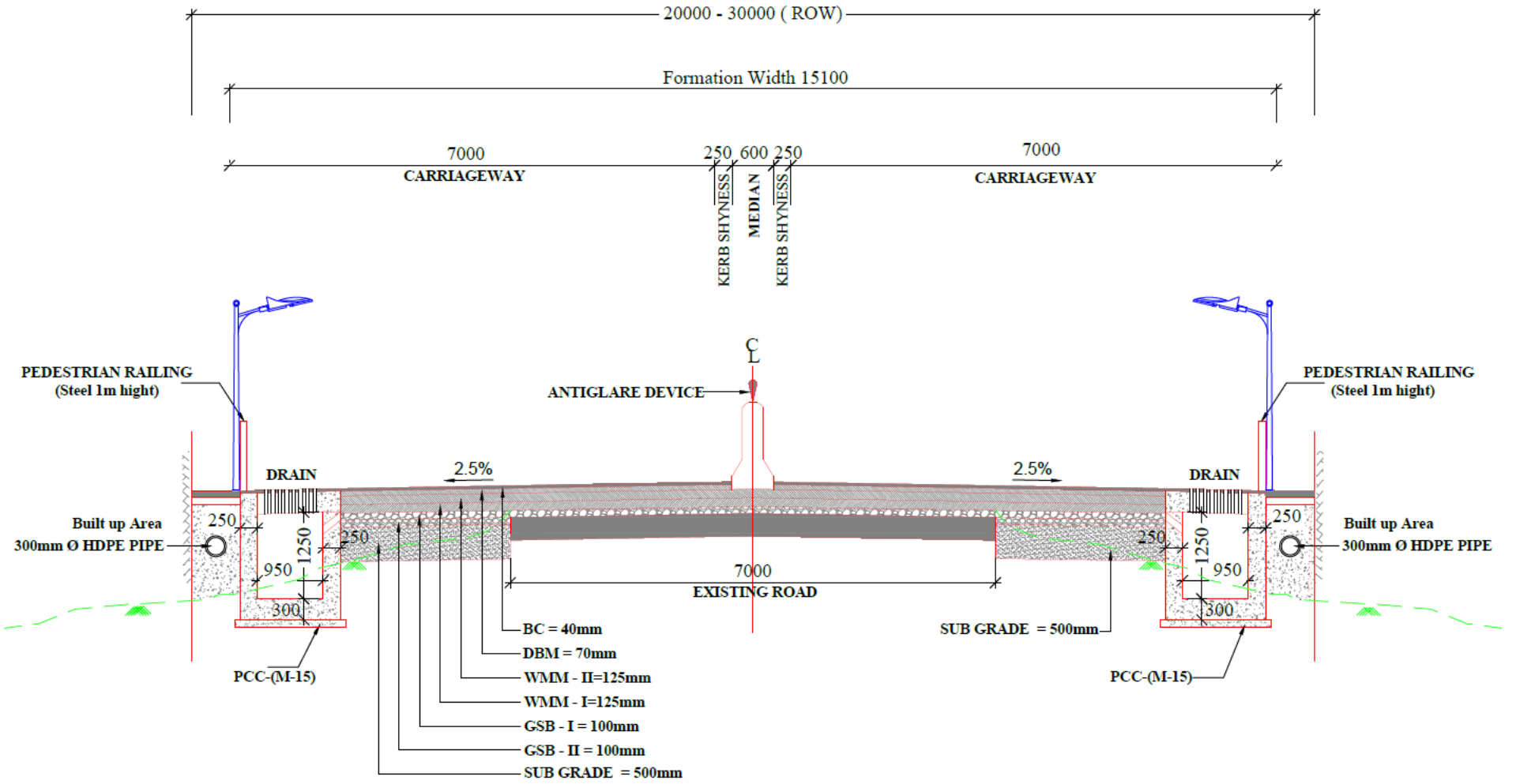
TCS-I TYPICAL CROSS SECTION FOR 2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN WITH LEFT SIDE CUT (RURAL SECTION)



TCS-2 TYPICAL CROSS SECTION FOR 2 LANE CARRIAGEWAY WITH PAVED SHOULDER IN ROLLING/MOUNTAINOUS TERRAIN (RECONSTRUCTION)



TCS - 3 TYPICAL CROSS SECTION FOR 4 LANE CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN(URBAN SECTION RECONSTRUCTION)



TCS - 4 TYPICAL CROSS SECTION FOR 4 LANE DIVIDED CARRIAGEWAY IN ROLLING/ MOUNTAINOUS TERRAIN(URBAN SECTION WITHOUT FOOTPATH RECONSTRUCTION)

8.4 Requirement of Bypass

No bypass/realignments are being proposed along the project road.

8.5 Geometric Improvement Design

As per the IRC: SP: 73-2018 the project highway should be design with 100 km/hr ruling speed and minimum speed of 80 km/hr.

8.6 Improvement of Bridges

The following approach and methodology for the finalization of designs and drawings for the existing and proposed bridge structures are proposed.

8.6.1 General

- Review of Past records like Studies, Reports and Data's.
- Data relevant to bridges shall also be collected from the PWD (NH) and irrigation departments of Chhattisgarh. The following data will generally be looked to the extent available:
  - ✓ Hydrological and geo-technical reports of the existing CD structures.
  - ✓ Complete 'as built' drawings of existing two-lane bridges along with their design calculations, if available.
  - ✓ Details of repair/rehabilitation, if any, carried out for the existing Single lane bridges.
  - ✓ Nature and extent of damage observed during floods to any of the existing two-lane bridges.
  - ✓ Utility services to be carried over the bridges.
  - ✓ Any other engineering data found suitable for the detailed engineering of proposed bridge structures.

This Chapter covers the various methodologies and design criteria, Codal provisions for proposed Bridges.

Following are the grades of construction material proposed for the project

Foundation

Concrete Grade : M35 for Bridges & Culverts

Reinforcement : HYSD of grade Fe500D

Abutment / Abutment Cap and Pier / Pier Cap

Concrete Grade : M35 for Bridges with RCC Substructure and Foundation

Reinforcement : HYSD of grade Fe500D

Superstructure

Concrete Grade : M45 for PSC precast girders

: M35 for Bridge decks over girders

: M35 for RCC solid slabs

: M35 for RCC solid slab of Slab Culverts

: M30 for RCC Box Structures

Reinforcement : HYSD of grade Fe500D

Structural Steel : Grade E250 (Fe410 W B grade) (For ROB)

Crash Barrier

Concrete Grade : M40

Reinforcement : HYSD steel of grade Fe500D

Approach Slab

Concrete Grade : M30

Reinforcement : HYSD steel of grade Fe500D

Clear Cover to any Reinforcement is followed as below

Foundation : 75 mm

Substructure : 50 mm

Superstructure : 40 mm

Bearings

- For Span 6.00 - 10.00 m, Tar paper bearings shall be adopted for slab superstructure.
- For Span 10.00 – 20.00 m, Elastomeric Bearing for RCC solid slab, RCC girder superstructure.
- For Larger span, POT / PTFE bearing for RCC / PSC girder superstructure.

Expansion Joints

Compression seal for slab superstructure and strip seal for girder superstructure.

Wearing Coat

- Cross –drainage structure: 40 mm thick bituminous concrete overlaid with 16 mm thick mastic asphalt.
- Minor and Major Bridges: 40 mm thick bituminous concrete overlaid with 25 mm thick mastic asphalt.

Approaches

RCC Return or Retaining wall for Culverts and Bridges are considered.

Drainage Provisions.

Drainage spouts shall be placed at 5m centre to centre and not greater than 10m. Down take pipes will be provided to dispose the water.

Margins in Material (FOS)

All critical sections shall be checked for stresses under various load combinations. A suitable margin (preferably 8-10%) shall be there between maximum stress and allowable stress in concrete as well as reinforcement in the final design.

Conceptual Guidelines for Structure

Following guidelines will be followed in design and construction of structures:

- The existing structures will be widened or extended to match the new road cross sections.
- For Major and Minor bridges in urban or rural areas, open median shall be provided with minimum 3.50 m clear gap between two crash barriers of bridges.
- New Bridges will be planned without affecting the foundations of adjacent existing bridges, if any.
- All new / reconstructed pipe culverts will constitute minimum 1.20 m diameter size pipes that confirm to NP4 specifications. The existing 0.90 m or more diameter pipe culverts will be extended to new carriageway with the same diameter or 1.20 m diameter pipes. In case where the culverts are hydraulically inadequate, shall be replaced by RCC Box / RCC Slab culvert of adequate size.
- Rehabilitation of substructure / superstructure of the existing Bridges which are proposed to be retained, including, but not limited to, replacement of bearings, expansion joints, pitching, bed protection, provision of crash barrier and railings, shall be done by

the Concessionaire in accordance with - the Concession Agreement.

Relevant Codes Followed for Design of Structures

List of IRC Codes

The list of IRC codes for the design of various all types of structures are as follows.

- IRC: 5-2015 - Standard Specifications & code of Practice for Road Bridges. Section-I General features of Design (8th revision)
- IRC: 6-2017 - Standard Specifications & code of Practice for Road Bridges. Section-II Loads and Stresses (5th revision)
- IRC: 7-2017 - Recommended Practice for numbering Bridges and culverts (1st revision)
- IRC: 112-2011 - Standard Specifications & code of Practice for Road Bridges
- IRC: 24-2010 - Standard Specifications & code of Practice for Road Bridges. Section-V Steel Road bridges (1st revision)
- IRC: 78-2014 - Standard Specification & code of Practice for Road Bridges. Section-VII Foundations and Substructure (2nd revision)
- IRC: 83-2018 (part III) - Standard Specifications & code of Practice for Road Bridges. Section-IX Bearings Part II- Elastomeric Bearings
- IRC: 89-2019 - Guidelines for Design & Construction of River training & Control works for Road Bridges (1st revision).

List of IRC-SP Codes

- IRC: SP: 13-2004 - Guidelines for the Design of Small Bridges and Culverts
- IRC: SP: 35-1990 - Inspection and maintenance of Bridges
- IRC: SP: 40-2019 - Guidelines on Strengthening and Rehabilitation of Bridges
- IRC: SP: 84-2019 – Manual of Specifications and Standards for Four Laning of Highways through public private partnership

Ministry of Surface Transport Publications

MORT&H Specifications for Road and Bridge Works, 2013 (Fifth Revision)

Existing structures on the project road have been classified in three categories based on the reconnaissance survey.

(a) Culverts

Structures having an overall length up to 6.0m shall be treated as culverts. Most of the culverts have no protection works.

(b) Minor Bridges

Structures having a length between inner face of dirt walls more than 6.0m and up to 60.0m shall be treated as minor bridges. These bridges on project roads are of reinforced concrete solid slab, structural steel trusses/ girder and RCC I- beam girders type. Minor bridges seen during the site visit have spans varying from 8.0m to 50.0 m with R&R masonry wall type abutments and stone masonry/plain cement concrete wall type piers. The protection works around abutments are either damaged or not existing.

(c) Major Bridges

Structures having a length of more than 60.0m shall be called major bridges.

8.6.2 Type of Proposed Bridges

Following type of super-structures will be most suitable for bridges:

- Structural steel girders/trusses
- Reinforced concrete pre-cast bridges
- Pre-cast Post tensioned concrete bridges
- RCC Box type structures where SBC is less

Following type of sub-structures will be most suitable for bridges:

- RCC abutment and pier for bridges
- PCC abutment and pier for culverts

Piers shall be avoided in the mid-stream where velocity of water is more than 5.0m/second. It is generally seen that it is very difficult to construct sub-structure in such locations and there is possibility of bridge being washed away. Thus, all efforts shall be made to provide large spans for the mid-stream in order to avoid any pier.

Circular/cellular circular/wall type piers shall be used after considering the aesthetics and economy. Solid wall type abutments/counter fort type abutments based on the height shall be selected. Counter fort type abutments are generally provided if height of the abutments is more than 10.0 metres

Submersible Structures

Submersible Bridges and Causeway are highly suitable where the floods are flash and do not interrupt the traffic for long period.

These are normally built on non-erodible bed rock with protective pitching or apron.

Though submersible bridges are cheap compared to high level bridges, they need greater maintenance for approaches if there is considerable spread of water. Design of hand rails, impact of floating debris and the hydrodynamic effect of the water acting over the whole bridges also required to design submersible Bridges. These have to be considered along with the buoyancy in design.

