0.0 Executive Summary

0.1 Prelude

National Highways & Infrastructure Development Corporation Ltd., Ministry of Road Transport & Highways, Government of India, has been assigned the work of preparation of feasibility study / DPR of road stretches/ corridors for up-gradation to two/ four laning with paved shoulder NH Configuration.

In pursuance of the above, M/S Wadia Techno Engg.Ltd in Association with M/s Zoma Engineers have been appointed as Consultants to carry consultancy services for Project Management including preparation of Detailed Project Report for Construction of 2 Lane with Paved Shoulder **Chenani – Sudhmahadev** section of NH-244 (Old NH-1B)-Phase-I in the state of Jammu and Kashmir.

0.2 Scope of Study

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

Stage	Report and Deliverables
1	Inception Report (IR)
2	Feasibility Report (FR)
3	Project Clearances
4	Detailed Project Report (DPR)

0.3 Socio - Economic Profile

The details on Socio-economic parameters will include per capita income, demographic details, growth of primary, secondary and tertiary sectors of economy, GNP, NSDP, traffic growth rates, number of villages connected with the roads, density of road network and other modes of transport in the region, achievement of five-year plan outlays and sectors having more emphasis in plan outlays of the State government etc. These details will be collected for the State and project road influence area giving true picture of the socio-economic profile of the region. The details collected will be utilized for the traffic forecasting and social analysis.

0.4 Project Description

The entire proposed project road is in the state of Jammu and Kashmir. The state occupies a total area of 222,236 square kilometres. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border with China in the north and east, and the Line of Control separates it from the Pakistan. Jammu and Kashmir consists of three divisions: Jammu, Kashmir Valley and Ladakh, and is further divided into 22 districts. The **Chenani-Sudhmahadev** road section “Project Road” situated in Jammu and Kashmir is having total length of about 22.713 Kilometre. This road stretch was earlier stand alone road. The project is situated on new alignment of NH-244. The total re-aligned portion of NH-244 is of approx. 54 km length. The instant project is situated on the new alignment of NH-244 the previous alignment was passing through Kud-Patnitop-Batote-Doda and Kishtwar and ends at Khanabal. The Government declared the new alignment starting from its junction with NH-44 passing through the villages of Chenani,

Sudhmahade, Goha, Khellani and meets at Doda town on the old alignment. The NH-244 then follows the same previous alignment. A tunnel of 4.5 km length has been provisioned between Sudhmahadev and Goha village. The project road has significant influence on Jammu and Kashmir State and on the Udhampur district . It starts at Junction with NH-44, Srinagar Kanyakumari Highway and terminates in village Sudhmahadev. The project stretch is a single-lane carriageway, the width of carriageway varies from 3.75 m to 11.0 m in entire stretch. Maximum portion of the project road is single lane. The surface of the carriageway is bituminous, and the surface of shoulders is unpaved. The condition of the pavement is good (70%) and some stretches are also poor, around 30%. Cracking is prominent for about 60% and edge break is around 90% on the project road. The condition of shoulders is generally poor, it is seen that earthwork was deposited at site on shoulder. The project road passes through many villages like Batna -Madha - Kud - Chenani – Ancha – Margna – Beshti – Chylar – Bashat – Karlah – Karwalt etc.

Table 0.1: Project Road Characteristics

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
1	0.000	0.100	0.100	Hilly	BT	10.800
2	0.100	0.200	0.100	Hilly	BT	10.800
3	0.200	0.300	0.100	Hilly	BT	10.800
4	0.300	0.400	0.100	Hilly	BT	10.800
5	0.400	0.500	0.100	Hilly	BT	10.800
6	0.500	0.600	0.100	Hilly	BT	10.800
7	0.600	0.700	0.100	Hilly	BT	10.800
8	0.700	0.800	0.100	Hilly	BT	10.800
9	0.800	0.900	0.100	Hilly	BT	10.800
10	0.900	1.000	0.100	Hilly	BT	10.800
11	1.000	1.100	0.100	Hilly	BT	10.800
12	1.100	1.200	0.100	Hilly	BT	10.800
13	1.200	1.300	0.100	Hilly	BT	10.800
14	1.300	1.400	0.100	Hilly	BT	10.800
15	1.400	1.500	0.100	Hilly	BT	10.800
16	1.500	1.600	0.100	Hilly	BT	10.800
17	1.600	1.700	0.100	Hilly	BT	10.800
18	1.700	1.800	0.100	Hilly	BT	7.000

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
19	1.800	1.900	0.100	Hilly	BT	7.000
20	1.900	2.000	0.100	Hilly	BT	7.000
21	2.000	2.100	0.100	Hilly	BT	7.000
22	2.100	2.200	0.100	Hilly	BT	7.000
23	2.200	2.300	0.100	Hilly	BT	7.000
24	2.300	2.400	0.100	Hilly	BT	5.500
25	2.400	2.500	0.100	Hilly	BT	5.500
26	2.500	2.600	0.100	Hilly	BT	5.500
27	2.600	2.700	0.100	Hilly	BT	5.500
28	2.700	2.800	0.100	Hilly	BT	5.500
29	2.800	2.900	0.100	Hilly	BT	5.500
30	2.900	3.000	0.100	Hilly	BT	7.000
31	3.000	3.100	0.100	Hilly	BT	7.000
32	3.100	3.200	0.100	Hilly	BT	7.000
33	3.200	3.300	0.100	Hilly	BT	7.000
34	3.300	3.400	0.100	Hilly	BT	7.000
35	3.400	3.500	0.100	Hilly	BT	7.000
36	3.500	3.600	0.100	Hilly	BT	7.000
37	3.600	3.700	0.100	Hilly	BT	7.000
38	3.700	3.800	0.100	Hilly	BT	3.900
39	3.800	3.900	0.100	Hilly	BT	3.900
40	3.900	4.000	0.100	Hilly	BT	3.900
41	4.000	4.100	0.100	Hilly	BT	3.900
42	4.100	4.200	0.100	Hilly	BT	3.900
43	4.200	4.300	0.100	Hilly	BT	3.900
44	4.300	4.400	0.100	Hilly	BT	3.900
45	4.400	4.500	0.100	Hilly	BT	3.900
46	4.500	4.600	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
47	4.600	4.700	0.100	Hilly	BT	3.900
48	4.700	4.800	0.100	Hilly	BT	3.900
49	4.800	4.900	0.100	Hilly	BT	3.900
50	4.900	5.000	0.100	Hilly	BT	3.900
51	5.000	5.100	0.100	Hilly	BT	3.900
52	5.100	5.200	0.100	Hilly	BT	3.900
53	5.200	5.300	0.100	Hilly	BT	3.900
54	5.300	5.400	0.100	Hilly	BT	3.900
55	5.400	5.500	0.100	Hilly	BT	3.900
56	5.500	5.600	0.100	Hilly	BT	3.900
57	5.600	5.700	0.100	Hilly	BT	3.900
58	5.700	5.800	0.100	Hilly	BT	3.900
59	5.800	5.900	0.100	Hilly	BT	3.900
60	5.900	6.000	0.100	Hilly	BT	3.900
61	6.000	6.100	0.100	Hilly	BT	3.900
62	6.100	6.200	0.100	Hilly	BT	3.900
63	6.200	6.300	0.100	Hilly	BT	3.900
64	6.300	6.400	0.100	Hilly	BT	3.900
65	6.400	6.500	0.100	Hilly	BT	3.900
66	6.500	6.600	0.100	Hilly	BT	3.900
67	6.600	6.700	0.100	Hilly	BT	3.900
68	6.700	6.800	0.100	Hilly	BT	3.900
69	6.800	6.900	0.100	Hilly	BT	3.900
70	6.900	7.000	0.100	Hilly	BT	3.900
71	7.000	7.100	0.100	Hilly	BT	3.900
72	7.100	7.200	0.100	Hilly	BT	3.900
73	7.200	7.300	0.100	Hilly	BT	3.900
74	7.300	7.400	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
75	7.400	7.500	0.100	Hilly	BT	3.900
76	7.500	7.600	0.100	Hilly	BT	3.900
77	7.600	7.700	0.100	Hilly	BT	3.900
78	7.700	7.800	0.100	Hilly	BT	3.900
79	7.800	7.900	0.100	Hilly	BT	3.900
80	7.900	8.000	0.100	Hilly	BT	3.900
81	8.000	8.100	0.100	Hilly	BT	3.900
82	8.100	8.200	0.100	Hilly	BT	3.900
83	8.200	8.300	0.100	Hilly	BT	3.900
84	8.300	8.400	0.100	Hilly	BT	3.900
85	8.400	8.500	0.100	Hilly	BT	3.900
86	8.500	8.600	0.100	Hilly	BT	3.900