8.6.3 Proposal of New CD Structure

A total of 109 culverts and 1 Side drain proposed out of which 107 are to be re-constructed and 02 are proposed as new construction. The Brief detail of proposed structures have been provided as **Table 8.13**.

Based on Hydraulics, alignment modifications, widening requirement etc. New C.D. structures along the project stretch are prepared and presented detailed vide **Annexure 8.2 and 8.3**.

Table 8.13: Culvert and Bridge Proposals

Sr. No.	Design Chainage	Proposed Span (W x H)	Proposed Type	Length	Width	Proposal	Deck Width	Remarks
1	148+654	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
2	148+861	3x2	RCC BOX	3	20	Re-construction	2 x 11	4 Lane
3	149+354	6x4	RCC BOX	6	20	Re-construction	2 x 11	4 Lane
4	149+629	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
5	149+999	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
6	150+219	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
7	150+279	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
8	150+314	4x3	RCC BOX	4	20	**New construction**	2 x 11	4 Lane
9	150+447	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
10	150+757	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
11	150+870	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
12	151+298	2X2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
13	151+540	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
14	151+951	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
15	152+280	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane

Sr. No.	Design Chainage	Proposed Span (W x H)	Proposed Type	Length	Width	Proposal	Deck Width	Remarks
16	152+901	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
17	153+060	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
18	153+224	3x3	RCC BOX	3	20	Re-construction	2 x 11	4 Lane
19	153+384	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
20	153+569	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
21	153+819	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
22	154+344	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
23	154+421	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
24	155+314	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
25	155+614	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
26	155+856	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
27	155+992	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
28	156+139	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
29	156+220	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
30	156+944	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
31	157+189	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
32	157+517	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
33	157+541	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
34	158+121	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
35	158+392	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
36	158+667	2X2	RCC BOX	2	15	Re-construction	12.00	2 Lane
37	159+741	3x3	RCC BOX	3	20	Re-construction	2 x 11	4 Lane
38	160+029	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
39	160+300	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
40	160+449	3x2	RCC BOX	3	15	Re-construction	12.00	2 Lane
41	160+701	6x4	RCC BOX	6	15	Re-construction	12.00	2 Lane
42	160+897	4x3	RCC BOX	4	15	Re-construction	12.00	2 Lane
43	161+233	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
44	161+383	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
45	161+529	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
46	161+604	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
47	161+792	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
48	161+854	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
49	162+129	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane

Sr. No.	Design Chainage	Proposed Span (W x H)	Proposed Type	Length	Width	Proposal	Deck Width	Remarks
50	162+406	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
51	162+984	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
52	163+139	2X2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
53	163+337	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
54	163+368	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
55	163+431	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
56	163+484	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
57	163+549	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
58	163+817	4x3	RCC BOX	4	15	Re-construction	12.00	2 Lane
59	164+134	4x3	RCC BOX	2	15	Re-construction	12.00	2 Lane
60	164+259	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
61	164+334	4x3	RCC BOX	4	15	Re-construction	12.00	2 Lane
62	164+525	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
63	164+620	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
64	164+902	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
65	165+085	3x3	RCC BOX	3	20	Re-construction	2 x 11	4 Lane
66	165+237	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
67	165+404	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
68	165+607	3X3	RCC BOX	3	20	**New construction**	2 x 11	4 Lane
69	165+808	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
70	166+242	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
71	166+327	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
72	166+614	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
73	166+743	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
74	166+784	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
75	167+104	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
76	167+312	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
77	167+794	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
78	168+153	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
79	168+304	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
80	168+499	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
81	168+797	4x3	RCC BOX	4	15	Re-construction	12.00	2 Lane
82	169+269	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
83	169+639	6x4	RCC BOX	6	15	Re-construction	12.00	2 Lane

Sr. No.	Design Chainage	Proposed Span (W x H)	Proposed Type	Length	Width	Proposal	Deck Width	Remarks
84	170+423	4x3	RCC BOX	6	15	Re-construction	2 x 11	4 Lane
85	170+545	2x2	RCC BOX	2	15.1	Re-construction	2 x 11	4 Lane
86	170+601	2x2	RCC BOX	2	15.1	Re-construction	2 x 11	4 Lane
87		4x3	**Side Drain of 50m long on Right Side**				12.00	2 Lane
88	170+897	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
89	171+422	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
90	171+582	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
91	171+967	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
92	172+422	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
93	172+667	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
94	172+872	6x3	RCC BOX	6	20	Re-construction	2 x 11	4 Lane
95	173+107	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
96	173+364	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
97	173+431	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
98	173+504	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
99	173+627	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
100	173+808	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
101	173+919	2x2	RCC BOX	2	15	Re-construction	12.00	2 Lane
102	173+991	2X2	RCC BOX	2	15	Re-construction	12.00	2 Lane
103	174+396	3X2	RCC BOX	3	15	Re-construction	12.00	2 Lane
104	175+127	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
105	175+462	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
106	175+547	4x3	RCC BOX	4	20	Re-construction	2 x 11	4 Lane
107	175+677	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
108	175+828	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
109	176+114	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane
110	176+382	2x2	RCC BOX	2	20	Re-construction	2 x 11	4 Lane

A total of 15 bridges (including Wangon and Hillar Bridge) are proposed in which 03 are reconstruction due to re-alignment, 07 are reconstruction due to Masonry structure, 02 existing bridges are proposed for additional 2- lane bridge and 02 bridges are retained without widening, and 01 is for repair work for protection works.

Structure Proposals (Bridges)						
Sr.No	**Design Chainage**	**Type of Structure**	**Proposed Span Arrangement**	**Total Length of Bridge (m)**	**Type of Superstructure**	**Proposed Lane**
1	151+096	Minor Bridge (Wangon Bridge)	1 x 30	30	Composite Steel Plate Girder	2-lane
2	152+790	Minor Bridge	1 x 10	10	RCC Solid Slab	4-Lane
3	158+054	Minor Bridge	1 x 10	10	RCC Solid Slab	2-lane
4	159+083	Minor Bridge	1 x 10	10	RCC Solid Slab	4-Lane
5	159+297	Minor Bridge	1 x 10	10	RCC Solid Slab	4-Lane
6	163+289	Minor Bridge	1 x 10	10	RCC Solid Slab	4-Lane
7	163+794	Minor Bridge	1 x 10	10	RCC Solid Slab	2-lane
8	163+984	Major Bridge (HILLAR Bridge)	3 X 35	105	PSC Box Girder	2-Lane
9	164+119	Minor Bridge	1 x 10	10	RCC Solid Slab	2-lane
10	164+396	Minor Bridge	1x 24.4	24.4	RCC T Girder	2-lane
11	164+729	Minor Bridge	1 x 40.7	40.7	PSC Box Girder	2-lane
12	164+833	Minor Bridge	1 x 10	10	RCC Solid Slab	2-lane
13	164+949	Minor Bridge	1 x 25	25	PSC I Girder	4-Lane
14	165+010	Minor Bridge	1 x 25	25	PSC I Girder	4-Lane
15	170+424	Minor Bridge	1 x 10	10	RCC Solid Slab	2-lane

8.7 Formation Width for New Bridges and Culverts

The formation width of structures shall be proposed to be maintained as full formation width of road section.

8.8 Drainage Design

A good drainage system is vital for the safety and longer life of any structure. This is more relevant in the case of highways. Proper drainage of road surface, pavement and the foundation layers is basic requirement for maintaining the structural soundness and functional efficiency of a road. Pavement structure including sub grade must be protected from any ingress of water. For this purpose, the following conditions have to be ensured:

- Interception of the surface runoff;
- Keeping the water flow duration on the pavement to a minimum;
- Saving the pavement structure from stagnation of water;
- Efficient dispersal and disposal of water; and
- Quick disposal of sub-surface water away from the pavement.

Design for drainage is proposed to be carried out in accordance with the provision contained

in IRC: SP 42-2014 and IRC: SP 50 -2013.

8.8.1 Hydrological Design Methodology

For the calculation of discharge of the stream by Area-Velocity method, topographical survey including levelling surveys have been carried out across and along the water courses to determine the cross-section and the slope. A number of cross-sections have been taken at regular intervals on both upstream and downstream side of the structure, including one at the proposed location of the structure in accordance with IRC specifications.

The following assumptions have been made for peak discharge calculation:

For locations where water spreads over the banks, the cross-sections were extended up to the HFL, in order to calculate the effective cross-section of flow.

The longitudinal section to determine the bed slope have been taken following the channel course extending on both the upstream and the downstream sides of the structure. Caution is taken by following the curved flow line for longitudinal gradient, rather than a straight line.

Assessment of Peak Discharge

The peak discharge is calculated by the following method for cross section on the upstream and the downstream sections.

Area – Velocity Method (Kutter's constant)

$$Q = A \times V$$

$$V = C \times \sqrt{(R \times S)}$$

Where, Q = the discharge in cumecs;

A = Area of the cross section in sq. m.

V = Velocity in m/sec;

R = Hydraulic mean depth in m. = A / P;

P = Wetted perimeter of the stream in m.

C = Kutter's constant which is given by

S = Bed slope of the stream; and

N = Co-efficient of rougosity which depends upon the roughness of the stream

The Design Discharge had been taken as the maximum of discharges at different cross sections. This will have 10% variations with one another.

Hydraulic Analysis for Design HFL

HFL is fixed at the bridge location by local enquiry, then line parallel the bed slope line is drawn at this HFL, from this line HFL at different cross sections are found.

Afflux Calculation

When the waterway area of the opening of a bridge is less than the unobstructed natural waterway area of the stream, i.e. when bridge contracts the stream, afflux occurs. The afflux will be calculated using Orifice formula as given below: -

$$Q=C_0 \times \sqrt{2g}\ L\ Dd \times \sqrt{\{h+ (1+e)\ (U^2/2g)\}}$$

Where, h = Afflux in meters;

Q = Discharge

U = velocity

L = Linear waterway

Dd = Depth at D/S side

W = width of River

C_o and 'e' = Orifice formula co-efficient is taken from graph

Scour Depth Calculation

To provide an adequate margin of safety for design of foundation, a further increase by 30% has been made over the design discharge as per IRC: 78-2014, to calculate mean scour depth.

By IRC: 5-2015 / IRC: 78-2014

As per IRC: 5-2015 or IRC: 78-2014, the mean depth of scour below the highest flood level, DSM, will be given by the following equation:

$$\mathbf{d_{sm} = 1.34 \times (D_b^2 / K_{sf})^{1/3}}$$

Where, D_b = the discharge in cumecs per meter width and Ksf = Silt Factor.

The value of 'D_b' shall be the total design discharge divided by the theoretical effective linear waterway between abutments.

For most of the bridges, the silt factor, K_{sf}, has been calculated as per guidelines given in IRC-78: 2014 since most of the bridges are Ghat section the bed material composes of pebbles and course sand for which silt factor assumed as 4.

Maximum Depth of Scour for Design of Foundation

The maximum depth of scour below the Highest Flood Level (HFL) for the design of piers (dsmp) and abutments (dsma), having individual foundations without any floor protection are as follows:

Near pier: $dsmp = 2 \times D_{sm}$

In the vicinity of abutment: $dsma = 1.27 \times D_{sm}$

Vertical Clearance

Provision of vertical clearance in bridges above HFL shall be kept as per IRC SP-13, clause 12.3 as under.

Discharge in m^3/s	Minimum Clearance in m
up to 0.30	0.15
Above 0.3 and up to 3.0	0.45
Above 3.0 and up to 30	0.6
Above 30 and up to 300	0.9
Above 300 and up to 3000	1.2
Above 3000	1.5

8.8.2 Design Storm Calculation

The design of drainage system involves – (a) calculating the total discharge that the system will require to drain off and (b) fixing the slope and dimensions of the drain to have adequate capacity to carry the discharge and afford maintenance.

(a) Hydrological Design

Hydrological study is an important step prior to the design of road drainage system. Such analysis is necessary to determine the magnitude of flow and the duration for which it would last. Hydrological data required for design includes drainage area map, water shed delineation, arrow indicating direction of flow, outfalls, ditches, other surface drainage facilities, ground surface conditions, rainfall and flood frequencies.