87	8.600	8.700	0.100	Hilly	BT	3.900
88	8.700	8.800	0.100	Hilly	BT	3.900
89	8.800	8.900	0.100	Hilly	BT	3.900
90	8.900	9.000	0.100	Hilly	BT	3.900
91	9.000	9.100	0.100	Hilly	BT	3.900
92	9.100	9.200	0.100	Hilly	BT	3.900
93	9.200	9.300	0.100	Hilly	BT	3.900
94	9.300	9.400	0.100	Hilly	BT	3.900
95	9.400	9.500	0.100	Hilly	BT	3.900
96	9.500	9.600	0.100	Hilly	BT	3.900
97	9.600	9.700	0.100	Hilly	BT	3.900
98	9.700	9.800	0.100	Hilly	BT	3.900
99	9.800	9.900	0.100	Hilly	BT	3.900
100	9.900	10.000	0.100	Hilly	BT	3.900
101	10.000	10.100	0.100	Hilly	BT	3.900
102	10.100	10.200	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
103	10.200	10.300	0.100	Hilly	BT	3.900
104	10.300	10.400	0.100	Hilly	BT	3.900
105	10.400	10.500	0.100	Hilly	BT	3.900
106	10.500	10.600	0.100	Hilly	BT	3.900
107	10.600	10.700	0.100	Hilly	BT	3.900
108	10.700	10.800	0.100	Hilly	BT	3.900
109	10.800	10.900	0.100	Hilly	BT	3.900
110	10.900	11.000	0.100	Hilly	BT	3.900
111	11.000	11.100	0.100	Hilly	BT	3.900
112	11.100	11.200	0.100	Hilly	BT	3.900
113	11.200	11.300	0.100	Hilly	BT	3.900
114	11.300	11.400	0.100	Hilly	BT	3.900
115	11.400	11.500	0.100	Hilly	BT	3.900
116	11.500	11.600	0.100	Hilly	BT	3.900
117	11.600	11.700	0.100	Hilly	BT	3.900
118	11.700	11.800	0.100	Hilly	BT	3.900
119	11.800	11.900	0.100	Hilly	BT	3.900
120	11.900	12.000	0.100	Hilly	BT	3.900
121	12.000	12.100	0.100	Hilly	BT	3.900
122	12.100	12.200	0.100	Hilly	BT	3.900
123	12.200	12.300	0.100	Hilly	BT	3.900
124	12.300	12.400	0.100	Hilly	BT	3.900
125	12.400	12.500	0.100	Hilly	BT	3.900
126	12.500	12.600	0.100	Hilly	BT	3.900
127	12.600	12.700	0.100	Hilly	BT	3.900
128	12.700	12.800	0.100	Hilly	BT	3.900
129	12.800	12.900	0.100	Hilly	BT	3.900
130	12.900	13.000	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
131	13.000	13.100	0.100	Hilly	BT	3.900
132	13.100	13.200	0.100	Hilly	BT	3.900
133	13.200	13.300	0.100	Hilly	BT	3.900
134	13.300	13.400	0.100	Hilly	BT	3.900
135	13.400	13.500	0.100	Hilly	BT	3.900
136	13.500	13.600	0.100	Hilly	BT	3.900
137	13.600	13.700	0.100	Hilly	BT	3.900
138	13.700	13.800	0.100	Hilly	BT	3.900
139	13.800	13.900	0.100	Hilly	BT	3.900
140	13.900	14.000	0.100	Hilly	BT	3.900
141	14.000	14.100	0.100	Hilly	BT	3.900
142	14.100	14.200	0.100	Hilly	BT	3.900
143	14.200	14.300	0.100	Hilly	BT	3.900
144	14.300	14.400	0.100	Hilly	BT	3.900
145	14.400	14.500	0.100	Hilly	BT	3.900
146	14.500	14.600	0.100	Hilly	BT	3.900
147	14.600	14.700	0.100	Hilly	BT	3.900
148	14.700	14.800	0.100	Hilly	BT	3.900
149	14.800	14.900	0.100	Hilly	BT	3.900
150	14.900	15.000	0.100	Hilly	BT	3.900