To estimate the amount of runoff requiring disposal at given instant, information regarding rainfall intensities within the catchment area and the frequency with which this precipitation to assess peak run-off is essential. The 'Rational Method' is universally accepted empirical formula relating rainfall to run-off and is applicable to small catchment areas not exceeding 50 sqkm. The discharge is calculated by,

$Q = 0.028\ P\ A\ Ic$

Where;

Q = Discharge (Peak run-off) in cum/ sec

P = Coefficient of run-off for the catchment characteristics

A = Area of catchment in Hectares

Ic = Critical intensity of rainfall in cm per hour for the selected frequency and for duration equal to the time of concentration

Coefficient of run-off 'P' for a given area is not constant but depends on a large number of factors such as porosity of soil, type of ground cover, catchment area, slope and initial state of wetness and duration of storm. For specific site conditions, the following values of 'P' given in IRC: SP 42-1994, 'Guidelines on Road Drainage' have been adopted.

Table 8.14: Values of Coefficient of Run-off

Sr. No.	Description of Surface	Coefficient of Run-off (P)
1.	Steep bare rock and watertight pavement surface	0.90
2.	Steep rock with some vegetative cover	0.80
3.	Plateau areas with light vegetative cover	0.70
4.	Bare stiff clayey soils (impervious soils)	0.60
5.	Stiff clayey soils with vegetative cover with uneven paved road surface	0.50
6.	Loam lightly cultivated or covered and macadam or gravel road	0.40
7.	Loam largely cultivated or turfed	0.30
8.	Sandy soil, light growth, parks, gardens, lawns and meadows	0.20
9.	Sandy soil covered with heavy bush or wooded/ forested areas	0.10

The primary component in designing storm water drains is the design storm i.e. rainfall value of specified duration and return period. For the project road a return period of 25 years is considered to be adequate. As the extent of drainage system for the project road is small, even an intense rainfall of short duration may cause heavy outflows. The storm duration chosen for design purposes is equal to time of concentration. It has two components- (a) entry time and (b) time of flow. Because of lack of data for small duration peak rainfall for small catchments in project influence area, the following equation has been used to estimate the rainfall intensity for the shorter durations:

$$i = \frac{F(T+1)}{T(t+1)}$$

Where,

i= Intensity of rainfall within a shorter period of 't' hrs within a storm

F= Total rainfall in a storm in cm falling in duration of storm of 'T' hrs

t= Smaller time interval in hrs within the storm duration in 'T' hrs

For the purpose of design storm, one-hour maps available from Directorate of Hydrology (small catchments), Central Water and Commission, New Delhi have been used. 1-hr rainfall for return period of 25 years for the project influence area has been taken as 100 mm.

(b) Design of Drain Section

For uniform flow in open channels, the basic relationships are expressed by the Manning's Formula:

$$Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

Where,

Q= discharge in cum/sec

n= Manning's roughness coefficient

R= hydraulic radius in m which is flow cross section divided by wetted perimeter

S= energy slope of the channel which is roughly taken as slope of drain bed

A= Area of flow cross section in sqm

In design, the flow is assumed to be sub-critical. The slope and velocity are kept below the critical level. If design depth is less than critical depth, the section is to be redesigned to avoid critical flow situation.

To simplify the analysis the following energy slopes have been considered for the site-specific conditions:

- For longitudinal median drain : 1 in 200
- For lateral median drain and intersection drainage system : 1 in 285
- For side drains in urban areas : 1 in 200
- For side drains in plain terrain : 1 in 100

8.8.3 Hydraulic Design and Resizing of Existing Culverts

Culverts like Slab culverts and Pipe culverts are predominant along the existing alignment. But they are neither sufficient in number not in terms of vent height at few locations. Hence as per

Hydraulic designs per SP13:2004, re-sizing of culverts are proposed and improvement of culverts are presented vide **Annexure 8.3.**

8.8.4 Slope Stabilisation and Protection Works

Erosion prevention is one of the major factors in design, construction and maintenance of highways. The most direct application of erosion control occurs in drainage design and in the writing of specifications for landscaping and slope planting. Erosion is minimized largely by the use of flat side slopes, rounded and blended with natural terrain; serrated cut slopes; drainage channels designed with due regard to width, depth, slopes, alignment, and protective treatment; inlets located and spaced with erosion control in mind; prevention of erosion at culvert outlets; proper facilities for groundwater interception; dikes, berms, and other protective devices to trap sediment at strategic locations; and protective ground covers and planting.

Protection works are provided on the roads to ensure safe and efficient driving at maximum design speed of the road. It does not let the vehicles to run out of the road or to collide with the adjacent slopes and with the other vehicles. It also ensures safety for the pedestrians who walk along the road or cross it.

Toe Wall

It is a small retaining wall structure at the foot of an earth slope. The list of Toe walls provided on the project road are given below:

	Toe Wall				
Sr. No.	Chainage		Length (m)	Height (m)	Side
	From	To			
1	151+015	151+080	65	2	Both
2	151+115	151+190	75	2	Both

8.8.4.1 Treatment of High Embankment

High embankment will be site specifically designed considering the quality of the available material, prevalent moisture condition and associated pore water pressure, bearing capacity of the founding strata and the requirement of any preloading etc. Stone pitching/gabion walls are proposed at these locations.

8.8.5 Design Methods for Widening of Bridges

Longitudinal drains are designed in such a way that drains merges either at invert level of culverts or at bridge. Also, all bridges are proposed to be widened or reconstructed 11.0m width without foot path and 16m with footpath which is more than full formation width of road i.e. 14.0m for 2 lanes. In case of 4 lane section two separate bridges / ROB/ flyover are

proposed with full formation width of 2 lanes for both side structures excluding median, if any.

8.8.6 Designs for Roadside Drainage

Presence of a good drainage system is essential. It is therefore necessary to perform a detailed survey of the existing drainage system, the adjoining terrain and its slope, and recommendations for new drainage system or modification to existing drainage system.

Some basic principles have been adopted in order to meet IRC standards.

The surface water from the carriageway, the paved shoulders, the embankment slopes and the adjoining land must be effectively drained off without allowing it to percolate into the sub-grade.

The drains must have sufficient capacity and adequate longitudinal slope to drain away the entire collected surface water to the nearest natural surface stream, river or nallah.

No roadside drains are proposed where the longitudinal water bodies are present parallel to the road. In the project alignment, the following types of drains will have to be proposed:

- Unlined Open Drain in rural section
- Lined Drain in urban areas
- Chute Drains

The hydraulic adequacy of the drains shall be checked as per IRC SP-42 "Guidelines on Road Drainage". The design return period for the drains shall be taken as 25 years for median drains, chute drains, urban drains and other important drainage systems while the 2 years shall be taken as rural drainage system.

The rainwater from the right of way of the road is ultimately required to be transported away before it can cause nuisance or damage. First of all, water has to be transported over the surface. This aspect has been well looked after by providing adequate cross-slope and compatible longitudinal profile. After running over the surface, most of the runoff is collected in the covered / open drain along the road. Open drains are preferred over covered ones as these are easier to maintain and allow removal of silt and other solids easily. Also, for a given cross section open drains can carry much larger discharge particularly in flood conditions where drain is surcharged.

8.8.6.1 Unlined Open Drain in Rural Section

In rural areas where embankment height is less than 1.5m, open unlined toe drains and 1V: 2H side slope have been proposed near ROW on both sides of the road as per guidelines given IRC

SP-42: 2014.

8.8.6.2 Lined Drain in Urban Areas

In urban areas, water will flow across separators through cross cuts of size 150 cm x 150 cm top covered by precast slab in RCC M 20 grade provided at an interval of 10 m. This will also facilitate crossings near building lines/built up areas. However, an attempt has been made to minimize such locations as low-level maintenance of covered drain is envisaged in post-construction phase. The design runoff has been considered not only from the road but also from the adjoining building lines.

8.8.6.3 Drainage at Intersections

Any stagnation of water at intersections would reduce the capacity of junction resulting in queuing up of traffic. The level of junction has been kept higher than the cross roads so that water can reach the main drainage system which is along the main carriageway. No covered drain will be provided as these are likely to be choked due to sweepings from the road during the dry season. The side drain will have to be extended along the cross roads till the appropriate out-fall. In extreme cases, pipe drain will have to be proposed across the cross road to maintain the continuity of the drainage network if out-fall is not possible near-by due to site conditions.

The details of various types of drain adopted as per design chainage is given below:

Table 8.15: PCC Drain

Roadside PCC Drainage List						
Design Chainage		Design Length (m)	TCS Detail	TCS Type	Side	Roadside Drain Length (m)
From	To					
148+589	148+790	201.463	2-Lane Left side Cut	TCS-1	LHS	201.46
Total Roadside PCC Drainage Length						**201.46**

Table 8.16: RCC Drain without footpath

RCC Drain Without Footpath							
Sr. No	Design Chainage		Design Length	TCS Detail	TCS Type	Both	Total Length
	From	To					
1	150+290	150+490	200	4-Lane Urban(15m)	TCS-4	Both	400
2	152+890	153+090	200	4-Lane Urban(15m)	TCS-4	Both	400
3	156+290	156+490	200	4-Lane Urban(15m)	TCS-4	Both	400
4	170+260	170+450	190	4-Lane Urban(15m)	TCS-4	Both	380
5	170+460	170+780	320	4-Lane Urban(15m)	TCS-4	Both	640
6	173+090	173+590	500	4-Lane Urban(15m)	TCS-4	Both	1000
7	175+160	175+300	140	4-Lane Urban(15m)	TCS-4	Both	280

RCC Drain Without Footpath							
Sr. No	Design Chainage		Design Length	TCS Detail	TCS Type	Both	Total Length
	From	To					
Total Length							3500

Table 8.17: RCC cover drain with footpath.

RCC Cover Drain with Footpath							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Length
	From	To					
1	148+790	150+290	1500	4-Lane Urban	TCS-3	Both	3000
2	150+490	150+940	450	4-Lane Urban	TCS-3	Both	900
3	151+240	151+690	450	4-Lane Urban	TCS-3	Both	900
4	152+290	152+786	496	4-Lane Urban	TCS-3	Both	992
5	152+796	152+890	94	4-Lane Urban	TCS-3	Both	188
6	153+090	153+490	400	4-Lane Urban	TCS-3	Both	800
7	154+090	156+290	2200	4-Lane Urban	TCS-3	Both	4400
8	156+490	157+740	1250	4-Lane Urban	TCS-3	Both	2500
9	158+910	159+079	169	4-Lane Urban	TCS-3	Both	338
10	159+089	159+293	204	4-Lane Urban	TCS-3	Both	408
11	159+303	160+440	1137	4-Lane Urban	TCS-3	Both	2274
12	161+140	163+285	2145	4-Lane Urban	TCS-3	Both	4290
13	163+295	163+740	445	4-Lane Urban	TCS-3	Both	890
14	164+890	164+938	47.5	4-Lane Urban	TCS-3	Both	95
15	164+963	164+999	36	4-Lane Urban	TCS-3	Both	72
16	165+024	166+990	1966.5	4-Lane Urban	TCS-3	Both	3933
17	167+590	168+690	1100	4-Lane Urban	TCS-3	Both	2200
18	169+790	170+260	470	4-Lane Urban	TCS-3	Both	940
19	170+780	171+590	810	4-Lane Urban	TCS-3	Both	1620
20	172+410	173+090	680	4-Lane Urban	TCS-3	Both	1360
21	173+590	173+890	300	4-Lane Urban	TCS-3	Both	600
22	175+090	175+160	70	4-Lane Urban	TCS-3	Both	140
23	175+300	176+390	1090	4-Lane Urban	TCS-3	Both	2180
Total Length							35020

Table 8.18: Unlined Drains

Unlined Drain							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Total Length
	From	To					
1	148+589	148+790	201.46	2-Lane Left side Cut	TCS-1	One	201.46
2	150+940	151+082	142	2-Lane Rural	TCS-2	Both	284
3	151+112	151+240	128	2-Lane Rural	TCS-2	Both	256
4	151+690	152+290	600	2-Lane Rural	TCS-2	Both	1200
5	153+490	154+090	600	2-Lane Rural	TCS-2	Both	1200
6	157+740	158+050	310	2-Lane Rural	TCS-2	Both	620
7	158+060	158+910	850	2-Lane Rural	TCS-2	Both	1700
8	160+440	161+140	700	2-Lane Rural	TCS-2	Both	1400

Unlined Drain							
Sr. No.	Design Chainage		Design Length	TCS Detail	TCS Type	Side	Total Length
	From	To					
9	163+740	163+790	50	2-Lane Rural	TCS-2	Both	100
10	163+800	163+933	132.5	2-Lane Rural	TCS-2	Both	265
11	164+038	164+115	77.5	2-Lane Rural	TCS-2	Both	155
12	164+125	164+385	259.8	2-Lane Rural	TCS-2	Both	519.6
13	164+409	164+710	300.45	2-Lane Rural	TCS-2	Both	600.9
14	164+750	164+829	78.65	2-Lane Rural	TCS-2	Both	157.3
15	164+839	164+890	51	2-Lane Rural	TCS-2	Both	102
16	166+990	167+590	600	2-Lane Rural	TCS-2	Both	1200
17	168+690	169+790	1100	2-Lane Rural	TCS-2	Both	2200
18	171+590	172+410	820	2-Lane Rural	TCS-2	Both	1640
19	173+890	175+090	1200	2-Lane Rural	TCS-2	Both	2400
20	176+390	176+532	142.04	2-Lane Rural	TCS-2	Both	284.08
Total Length							**16485.34**

8.8.6.4 Drainage at Bridge

In case of bridges across a river, the main water is to be discharged into river bed through drainage spouts as per IRC standards. Properly designed filter media is to be provided behind abutment / earth retaining structures along with weep hole arrangement at 1.0 m interval to drain out the percolated water.

On approach portion longitudinal drains will have to be provided at the edges of roadway as kerb channel cum ditch drain. Kerb channel will be 55 cm wide having 6% slope and ditch will be of size 50 cm x 45 cm. Kerb channel will have RCC grating at 4.5 m interval to guide water into ditch. In initial stretch smaller depth, say 30 cm, can be adopted which then can be increased progressively to achieve 45 cm depth at the end of ramp.

8.9 Road Markings, Signs and Other Safety Devices

8.9.1 Road Markings

Road markings will be made for centre and edge lines using reflective thermoplastic paints. Appropriate road markings will also be provided at junctions and crossings.

8.9.2 Road Signs

Road signs are to place according to IRC: 67-2012. The signs are to be placed on embankment so that extreme edge of sign would be 2.0m away from the edge of the carriageway. The location of each sign is to be decided in accordance with the guidelines there in.

8.9.3 Safety Barrier

Traffic barriers are protective devices that are placed between traffic and a potential

Hazard off the roadway, with the intention of reducing the severity of a collision when an errant vehicle leaves the travelled portion of the roadway. Barriers are to be provided at high embankments, sharp curves and bridge approaches. The barrier is to be located at the edge of paved shoulders.

Table 8.19: Jersey barrier at Median.

Jersey Barrier List					
Sr. No.	Design Chainage		Design Length (m)	TCS Type	Jersey Barrier Detail
	From	To			
1	148+790	150+290	1500	TCS-3	1500
2	150+290	150+490	200	TCS-4	200
3	150+490	150+940	450	TCS-3	450
4	151+240	151+690	450	TCS-3	450
5	152+290	152+786	496	TCS-3	496
6	152+796	152+890	94	TCS-3	94
7	152+890	153+090	200	TCS-4	200
8	153+090	153+490	400	TCS-3	400
9	154+090	156+290	2200	TCS-3	2200
10	156+290	156+490	200	TCS-4	200
11	156+490	157+740	1250	TCS-3	1250
12	158+910	159+079	169	TCS-3	169
13	159+089	159+293	204	TCS-3	204
14	159+303	160+440	1137	TCS-3	1137
15	161+140	163+285	2145	TCS-3	2145
16	163+295	163+740	445	TCS-3	445
17	164+890	164+938	47.5	TCS-3	47.5
18	164+963	164+999	36	TCS-3	36
19	165+024	166+990	1966.5	TCS-3	1966.5
20	167+590	168+690	1100	TCS-3	1100
21	169+790	170+260	470	TCS-3	470
22	170+260	170+450	190	TCS-4	190
23	170+460	170+780	320	TCS-4	320
24	170+780	171+590	810	TCS-3	810
25	172+410	173+090	680	TCS-3	680
26	173+090	173+590	500	TCS-4	500
27	173+590	173+890	300	TCS-3	300
28	175+090	175+160	70	TCS-3	70
29	175+160	175+300	140	TCS-4	140
30	175+300	176+390	1090	TCS-3	1090
Total Length					**19260**

Table 8.20: Pedestrian railing Details

Pedestrian Railing Details					
Sr. No.	Design Chainage	Design Length	TCS Type	Side	Pedestrian railing

	From	To	(m)			
1	148+790	150+290	1500	TCS-3	LHS+RHS	3000
2	150+290	150+490	200	TCS-4	LHS+RHS	400
3	150+490	150+940	450	TCS-3	LHS+RHS	900
4	151+240	151+690	450	TCS-3	LHS+RHS	900
5	152+290	152+786	496	TCS-3	LHS+RHS	992
6	152+796	152+890	94	TCS-3	LHS+RHS	188
7	152+890	153+090	200	TCS-4	LHS+RHS	400
8	153+090	153+490	400	TCS-3	LHS+RHS	800
9	154+090	156+290	2200	TCS-3	LHS+RHS	4400
10	156+290	156+490	200	TCS-4	LHS+RHS	400
11	156+490	157+740	1250	TCS-3	LHS+RHS	2500
12	158+910	159+079	169	TCS-3	LHS+RHS	338
13	159+089	159+293	204	TCS-3	LHS+RHS	408
14	159+303	160+440	1137	TCS-3	LHS+RHS	2274
15	161+140	163+285	2145	TCS-3	LHS+RHS	4290
16	163+295	163+740	445	TCS-3	LHS+RHS	890
17	164+890	164+938	47.5	TCS-3	LHS+RHS	95
18	164+963	164+999	36	TCS-3	LHS+RHS	72
19	165+024	166+990	1966.5	TCS-3	LHS+RHS	3933
20	167+590	168+690	1100	TCS-3	LHS+RHS	2200
21	169+790	170+260	470	TCS-3	LHS+RHS	940
22	170+260	170+450	190	TCS-4	LHS+RHS	380
23	170+460	170+780	320	TCS-4	LHS+RHS	640
24	170+780	171+590	810	TCS-3	LHS+RHS	1620
25	172+410	173+090	680	TCS-3	LHS+RHS	1360
26	173+090	173+590	500	TCS-4	LHS+RHS	1000
27	173+590	173+890	300	TCS-3	LHS+RHS	600
28	175+090	175+160	70	TCS-3	LHS+RHS	140
29	175+160	175+300	140	TCS-4	LHS+RHS	280
30	175+300	176+390	1090	TCS-3	LHS+RHS	2180
Total Pedestrian Railing Length						**38520**

8.10 Pavement Design

The project road will be constructed as two-lane with paved shoulder, four lane carriageway and four lane divided carriageway and upgrading of the existing pavement to carry the anticipated traffic over the design period. This would involve:

i) Construction of new pavement for widened and realigned/new alignment.

Flexible pavement is adopted for proposed new carriageway and reconstruction. Design period of 20 years considered for new carriageway.

8.10.1 Traffic or Cumulative Equivalent Single Axle Loads

The project road is used by all types of vehicle with different loading and different axle configuration. For pavement design it is very necessary that all kinds of loads converted to a single common axle load hence using equivalent factor. The equivalent axle load factor (EALF)

is based on a procedure of converting the number of repetitions of a given load into an equivalent number of repetitions of 8.16 tonne single axle load. The EALF based on fatigue cracking is different from that based on permanent deformation. The use of a single value for both modes of failure is approximate, at best. The most widely used method for determining the EALF is that which uses the empirical equations developed from the AASHTO Road Test, according to which the damage caused increases as the fourth power of the load. For example, a 10.2 tonne axle load would result in EALF of $(10.2/8.16)^4 = 2.5$. Thus, an increase of 25 % in the axle load would result in 2.5 times more damage. This fact becomes even more significant in India where overloading is a norm. The fourth power relationship is internationally accepted and is used for design.

Equivalent single axle loads (ESALs) depends upon:

i) Initial traffic

ii) Traffic growth (r)

iii) Directional split of the traffic or directional distribution factor (DDF)

iv) Number of lanes or lane distribution factor (LDF)

v) Axle load spectrum or vehicle damage factor (VDF)

Traffic surveys and subsequent analyses were carried out to determine the above parameters.

From the axle-load survey, VDF for each type of vehicle can be determined. The cumulative ESAL is calculated using the following equations:

$$\text{ESAL} = \sum_{i=1}^{i=j} \text{Initial Traffic} \times 365 \times \frac{(1+r)^n - 1}{r} \times \text{Lane Factor} \times \text{DDF} \times \text{VDF}$$

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the year 2023. Design ESAL in Millions i.e. MSA for project road has been provided in Annexure 8.4. However concise details are provided in table below:

Table 8.21: MSA projection for 20 years

Year	2027	2032	2037	2042
MSA	3.386	6.018	9.377	13.665

For pavement design of project road, the above MSA values have been adopted. Pavement thickness is a function of log MSA, therefore, at high MSA values the change in pavement thickness is rather minor compared to the change in the MSA value.

8.10.2 Shoulder

As per AASHTO, "as shoulder is the portion of the roadway contiguous with the travelled way for accommodation of stopped vehicles, for emergency use and for lateral support of sub-base, base and surface course." There should be continuous paved shoulder on both the right and the left side of all freeways facilities and the usable paved width of the shoulder should be between 10ft (3.048m) to 12ft (3.658m).

The factors affecting shoulder design are similar to those of mainline pavement design. The major difference is the amount of traffic. Traffic volume on shoulders is lower than on a mainline and much difficult to predict.

Three types of traffic may be considered in shoulder design:

- Encroaching traffic
- Parking traffic, and
- Regular traffic

Regular traffic is considered only if the use of shoulder as an additional lane for peak hour or detoured traffic is anticipated. If there is no regular traffic, the sum of encroaching and parking traffic is used to design the inner edge of shoulder adjacent to the mainline; while parking traffic is used to design the outer edge of shoulder. When there is a paved shoulder and no lateral obstruction within the shoulder area, trucks using the outer traffic lane tend to encroach on the shoulder. The percentage of parking traffic should be added to the encroaching traffic because any truck must encroach to park on the shoulder. It is a common practice to design mainline and shoulder pavements a single unit.

8.10.3 Drainage

Design methods that develop pavement cross-sections on the assumption that the controlling factors are stress, strain, deformation and fatigue under repeated wheel loads, and ignore the effects of wheel load on water trapped in the pavement structure are a recipe for "designed to fail" pavement design. The trapped water in the pavement structure under the wheel loads generates pore pressures which drastically reduce the bearing capacity or strength of the granular layer and erodes the base and sub-base material, resulting in damage which may cause premature failure of the pavement.

To ensure adequate internal drainage of the pavement a full width of bottom most granular layer is proposed in the case of new rigid pavement, and a drainage layer under the rigid pavement has been provided.