151	15.000	15.100	0.100	Hilly	BT	3.900
152	15.100	15.200	0.100	Hilly	BT	3.900
153	15.200	15.300	0.100	Hilly	BT	3.900
154	15.300	15.400	0.100	Hilly	BT	3.900
155	15.400	15.500	0.100	Hilly	BT	3.900
156	15.500	15.600	0.100	Hilly	BT	3.900
157	15.600	15.700	0.100	Hilly	BT	3.900
158	15.700	15.800	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
159	15.800	15.900	0.100	Hilly	BT	3.900
160	15.900	16.000	0.100	Hilly	BT	3.900
161	16.000	16.100	0.100	Hilly	BT	3.900
162	16.100	16.200	0.100	Hilly	BT	3.900
163	16.200	16.300	0.100	Hilly	BT	3.900
164	16.300	16.400	0.100	Hilly	BT	3.900
165	16.400	16.500	0.100	Hilly	BT	3.900
166	16.500	16.600	0.100	Hilly	BT	3.900
167	16.600	16.700	0.100	Hilly	BT	3.900
168	16.700	16.800	0.100	Hilly	BT	3.900
169	16.800	16.900	0.100	Hilly	BT	3.900
170	16.900	17.000	0.100	Hilly	BT	3.900
171	17.000	17.100	0.100	Hilly	BT	3.900
172	17.100	17.200	0.100	Hilly	BT	3.900
173	17.200	17.300	0.100	Hilly	BT	3.900
174	17.300	17.400	0.100	Hilly	BT	3.900
175	17.400	17.500	0.100	Hilly	BT	3.900
176	17.500	17.600	0.100	Hilly	BT	3.900
177	17.600	17.700	0.100	Hilly	BT	3.900
178	17.700	17.800	0.100	Hilly	BT	3.900
179	17.800	17.900	0.100	Hilly	BT	3.900
180	17.900	18.000	0.100	Hilly	BT	3.900
181	18.000	18.100	0.100	Hilly	BT	3.900
182	18.100	18.200	0.100	Hilly	BT	3.900
183	18.200	18.300	0.100	Hilly	BT	3.900
184	18.300	18.400	0.100	Hilly	BT	3.900
185	18.400	18.500	0.100	Hilly	BT	3.900
186	18.500	18.600	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
187	18.600	18.700	0.100	Hilly	BT	3.900
188	18.700	18.800	0.100	Hilly	BT	3.900
189	18.800	18.900	0.100	Hilly	BT	3.900
190	18.900	19.000	0.100	Hilly	BT	3.900
191	19.000	19.100	0.100	Hilly	BT	3.900
192	19.100	19.200	0.100	Hilly	BT	3.900
193	19.200	19.300	0.100	Hilly	BT	3.900
194	19.300	19.400	0.100	Hilly	BT	3.900
195	19.400	19.500	0.100	Hilly	BT	3.900
196	19.500	19.600	0.100	Hilly	BT	3.900
197	19.600	19.700	0.100	Hilly	BT	3.900
198	19.700	19.800	0.100	Hilly	BT	3.900
199	19.800	19.900	0.100	Hilly	BT	3.900
200	19.900	20.000	0.100	Hilly	BT	3.900
201	20.000	20.100	0.100	Hilly	BT	3.900
202	20.100	20.200	0.100	Hilly	BT	3.900
203	20.200	20.300	0.100	Hilly	BT	3.900
204	20.300	20.400	0.100	Hilly	BT	3.900
205	20.400	20.500	0.100	Hilly	BT	3.900
206	20.500	20.600	0.100	Hilly	BT	3.900
207	20.600	20.700	0.100	Hilly	BT	3.900
208	20.700	20.800	0.100	Hilly	BT	3.900
209	20.800	20.900	0.100	Hilly	BT	3.900
210	20.900	21.000	0.100	Hilly	BT	3.900
211	21.000	21.100	0.100	Hilly	BT	3.900
212	21.100	21.200	0.100	Hilly	BT	3.900
213	21.200	21.300	0.100	Hilly	BT	3.900
214	21.300	21.400	0.100	Hilly	BT	3.900