8.10.4 Flexible Pavement Structural Design for New Construction

8.10.4.1 Recommended Pavement Design

Granular subbase should be laid in up to formation width. Similarly, a dense bituminous macadam thickness is proposed as per IRC design, would be most appropriate, and does not affect either design drastically. The recommended pavement design on project road, therefore, should consist of layer composition as per **Table 8.16**

Table 8.22: Recommended New Pavement Design

Crust Composition for New Pavement as per IRC 37 - 2018										
Homogeneous Section	Design Chainage		CBR	MSA	Crust				Sub-Grade	Total Thickness
	From	To			BC	DBM	WMM	GSB		
1	148+589	176+532	10	20	40	70	250	200	500	**1060**

8.11.7 Scheme of Widening

The existing section of Vailoo-Donipawa under scope of study has multi-dimensional facets in terms of tourist place like Korernag & Achabal, geometry, pavement condition, existing utilities, religious structure at Achabal, etc. and considering all these aspects the section-wise policy adopted for widening based on the investigations is given in below:

Table 8.23: Tentative widening Schedule

Sr. No.	Chainage		Length	TCS Type	TCS DETAILS
	From	To			
1	148+589	148+790	201.5	TCS-1	2-Lane Left side Cut
2	148+790	150+290	1500	TCS-3	4-Lane Urban
3	150+290	150+490	200	TCS-4	4-Lane Urban(15m)
4	150+490	150+940	450	TCS-3	4-Lane Urban
5	150+940	151+082	142	TCS-2	2-Lane Rural
6	151+082	151+112	30	Minor Bridge	Wangon Bridge
7	151+112	151+240	128	TCS-2	2-Lane Rural
8	151+240	151+690	450	TCS-3	4-Lane Urban
9	151+690	152+290	600	TCS-2	2-Lane Rural
10	152+290	152+786	496	TCS-3	4-Lane Urban
11	152+786	152+796	10	Minor Bridge	
12	152+796	152+890	94	TCS-3	4-Lane Urban
13	152+890	153+090	200	TCS-4	4-Lane Urban(15m)
14	153+090	153+490	400	TCS-3	4-Lane Urban
15	153+490	154+090	600	TCS-2	2-Lane Rural
16	154+090	156+290	2200	TCS-3	4-Lane Urban
17	156+290	156+490	200	TCS-4	4-Lane Urban(15m)
18	156+490	157+740	1250	TCS-3	4-Lane Urban
19	157+740	158+050	310	TCS-2	2-Lane Rural

Sr. No.	Chainage		Length	TCS Type	TCS DETAILS
	From	To			
20	158+050	158+060	10	Minor Bridge	
21	158+060	158+910	850	TCS-2	2-Lane Rural
22	158+910	159+079	169	TCS-3	4-Lane Urban
23	159+079	159+089	10	Minor Bridge	
24	159+089	159+293	204	TCS-3	4-Lane Urban
25	159+293	159+303	10	Minor Bridge	
26	159+303	160+440	1137	TCS-3	4-Lane Urban
27	160+440	161+140	700	TCS-2	2-Lane Rural
28	161+140	163+285	2145	TCS-3	4-Lane Urban
29	163+285	163+295	10	Minor Bridge	
30	163+295	163+740	445	TCS-3	4-Lane Urban
31	163+740	163+790	50	TCS-2	2-Lane Rural
32	163+790	163+800	10	Minor Bridge	
33	163+800	163+933	132.5	TCS-2	2-Lane Rural
34	163+933	164+038	105	Major Bridge	Hiller Bridge
35	164+038	164+115	77.5	TCS-2	2-Lane Rural
36	164+115	164+125	10	Minor Bridge	
37	164+125	164+385	259.8	TCS-2	2-Lane Rural
38	164+385	164+409	24.4	Minor Bridge	
39	164+409	164+710	300.45	TCS-2	2-Lane Rural
40	164+710	164+750	40.7	Minor Bridge	
41	164+750	164+829	78.65	TCS-2	2-Lane Rural
42	164+829	164+839	10	Minor Bridge	
43	164+839	164+890	51	TCS-2	2-Lane Rural
44	164+890	164+938	47.5	TCS-3	4-Lane Urban
45	164+938	164+963	25	Minor Bridge	
46	164+963	164+999	36	TCS-3	4-Lane Urban
47	164+999	165+024	25	Minor Bridge	
48	165+024	166+990	1966.5	TCS-3	4-Lane Urban
49	166+990	167+590	600	TCS-2	2-Lane Rural
50	167+590	168+690	1100	TCS-3	4-Lane Urban
51	168+690	169+790	1100	TCS-2	2-Lane Rural
52	169+790	170+260	470	TCS-3	4-Lane Urban
53	170+260	170+450	190	TCS-4	4-Lane Urban(15m)
54	170+450	170+460	10	Minor Bridge	
55	170+460	170+780	320	TCS-4	4-Lane Urban(15m)
56	170+780	171+590	810	TCS-3	4-Lane Urban
57	171+590	172+410	820	TCS-2	2-Lane Rural
58	172+410	173+090	680	TCS-3	4-Lane Urban
59	173+090	173+590	500	TCS-4	4-Lane Urban(15m)
60	173+590	173+890	300	TCS-3	4-Lane Urban
61	173+890	175+090	1200	TCS-2	2-Lane Rural
62	175+090	175+160	70	TCS-3	4-Lane Urban
63	175+160	175+300	140	TCS-4	4-Lane Urban(15m)

Sr. No.	Chainage		Length	TCS Type	TCS DETAILS
	From	To			
64	175+300	176+390	1090	TCS-3	4-Lane Urban
65	176+390	176+532	142.03536	TCS-2	2-Lane Rural

8.11.8 Proposed Intersections

A total of 2 major and 29 minor junctions are proposed on the alignment.

Table 8.24: Proposed Junction List

Sr. No.	CHAINAGE	JUNCTION	TYPE
1	148+589	**MAJOR**	**T**
2	151+290	MINOR	**Y**
3	152+790	MINOR	**Y**
4	152+990	MINOR	**T**
5	154+630	MINOR	**T**
6	154+690	MINOR	**T**
7	154+990	MINOR	**T**
8	159+280	MINOR	**T**
9	159+420	MINOR	**T**
10	159+505	MINOR	**T**
11	159+600	MINOR	**T**
12	162+290	MINOR	**Y**
13	163+770	MINOR	**Y**
14	164+370	MINOR	**T**
15	164+640	MINOR	**Y**
16	164+915	MINOR	**T**
17	166+405	MINOR	**T**
18	167+480	MINOR	**T**
19	168+170	MINOR	**Y**
20	168+280	MINOR	**T**
21	168+705	MINOR	**Y**
22	169+640	MINOR	**Y**
23	170+690	**MAJOR**	**X**
24	171+360	MINOR	**T**
25	172+880	MINOR	**T**
26	173+660	MINOR	**T**
27	173+730	MINOR	**T**
28	175+190	MINOR	**Y**
29	175+555	MINOR	**T**
30	175+770	MINOR	**Y**
31	176+190	MINOR	**T**

8.11 Utilities and Project Facilities

8.11.1 Utility Ducts

Utility ducts of NP-4 having 600 mm dia. have been proposed throughout the project stretch having spacing of 500 m in Builtup areas and 2000 m in open areas.

And 300 mm dia HDPE pipe is proposed throught the project road to accommodate the utilities.

8.11.2 Roadside Furniture

Traffic signs, kilometre stone (5th km, km and hectometre), Road marking, Road Delineator, Crash barrier, Road studs etc. has been proposed along the project road as per manual.

8.11.3 Lighting

The provisions have been considered while proposing the locations as per IRC and MORTH guidelines. The street lighting has been proposed at the location interchange i.e. Major junction, Major Bridge and other locations if found necessary.

8.11.4 Rainwater harvesting System

In order to replenish the ground water table and conservation of freshwater resource. Rainwater harvesting systems have been proposed at approx. 1000 m length on both side of the project road. A total of 56 rain water harvesting pits have been proposed.

8.11.5 Bus Stops

In order to promote and facilitate the use of public transport bus stops have been proposed along the length of the project. A total of 38 nos. of bus stops have been proposed. The location may be decided during the execution with concern of Authority Engineer. The tentative locations are presented in table below:

Table 8.25: Bus stop location

Sr. No.	Chainage	Side
1	148+840	Both
2	151+260	Both
3	152+740	Both
4	154+590	Both
5	156+160	Both
6	156+940	Both
7	157+690	Both
8	159+590	Both
9	161+740	Both
10	162+690	Both
11	164+340	Both

Sr. No.	Chainage	Side
12	165+390	Both
13	166+790	Both
14	168+240	Both
15	170+540	Both
16	172+490	Both
17	173+790	Both
18	175+570	Both
19	176+430	Both

8.12 Traffic Management and Safety Considerations

During construction work it becomes quite necessary to provide passengers a safe passage throughout the construction zone. The Contractor shall take all the required measures and make arrangements for the safety of Users during the Construction and Maintenance of the Project Highway or a Section thereof in accordance with the provisions of MORTH Specifications. It shall provide, erect and maintain all such barricades, signs, markings, flags, and lights as may be required by Good Industry Practice for the safety of the traffic passing through the Section under construction or maintenance. Some of the necessary temporary structures and measures are as follows:

- Portable Type Barricade in Construction Zone.
- Traffic Signs for Diversion/construction zone.
- Filling of Pot- holes and Patch Repairs on existing road.
- Providing, laying and rolling of built-up-spray grout layer over prepared base on existing road.
- Maintenance of Earthen Shoulders.
- Diversion at the structure's location etc.

Chapter 9

Cost Estimate

9.0 COST ESTIMATE

9.1 Introduction and Assumptions

Detailed cost estimate for **Vailoo – Donipawa** road section has been finalised based on the improvements proposed under Chapter – 8. The detailed estimate is worked out based on the quantities calculated for the items of work to be executed in the project and rates derived after detail analysis and as contained in the government Basic schedule of Rates.

Following assumptions have been made for calculating quantities, rate analysis and cost estimate.

a) It is assumed that suitable water would be available for construction purpose within reasonable lead and hence no separate haulage / rate has been considered for this purpose.

b) Establishment of good hygienic labour camp is deemed to be included in adopted rates and hence no separate provision has been made.

c) Establishment of field laboratory for conducting basic tests on soils, construction material and for quality control is also deemed to be included in adopted rates.

d) For road work, bituminous construction, bridge work and CD work, basic lead of 5 km is considered for all completed items and thereafter additional lead component has been considered.

e) All sundries, contractor profit, and other overhead charges are deemed to be included in the derived rates. Items required for adhering to safety standards during construction and maintenance phases mentioned in O&M standards are also deemed to be considered.

f) Mechanised construction using hot mix batching plant, pavers, concrete batching plant etc. has been assumed while working out the rates.

9.2 Adoption of Unit Rates

The cost estimate of the project road as presented in the Feasibility Report is based on the final development proposals and priced at latest schedule of rates of Jammu and Kashmir.

The cost estimate has been done with the consideration that the full proposed length of the road will be constructed in one section under one construction package.

For arriving at unit rates at Feasibility stage, it has been assumed that the specifications generally conform to the provisions made in "**Specifications for Road and Bridge Works (Vth Edition)**" of **MORT&H**.

To develop a thorough understanding of the prevailing construction rates, the Consultant have reviewed prevailing **J&K Schedule of Rates-2020, for Civil works of all Engineering Departments, sanctioned vide Govt. Order no. 192-PW(R&B) of 2020 dated 07.07.2020.**

9.2.1 Based on Rate Analysis

The consultant has adopted the rates from Schedule of Rates, 2020 of Road Construction Department, Government of Jammu and Kashmir.

The item rate for road works and bridge works have been worked out based on prevailing **J&K Schedule of Rates-2020, for Civil works of all Engineering Departments, sanctioned vide Govt. Order no. 192-PW(R&B) of 2020 dated 07.07.2020** and MORT&H Standard Data Book for Analysis of Rates

9.2.2 Based on Market Rates

The consultant has thoroughly reviewed the market rate and adopted the market for the items of works such as Bitumen, steel, cement etc.

9.3 Bill of Quantities for Civil Works

The quantities of major items of works have been worked out based on the preliminary highway design, inventory, condition surveys, and other pavement investigations data. The pavement quantities have been worked out based the geometrics and cross sections, pavement design done based on traffic and laboratory investigations.

Site Clearance:

The area considered for Site Clearance is the area within the proposed Right of Way minus the existing carriageway area.

Earth Works:

This item provides for roadway excavation, earthwork in embankment, subgrade and shoulders including disposal of surplus earth and unsuitable material. The earth work quantities like roadway in embankment have been computed based on the data collected during inventory survey. The quantity for cutting in deep section is computed and further classified as cutting in ordinary rock or cutting by open/ controlled blasting in hard rock. The earthwork quantities are based on our site surveys and highway design. Sub-grade having a CBR > 9% will be taken from borrows area.

Sub-base, Base, Surface Courses:

These provide for the items of GSB and WMM for the main carriageway. The quantities for road pavement, base, sub-base etc. for main carriageway have been calculated through applicable cross-sectional template developed in excel software. A provision for cross-fall correction layer has been made for existing carriageway and its quantity has been worked out.

Bituminous Works:

Flexible pavement has been considered for the project road. Bituminous works provide for all items of bituminous courses and surfacing. Quantities for the pavement component are based on the pavement designs proposed in **Chapter 8**.

Culverts:

The estimation of quantities for culverts was based on site inventory condition survey and study of require hydraulics. The detailed recommendations are given in **Chapter 8**. The quantities for structures have been calculated based on detailed General Arrangement Drawings (GAD) and other associated drawings using STAAD software and in-house software.

Bridges and structures:

The cost for bridges has been worked out based on the quantities derived from per sqm rate.

Junctions Improvement:

The cost for junctions also includes the cost for 'at grade' junctions, which need improvement along the highway.

Traffic Signs and Markings:

Proper traffic signs were planned at required locations along the project corridor. It is reviewed considering the traffic and pedestrian safety. The number of traffic signs shall be adequate and modified if required. Centre line and edge markings required from safety point of view were considered in the quantity estimate. RCC boundary pillar, Road studs, antiglare screen and pedestrian steel railing have been considered at appropriate locations.

Drainage and Protection works:

Provision under this sub-head has been made for surface and roadside drains, drainage chutes in cement concrete and stone pitching at outfalls/escapes for drainage. This covers for unlined, open lined and covered drains. The quantities for drainage, protection of embankment & protection against tank bund and river training works are computed based on typical drain drawings and tentative drainage plan.

Miscellaneous Items:

A lump sum amount has been provided for project house, furniture and equipment required for project maintenance, parking, footpath, electrifications, and roadside amenities. In addition to these, traffic control and diversion, bus-stops and cross utility ducts have also been provided.

Utility Shifting

Broad provision is made in the cost estimate for raising and or shifting high-tension lines, electric supply lines, telephone lines and other utilities.

Table 9.1: Description of Bills for Cost Estimate

Major Heading	Item of Works
Site Clearance	• Clearing and Grubbing • Dismantling of existing structures/km stones/ pavement/ road signs • Cutting of Trees and Removal of stumps

Major Heading	Item of Works
	• Scarifying existing bituminous surface • Dismantling
Earth work	• Earthwork in excavation for Ordinary soil / soft rock / hard rock • Embankment construction with material from borrow area • Embankment construction with material from road cutting • Subgrade and Shoulder construction • Turfing
Non-Bituminous Courses	• Granular sub-base • Wet mix macadam • GSB as Profile Corrective Course on existing road.
Bituminous Course	• Prime coat • Tack coat on GSB • Dense Graded Bituminous Macadam • Tack coat on Bituminous Macadam • Bituminous Concrete
Bridge and Cross Drainage Structures	• Earthwork in excavation for Ordinary soil / soft rock / hard rock • Concrete work in foundation, substructure and superstructure • CR masonry work in foundation and substructure • Slab culvert (widening / new construction / repair / on cross road) • Pipe culvert (widening / new construction / repair / on cross road/ duct for utility crossing) • Major/Minor Bridge (widening / new construction / repair) • RCC bore pile and pile cap • Load test of Pile • Reinforcement in foundation, substructure and superstructure • HT Steel • Steel liner • Bearing - PTFE, Tar paper, elastomeric • Expansion joint - Strip seal, Pre-moulded filler • Asphaltic Wearing coat • Cement paint to exposed concrete • PMC mortar & epoxy bonding coat to concrete • Stone pitching in slope and apron • NP-4 Pipe for culvert
Drainage and Protection works	• Roadside PCC Drain • RCC Covered Drain including Footpath • RCC Drain without Footpath • Unlined surface drains • RRM Toe wall
Traffic Signs, Markings & Other Road Appurtenances	• Km. stone / Boundary stone • Road signs • Pavement markings • Road signage • Crash Barrier • Road stud

Major Heading	Item of Works
	• Railing • Kerb
Maintenance	• Diversion • Routine Maintenance
Electrical Works	• Streetlight in Urban area • Lighting at Bus byes • Lighting at Intersections
Miscellaneous Items	• Road side Barriers
Way side amenities	• Utility duct • Bus shelter • Tree plantation

9.4 Costing for Safety Devices

The safety devices have been proposed based on criteria given in Chapter 9 – Improvement Proposal. Cost for safety devices like crash barrier, road signs and markings, delineators, kerbs, etc. have been derived in Bill of Traffic Signs, Markings & Other Road Appurtenances.

9.5 Land Acquisition Cost

As EROW is sufficient to cater the proposed road section thus there is no need for acquisition of land. However, we found some of the encroachments during ground verification & need to shift from EROW. Rehabilitation & Resettlement Cost including fruit bearing trees (Approx.) cost is Rs. 5.08 Crores.

9.6 Cost of R&R

R & R cost (i.e. cost for acquisition of structures, resettlement site development, transitional allowance, staff training, and institutional arrangement & strengthening etc,) has been derived in cost estimate summary.

9.7 Cost of Environmental Mitigation Plan

EMP cost for implementing of various mitigation measures on different items has been derived in cost estimate.

9.8 Total Cost Estimate

The Abstract and Detailed cost estimate is presented and summarised in this chapter. The summary of cost estimate has been computed and presented in **Table 9.2** below.

Table 9.2: Section wise Cost of Civil Works

Section	Proposed Length (km)	Base Cost including GST (crore)	Total Project Cost (Crores)
Vailoo – Donipawa	27.943	227.41	280.81

General Abstract of Cost

Sr No	Detail	Unit	No	Length	Rate	Cost
1	**Road Work**					
(a)	**Site Clearance**					5,768,062.05
(b)	Typical Cross Section Type- 1	Km	1	0.201	18,600,997	3,747,421.01
(c)	Typical Cross Section Type- 2	Km	1	8.142	19,495,993	158,735,115.97
(d)	Typical Cross Section Type- 3	Km	1	17.510	25,972,514	454,778,723.64
(e)	Typical Cross Section Type- 4	Km	1	1.750	19,653,546	34,393,705.85
(f)	Cutting & Filling					27,758,191.07
	Total Road Works					**685,181,219.60**
2	**Culvert**					
(i)	Construction of Culvert					308,916,707.00
	Total Culvert Works					**308,916,707.00**
3	**Bridge**					
(i)	Minor Bridges					167,620,783.90
(ii)	Hillar & Wangon Bridges					75,441,144.78
(iii)	Repair and Rehabilitation work of Existing Bridge					1,248,755.85
	Total Bridge Works					**244,310,684.53**
4	**Other Works**					
(i)	Drainage Work (RCC Covered Drain 2 x 19260m)					451,983,597.38
(ii)	Protection Work (Toe Wall=280 m)					5,925,942.40
(iii)	Traffic Signs					234,347,033.67
(iv)	**Junction**					
a)	Major Junctions (2 Nos.)					6,706,465.28
b)	Minor Junctions (29 Nos.)					20,378,714.63
(v)	Bus Stop (38 Nos.)					4,750,000.00
(vi)	Safety and Traffic Management During Construction					25,462,294.59
(vii)	Miscellaneous					42,469,898.32
	Total Other Works					**792,023,946.27**
Grand Total						**2,030,432,557.40**

SUMMARY OF COST

Item No.	Description	Total Amount (Rs. in Crores)
BILL NO. 1	SITE CLEARANCE	0.58
BILL NO. 2	EARTH WORKS	5.37
BILL NO. 3	SUB-BASES AND BASES COURSES	27.56
BILL NO. 4	BITUMINOUS COURSES	35.02
BILL NO. 5	CROSS DRAINAGE WORKS(CULVERTS)	30.89
BILL NO. 6A	BRIDGES	24.31
BILL NO. 6B	REPAIR AND REHABILITATION OF EXISTING BRIDGES	0.12
BILL NO. 7	TRAFFIC SIGNS, MARKINGS & OTHER ROAD APPURTENANCES	23.43
BILL NO. 8	DRAINAGE & PROTECTION WORK	
BILL NO. 8 A	DRAINAGE (RCC Covered Drain 2 x 19260m)	45.20
BILL NO. 8 B	PROTECTION WORK (Toe Wall= 280m)	0.59
BILL NO. 9	SAFETY AND TRAFFIC MANAGEMENT DURING CONSTRUCTION	2.55
BILL NO. 10	JUNCTIONS (Minor Junctions = 29 Nos. & Major Junctions= 02 Nos.)	2.71
BILL NO. 11	BUS STOP (38 Nos)	0.48
BILL NO. 12	MISCELLANEOUS ITEMS -(Road side Plantation, Street Lighting, Rain Water Harvesting)	4.25
A	**Civil Cost**	**203.04**
B	**GST @ 12% Payable on Civil Cost only of (A)**	**24.37**
C	**Sub Total (A+B)**	**227.41**
D	Contingencies @ 2.8% of (A)	5.69
E	Construction Supervision Charges @ 3% of (A)	6.09
F	Agency Charge @ 3% of (A)	6.09
G	Escalation @ 5% per annum for 2nd year during construction Payable to Contractor of (A)	10.15
H	**Total Cost including centages (C+D+E+F+G)**	**255.43**
I	5 years Maintenance Period including structures: No maintenance charges shall be paid for the first year; 0.50%of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year	5.08
J	**Total Project Cost (TPC) (H+I)**	**260.50**
K	Rehabilitation & Resettlement Cost including fruit bearing trees (Approx.)	5.08
L	Utility Shifting (Electric pole ,Transformer, PHE) (Approx.)	15.23
TOTAL CAPITAL COST (TCC) (J+K+L+M)		**280.81**

Chapter 10

Economic Analysis

10.0 ECONOMIC ANALYSIS

An infrastructure project is subjected to economic appraisal to ensure that the investment proposed would yield appropriate return to the national economy. It is therefore important that decisions about investments in roads are made on objective judgments and therefore, Economic appraisal has been carried out for each traffic homogenous section of entire Project road.

The basic purpose of the economic analysis is to enable the decision-makers in the Government to decide whether the project is worthy of investment keeping in view the benefits to the society. The Proposal for project road is "**Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing Pre-Construction Services for upgradation to 2 lane with paved shoulder from Km 235.000 (Vailoo Village) to Km 269.000 (Khanabal) of Khellani – Kishtwar – Chattroo - Khanabal Section of NH 244 in the newly formed Union Territory of Jammu and Kashmir**. For this purpose, the entire Project Road has been considered along with its proposed maintenance and improvement proposals.

10.1 Economic Analysis Approach

The economic evaluation has been carried out within the broad framework of social - benefit analysis assuming the project life for a period 20 years. The economic feasibility of the project has been sought to maximize the economic returns on investment. There will be reduction in road user costs of motorized traffic (MT) on the existing parallel roads, which are likely to be affected in consequence of construction of this road. The economic savings at significant level in the following areas are expected to occur due to introduction of this road.

- Vehicle traffic congestion
- Journey time of passengers and goods

The economic analysis has been based on comparison of costs and benefits under two scenarios 'without the improvement of road project' and 'with the improvement of road project'. All costs and benefits are valued in monetary terms and expressed in economic prices to have the analysis on resource-based framework. The analysis is made corridor-wise as well as project-wise. The results are expressed in terms of Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV).

Table10.1: Total Transport Costs

Road Supplier Costs	Road User Costs

Construction Costs	Vehicle Operating Costs (VOC) both MT & NMT
Maintenance Costs	Travel Time Costs
Replacement Costs: Costs of Environmental Impact Mitigation Measures, Costs of Rehabilitation and Resettlement (R&R) measures	

These costs are generated using HDM – IV for every year of the analysis period (cost-benefit stream) from which economic indicator parameters that essential for viability of project namely Net Present Value (NPV), Economic Rate of Return (EIRR) and Benefit Cost Ratio (B/C) are the final economic outputs.

NPV is the present value of Net Benefits (NB) during the project period. EIRR is the discount rate at which the NPV of the Net Benefit (NB) is zero. Net Benefit is the cumulative sum of the difference between yearly benefit and yearly costs incurred after discounting.

$$NB = \sum_{n=1}^{M} (Benefit(n) - Cost(n))$$

Savings from vehicle emission reduction and less energy consumption due to improved facility are also important economic savings which are possible to calculate but these quantities are not converted to economic cost inside the software. So these benefits are not included.

The appraisal period (including the construction period) has been taken as 30 years after which a residual value of investment is assumed as 10%.

10.2 Project Economic Evaluation using HDM - 4

Economic evaluation for road section is carried out by consideration of two alternatives In HDM – 4.

10.2.1 Alternative 1: Existing

For without project consideration, project road will carry existing traffic on it without any improvement and maintenance in present condition that means No treatment is given to existing road for improving its capacity augmentation, functional and structural pavement quality and geometry standards.

10.2.2 Alternative 2: Proposed

For with project consideration, Project road is rehabilitated and upgraded as 2 lanes with paved shoulders. In this alternative, project road improvements are made by improving its geometry through realignments, providing bypasses and rehabilitation to existing pavement though reconstruction and strengthening.

10.3 Project Cost and Scheduling

The project road is 27.943 km. Project road is consists of two lane with paved shoulder in rural section , four lane carriageway and four lane divided carriageway in urban section to facilitate the proposed road section area. Accordingly, economic analysis of the project road has been carried out in section as below:

Table 10.2: Section Details

Design Chainage		*Design Length*	*Improvement Details*
From	*To*		
148+589	148+790	201.46	2-Lane Left side Cut
148+790	150+290	1500.00	4-Lane Urban
150+290	150+490	200.00	4-Lane Urban(15m)
150+490	150+940	450.00	4-Lane Urban
150+940	151+082	142.00	2-Lane Rural
151+082	151+112	30.00	Wangon Bridge
151+112	151+240	128.00	2-Lane Rural
151+240	151+690	450.00	4-Lane Urban
151+690	152+290	600.00	2-Lane Rural
152+290	152+786	496.00	4-Lane Urban
152+786	152+796	10.00	Minor Bridge
152+796	152+890	94.00	4-Lane Urban
152+890	153+090	200.00	4-Lane Urban(15m)
153+090	153+490	400.00	4-Lane Urban
153+490	154+090	600.00	2-Lane Rural
154+090	156+290	2200.00	4-Lane Urban
156+290	156+490	200.00	4-Lane Urban(15m)
156+490	157+740	1250.00	4-Lane Urban
157+740	158+050	310.00	2-Lane Rural
158+050	158+060	10.00	Minor Bridge
158+060	158+910	850.00	2-Lane Rural
158+910	159+079	169.00	4-Lane Urban
159+079	159+089	10.00	Minor Bridge
159+089	159+293	204.00	4-Lane Urban
159+293	159+303	10.00	Minor Bridge
159+303	160+440	1137.00	4-Lane Urban
160+440	161+140	700.00	2-Lane Rural
161+140	163+285	2145.00	4-Lane Urban
163+285	163+295	10.00	Minor Bridge
163+295	163+740	445.00	4-Lane Urban

Design Chainage		***Design Length***	***Improvement Details***
From	***To***		
163+740	163+790	50.00	2-Lane Rural
163+790	163+800	10.00	Minor Bridge
163+800	163+933	132.50	2-Lane Rural
163+933	164+038	105.00	Hiller Bridge
164+038	164+115	77.50	2-Lane Rural
164+115	164+125	10.00	Minor Bridge
164+125	164+385	259.80	2-Lane Rural
164+385	164+409	24.40	Minor Bridge
164+409	164+710	300.45	2-Lane Rural
164+710	164+750	40.70	Minor Bridge
164+750	164+829	78.65	2-Lane Rural
164+829	164+839	10.00	Minor Bridge
164+839	164+890	51.00	2-Lane Rural
164+890	164+938	47.50	4-Lane Urban
164+938	164+963	25.00	Minor Bridge
164+963	164+999	36.00	4-Lane Urban
164+999	165+024	25.00	Minor Bridge
165+024	166+990	1966.50	4-Lane Urban
166+990	167+590	600.00	2-Lane Rural
167+590	168+690	1100.00	4-Lane Urban
168+690	169+790	1100.00	2-Lane Rural
169+790	170+260	470.00	4-Lane Urban
170+260	170+450	190.00	4-Lane Urban(15m)
170+450	170+460	10.00	Minor Bridge
170+460	170+780	320.00	4-Lane Urban(15m)
170+780	171+590	810.00	4-Lane Urban
171+590	172+410	820.00	2-Lane Rural
172+410	173+090	680.00	4-Lane Urban
173+090	173+590	500.00	4-Lane Urban(15m)
173+590	173+890	300.00	4-Lane Urban
173+890	175+090	1200.00	2-Lane Rural
175+090	175+160	70.00	4-Lane Urban
175+160	175+300	140.00	4-Lane Urban(15m)
175+300	176+390	1090.00	4-Lane Urban
176+390	176+532	142.04	2-Lane Rural
TOTAL DESIGN LENGTH		***27943.50***	

The Economic analysis was carried out for 30-year benefit period (2022-2052). For performing economic evaluation, a 'project' is formulated in which comparison is made between two scenarios namely (1) Existing and (2) Proposed.

10.3.1 Capital Cost

Total Project cost is **Rs. 280.81** Crore for project road. For economic evaluation base costs have been taken as factor cost of civil works and other cost related to social environmental and utility relocations that mean Capital cost is the total construction cost of civil works for the project improvement.

The construction cost for homogeneous section is tabulated in **Table 10.3** for the year 2020 at which Project will start to implement. The construction cost of project will be utilised in two phases i.e. 40 % in the first year and 60 % in second year as construction period of 24 months.

The cost estimate for each section has been calculated separately based on the quantities worked out for major items of work to be executed in the project on the basis of preliminary engineering design of roads, structures and the adopted rates. A conversion factor of 0.85 has been used to convert financial cost into economic costs.

The economic cost for each package is as under:

Table 10.3: Total Project Cost

Homogeneous Section	Financial Cost (Cr)	Economical Cost
Vailoo - Donipawa	280.81	227.41

10.3.2 Maintenance Cost

5 years Maintenance Period including structures:

No maintenance charges shall be paid for the first year; 0.50 % of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year.

10.4 Project Benefits

Project Benefits mainly occurs due to Reduction in Vehicle operating cost and travel time savings.

The vehicle operating cost (VOC) components are

- Fuel
- Lubricants
- Tyres

- Spare Parts
- Maintenance Labour
- Wages of Crew
- Fixed costs including overheads, administration, interest on borrowed capital
- Depreciations
- Travel time cost
- Social Development around the project length

10.4.1 Vehicle Fleet

10.4.1.1 Fleet Utilization

Fleet utilization data adopted for the analysis is based on the findings of Road User Cost study in 2001, IRC SP: 30-2009. The adopted values are summarized as shown in table below.

Table 10.4: Life Norms for Vehicles

Particulars	Km Driven	Life, Year	Working Hour	Passenger
2 Axle Truck	90000	12	1950	-
Multi Axle Truck	75000	12	2100	-
3 Axle Truck	75000	12	2100	-
LCV	45500	10	1050	-
Bus/Mini-Bus	125000	10	2400	45
Car / Jeep / Van	87500	10	1750	5
Two-Wheeler	28800	10	636	1.5

10.4.2 Vehicle Resources

10.4.2.1 Vehicle and Tyre Cost

Economic costs of vehicle and tyre are derived from the market survey. Ex-Show Room Price for each category of vehicle have been collected and elements of taxes, duties, freight, dealer's margin and incentives as applicable have been removed to arrive at the economic costs. The adopted economic costs are summarized as presented in table below.

Table 10.5: Prices of Vehicles

Category	Vehicle (Rs.)	Tyre (Rs.)
2 Axle Truck	2000000	15000
3 Axle Truck	2500000	20000
Multi Axle Truck	3500000	25000
LCV	1000000	10000
Bus	2500000	13500
Car / Jeep / Van	750000	7500
Two-Wheeler	55000	2000

10.4.2.2 Fuel & Lubricant

Economic Prices fuel and lubricant are arrived based on ratio of WPI for all commodities of

June 2020 with respected to March 2009 and applying that ratio to search out actual value.

Table 10.6: Economic Cost of Fuel & Lubricants

Item	Price/ litre as per SP 30:2009 without taxes	WPI Ratio	Present Cost/ litre
Petrol	18.55	4.28	79.39
Diesel	18.20	3.81	69.34
Lubricants	56.70	4.05	229.6

10.4.2.3 Maintenance Labour and Crew Wages

Adopted values for Maintenance Labour and Crew Wages are based on the enquiries made by the Consultant with transport operators and workshops in and around the project Road. The adopted values are summarized vide in table below.

Table 10.7: Labour and Crew Wages

(Cost in Rs. per hour)

Category	Maint. Labour	Crew Wage
Truck	250	250
3 Axle and Multi Axle Truck	250	450
LCV	250	200
Bus	250	400
Car / Jeep / Van	250	200
Two-Wheeler	250	-

10.4.2.4 Annual Overhead

Recommendations of the "Study for Updating Road User Cost Data: 2001"and IRC SP: 30-2009 are considered to arrive at annual overhead cost per vehicle and are summarised in table below:

Table 10.8: Annual Overheads

Category	Annual Overhead Cost (Rs.)
2 Axle Truck	192500
3 Axle and Multi Axle Truck	258000
LCV	128000
Bus	155000
Car / Jeep / Van	80000
Two-Wheeler	6624

10.4.2.5 Annual Interest

An Economic Interest Rate of 12% has been adopted for the analysis.

10.4.2.6 Time Value of Passengers

Time Value of Passenger (Work Trips and Non-Work Trips) is arrived based on "Manual of

Economic evaluation of Highway Projects in India (" IRC SP: 30 -2009)". The values of 2009 are upgraded by considering Wholesale Price Index Ratio for the year 2009 and 2015. Non work time value of passenger is considered 15% and work time value of passenger is considered 85 % of time value of passengers as suggested in IRC SP:30 -2009". The adopted values are summarized as given in table below.

Table 10.9: Time Value of Passengers

Mode of Travel	Unit	2-Wheeler	Car/ Taxi	Bus
Travel time Value RUCS-March 2009	Rs/Hour	62.5	32.0	39.5
WPI Ratio 2010/ 2009	-	1.156	1.156	1.156
Travel time Value RUCS-august2010	Rs/Hour	31.0	61.0	39.0
Eq. Non-work Time Value in 2010	Rs. /Hour	5.5	10.8	6.8

10.4.2.7 Time Value of Cargo

Average value of commodity is based on "Manual of Economic evaluation of Highway Projects in India (" IRC SP: 30 - 2009)". Equivalent cost of commodity in 2010-2011 is determined using the WPI ratio (1.156 over 2009). Average payload for each category of freight vehicles is based on axle load survey. Time-delay cost is estimated with an economic interest rate of 12% and economic conversion factor of 0.90 and provided in table below:

Table 10.10: Time Value of Cargo

Vehicle Category	Average Payload (Tonnes)	Average Running Time (hour/Year)	Time-delay Cost (Rs. /Hr)
2Axle Truck	15	1950	32.00
3 Axle and Multi Axle Truck	17	2100	55.00
LCV	8.25	1050	19.0

10.4.3 HDM Traffic

Following category of fast moving and slow-moving vehicles are considered for carrying out HDM 4 Analysis.

- 2 Axle Truck
- 3 Axle Truck
- Multi Axle Truck
- LCV
- Bus
- Minibus
- Car / Jeep / Van

- Two-Wheeler

As HDM-4 does not include 3-Wheeler and Agricultural Tractor Categories of Vehicle therefore these categories are not considered in the analysis. Percentage compositions of assigned traffic in AADT on the project road as on year 2019 and adopted for the analysis for the Project road are summarized as given in table below.

Table 10.11: Composition of Motorized Traffic assigned on Project road (%)

Section ID	2-Wheeler (PCU)	Passenger Car + Jeep	Bus	LCV	2-Axle	3-Axle	Multi Axle	AADT (PCU)
PT	1049	4370	374	492	975	45	20	8059

Adopted traffic growth rates as per traffic analysis is Presented in **Table10.12.**

Table 10.12: Traffic growth Rate of Motorized Traffic assigned on Project road (MT) (%)

Sr. No.	Period	Two Wheelers	Cars/jeeps	Buses	Trucks			LCV and Mini LCV
					2 Axle	3 Axle	M Axle	
1	Up to 2020	10.0	10.0	5.0	5.0	5.0	5.0	10.0
2	2021 -2025	9.0	9.0	5.0	5.0	5.0	5.0	9.0
3	2026 – 2030	8.0	8.0	5.0	5.0	5.0	5.0	8.0
4	2031 – 2035	7.0	7.0	5.0	5.0	5.0	5.0	7.0
5	Beyond 2035	6.0	6.0	5.0	5.0	5.0	5.0	6.0

10.5 Economics Internal Rate of Return

Economic Analysis has been carried out for construction option discussed above. Variables considered in for economic analysis of the project are volatile and depend on various factors. In general, in case of economic analysis is also recommended that analysis period should not be long as it may lead to erroneous results.

However, in order to be able to draw the conclusions on common platform Economic Analysis have also been carried out for 30 years of analysis period. The summary of Economic internal rate of return (EIRR) worked out, for construction option based on life cycle cost analysis is presented below.

The Economic Analysis Summary with time savings (By Alternative) is presented vide **Annexure 10.**

The EIRR and NPV at 12% discount rate for each construction package as worked out with and without benefits due to travel time savings are summarized as under:

Table 10.13: Results of Economic Analysis

Homogeneous Sections	Option	Net Economic Benefit (NPV @ 12%)	Economic Internal Rate of Return (12 %)
Vailoo – Donipawa	With time saving	-117.85	-0.8

10.6 Sensitivity Analysis

The Sensitivity analysis has been carried out in order to study the viability of the project against the uncertainties in traffic forecasting and the possible variations of project cost due to unforeseen reasons. The sensitivity analysis has been performed with following situations.

S1: Base cost plus 15% and Base Benefits

S2: Base cost and Base Benefits minus 15%

S3: Base cost plus 15% and Base Benefits minus 15%

The analysis has been done by changing the cost and benefit streams independently as well as in combination. The end results of this study have been summarised below:

Table 10.14: Results of Sensitivity Analysis

Option	Economic Internal Rate of Return (%)		
	S1	S2	S3
With time saving	1.62	1.72	2.60

10.7 Conclusion

Since the IRR is -0.8 % that is much less than the market interest rate and present NPV @ 12% is also negative (117.85). The project is not recommended for BOT mode and hence EPC mode can be adopted because the proposed bypass is necessary to decongest the Anantnag Town.

Chapter 11

Financial Analysis

11.0 FINANCIAL ANALYSIS

Financial Study is carried out for **Vailoo Donipawa** project road from design km 148+589 to km. 176+532.

This section is of **27.943 km.** proposed length. The commercial viability is assessed for **20 years** concession period by making financial analysis (BOT / Annuity analysis) as given below.

Alternative I - Construction Cost – **280.81 Crores.**

For above alternatives viability has been assessed for all possible modes i.e. EPC, BOT & PPP.

11.1 Approach

The viability of any EPC/ BOT / Annuity package depends on working cash flows available to service the debt and equity. This working cash flow is basically dependent upon the following:

a) Capital Cost

b) Traffic Forecast

c) User fee Structure

d) Operation and Maintenance expenses

e) Interest on Debt

f) Tax

Infrastructure projects are typically capital intensive and are characterised by long payback periods. To look at such projects on a commercial format, it becomes necessary to adopt measures, which significantly improve the financial viability of the project. Such steps include optimising capital costs and drawing up a user fee structure based on benefit analysis and revenue optimisation principles.

In this ultimate analysis, the extent to which such projects raise non-budgetary resources depend on the ability of the project to service investments at commercial terms. Presently, average returns on equity are structured to range from 12% to 13% per annum on an IRR basis. Likewise, debt instruments placed with financial institutions provide an average return of around 9% to 12% per annum. To raise the resources for such project, it is necessary that the project is expected to give the lucrative returns at healthy debt-equity ratio.

The main objective of Financial Analysis is to examine the viability of implementing the project on a BOT / PPP basis. The analysis attempts to ascertain the extent to which the investment can be recovered through toll revenue and the gap, if any, be funded through Grant / Subsidy. This covers aspects like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation, Annuity etc. The viability of the project is evaluated on the basis of Project FIRR (Financial Internal Rate of Return on total investment). The FIRR is estimated on

the basis of cash flow analysis, where both costs and revenue have been indexed to take account of inflation. Financial analysis has been carried out for debt equity ratio of 70:30.

11.2 Capital Cost

The construction is expected to be executed completely in 24 months; year-wise progress will be 40 % in first year and 60% in second year. The civil construction cost for the project road is considered as base cost. Total Project cost showing these additional provisions are tabulated below:

Table 11.1: Phasing of Cost

Section	Proposed Length (km)	Base Cost (Rs.)	Phasing of Cost
Vailoo - Donipawa	27.943	227.41	40% in first year and 60% in second year

11.2.1 Cost Escalation

The price escalation has been considered as 5 %.

11.2.2 Project Cost

In base construction cost, provision for physical contingency (2.8% of the base construction cost) has been made to arrive at the Engineering procurement cost (EPC). In addition to the above, a provision of 3% Supervision Charges, 3% Agency Charge, and 5% Escalation charges for 2nd year on Base Construction Cost have been made to get the project cost.

This financial implication increases the Total Project Cost by approximately 25% of Civil Construction Cost.

Sr. No.	Item of Works	Cost (cr.)
A	Civil Works Cost with 12% GST	227.41
B	Total Project Cost	280.41

11.3 Operation and Maintenance Costs

No maintenance charges shall be paid for the first year; 0.50 % of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year.

11.4 Project Revenue

Infrastructure project like Highways are generally having two types of revenue generation.

- Toll Revenue
- Advertisement Revenue

11.4.1 Toll Revenue

11.4.1.1 Basic Toll Rates

In assessing the financial viability of a user fee model road project, the willingness of people to pay user fees is a key issue. The standard approach to this issue is to estimate the generalised or perceived cost of trip making. To standardise the toll structure MORT&H has recommended that basic rate per km for National Highways are adopted for analysis purpose.

Table 11.3: Official Toll Rates

Vehicle Type	Base rate of fee per km for the base year 2007-08 (in Rupees)
Car	0.65
MINI-BUS/LCV	1.05
Bus/ 2 axle	2.20
3 - Axle	2.40
MAV (four to six axles)	3.45
Oversize Vehicle (seven or more axles)	4.20

The base rates given in **Table 11.3** shall be increased without compounding by three percent each year and such increased rate shall be deemed to be the base rate for next year. Such applicable base rate shall be revised annually to reflect the increase in wholesale price index; but restricted to forty percent of the increase in wholesale price index.

The toll rates are allowed with 10% inflation at every two years interval and shall be rounded off to nearest 5 rupees. User fees are revised once in every two years.

However, no toll plaza is proposed in the road stretch.

11.4.1.2 Location of Toll Plazas

No toll plaza is being proposed for the entire length of the project.

11.4.1.3 Traffic Assumptions and Forecast

Light vehicles especially Two/Three wheelers and slow-moving vehicles are exempted from user fee as per guidelines for toll roads. Toll able traffic has been assessed leaving slow moving and light vehicles except light commercial vehicles, car, minibuses, trucks and Tractor with trailers.

11.4.1.4 Concession Period

The guiding principle for determining project specific concession period is the carrying capacity of the respective highway at the end of the proposed concession period. As such, the concession period is proposed based on volume of present and projected traffic. In other ways concession period ends in the year when capacity of respective highway exhaust to cater project traffic volume.

Table provided below shows existing traffic and the year when traffic exceeds the capacity of the highway, calculated for "**Level of Service B** (LOS B) and warrants capacity augmentation.

Lane Capacity and Augmentation Required for the Project Corridor

Homogenous Section	LOS B	LOS C
	2-Lane with Paved Shoulder	2-Lane with Paved Shoulder
Vailoo – Donipawa (Ch. Km 148+589 to Km 176+532)	2020	2021

It is revealed from the capacity analysis results; the project road requires **2 lanes with paved shoulder** for capacity augmentation and efficient movement of traffic up to project common concession period of 20 years i.e. horizon year 2042.

11.4.2 Advertisement Revenue

The advertisement has been not recommended on the project road due to safety concern to the road users. So, revenue generation from the advisement is not taken into consideration for this project.

11.5 Financial Model Input and Analysis

11.5.1 Grant and Its Treatment

It shall be equal to the sum specified in the bid and as accepted by the authority but in no case greater than the equity and shall be further restricted to a sum not exceeding 40% of TPC i.e. maximum 40% of TPC (Total Project Cost). It shall be due and payable to the Concessionaire as per PPP guidelines. Further it shall be disbursed proportionately along with the loan funds. For analysis, VGF of 25% have been adopted to ensure minimum 12% IRR.

11.5.2 Proposed Sources of Finance

In general, the developer shall crystallize the sources of finance by optimizing his equity returns keeping in view the project cash flows, terms, and conditions of various financing options available. Further the market standing, and financial strength of the Developer would largely determine the terms and conditions of finance offered to the Developer by various lending agencies. For the study, following sources of finance have been taken:

- Equity: To be provided by the Developer
- Subsidy / Grant for viability of funding, to be provided by the client.
- Debt: To be arranged by the Developer / Concessionaire

11.5.3 Expenses

Expenses can broadly be classified based on the phases in which they are incurred, viz. construction period expenses and operation & maintenance period expenses.

11.5.4 Construction Period Expenses

- Preliminary and pre-operative expenses
- Contingency allowance
- Interest during construction period
- Finance Charges

11.5.5 Operation and Maintenance Period Expenses

- Toll collection expenses
- Administrative expenses for day-to-day operation including insurances
- Maintenance expenses, which include routine and periodic maintenance
- Interest expenses incurred for servicing term loans
- Tax

11.5.6 Financial Viability

To assess whether the project is a profitable proposition, the returns to investors are measured by the post-tax project FIRR and the equity FIRR, which is estimated from the cash-flow statements, based on discounted cash-flow technique. The returns expected by the investors are a function of the value of equity issues on the Indian stock Markets, Interest rates on commercial loans, the risk profile of the investment and alternative investment opportunities. To qualify the project in terms of attractive financial returns, the following criteria are adopted:

- Post tax IRR on Project Investment : minimum 12%
- Post tax IRR on Equity : minimum 12%
- DSCR : >1.0
- BCR : >1.3
- NPV @ 12% : must be positive

11.5.7 Findings of Financial Analysis

With the assumptions already stated above the financial analysis for the project corridor has been undertaken. The results of financial analysis have been presented in Annexure 10 for BOT and EPC option.

11.6 Recommendation & Conclusion on Type of Financing

- ❑ Project road section is financially not viable based on the forecasted traffic and MORT&H user fee with 25% government subsidy and maximum concession period of 20 years

- Therefore, the project road is being proposed under EPC mode of construction.

Chapter 12

Conclusion and Recommendations

12.0 Conclusion and Recommendations

12.1 General

Given the needs of the project to adequately address the concerns of the local population and latest IRC guidelines, the project has been conceived with the provision of underpasses, Railway over Bridges, service roads and wayside amenities completely integrated into the project wherever required. Looking at the peculiarity of soaring prices around the highways for which the widening works are in progress, the aspect of acquisition of wider land strip or formation of bypass has been examined wherever feasible.

12.2 Project Clearances

Following clearances are required before the commencement of construction work. Out of these, few are critical and need to be obtained immediately to avoid the time lag at later date.

Table 12.1: Project Clearances

Sr. No.	Item	Agency
1.	Forest Clearance	Jammu and Kashmir Forest Department
2.	Pollution Clearance -No Objection Certificate (NOC) (Exempted)	Jammu and Kashmir State Pollution Control Board
3.	Shifting of services and utilities including underground water pipeline sewerage line and optical fibre cables	BSNL, BSEB, Public Health Engineering department, Optical fibber cable operator
4.	Clearance for cutting trees and transporting	Forest Department, Department of Horticulture
5.	Dismantling of structure falling within right of way	Competent Land Acquisition Authority

12.3 Recommendations

It is intended that the conclusions and recommendations included in this report would generate discussion and interpretation of the environmental and social assessment scope of work. The following general recommendations are made:

- Based on the lane capacity analysis results, the project road requires 4 lanes with paved shoulder for capacity augmentation and efficient movement of traffic up to project common concession period of 20 years i.e. horizon year 2042.
- The project road can be improved without causing significant adverse environmental impacts to the natural, social, economic or cultural environments.

- There is no need for land acquisition for the project.
- The project can be constructed within 24 months period with strategic planning and through one construction package. The construction work may begin from April 2021. The estimated basic cost is given below table

Section	Proposed Length (km)	Base Cost in Crore Including GST
Vailoo - Donipawa	27.943	227.41

- Project road section is financially not viable based on the forecasted traffic and MoRT&H user fee with 40% government subsidy. Therefore, under EPC contract option proposed for the entire project section with single package and 20 years concession period is adopted