Sr. no.	Existing Chainage		Length (km)	Terrain	Pavement Type	Carriageway Width
	From (km)	To (km)				
215	21.400	21.500	0.100	Hilly	BT	3.900
216	21.500	21.600	0.100	Hilly	BT	3.900
217	21.600	21.700	0.100	Hilly	BT	3.900
218	21.700	21.800	0.100	Hilly	BT	3.900
219	21.800	21.900	0.100	Hilly	BT	3.900
220	21.900	22.000	0.100	Hilly	BT	3.900
221	22.000	22.100	0.100	Hilly	BT	3.900
222	22.100	22.200	0.100	Hilly	BT	3.900
223	22.200	22.300	0.100	Hilly	BT	3.900
224	22.300	22.400	0.100	Hilly	BT	3.900
225	22.400	22.500	0.100	Hilly	BT	3.900
226	22.500	22.600	0.100	Hilly	BT	3.900
227	22.600	22.713	0.100	Hilly	BT	3.900
	Total Length		**22.713**			

The project road traverses through Mountainous & Hilly terrain.

0.4.1 Road Junctions

There is one Major junction and 4 minor junctions in the project stretch.

Table 0.2: Details of Major Junction

S.No.	Chainage	Link	Type
1	0+000 (Km 24.711 of NH-44)	Srinagar	Y

0.4.2 Existing Bridge & Cross Drainage Structures

There 3 minor bridges, 71 Pipe culverts, 16 Slab culverts, 12 Stone Masonry Culverts, 2 Blocked culverts and 3 Causeways on project road on the project road section.

Table 0.3: Summary of Existing Bridges and Culverts

Sr. No.	Type	No's of structures
1	Minor Bridges	3
2	Causeway	3
3	Pipe Culverts	71
4	Slab Culverts	16
5	Stone Masonry Culverts	12
6	Blocked culverts	2
Total		**107**

0.4.3 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.

Batote to Kishtwar after the construction of Sudhmahadev tunnel and road stretch from Chenani to Sudhmaahdev, there could be increase in the traffic enroute to Doda Town and beyond. However, the proposed road configuration shall cater to the design service volume 9000(PCU). Further the road has been designed for 20 MSA against the projected 1.21 MSA (after 15 years)

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

0.4.4 Classified Continuous 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. Detailed site visit of project road and its influence/alternative transport network has been carried out between on 20th November 2017 to 26th November 2017. Traffic survey locations were finalised by consultation with client officials.

Table 0.4: Summary of Classified Volume Count Survey at all count stations

Sr. No.	Chainages	Justification/Rational
Classified Volume Count Surveys (CVC)		
1	Km 11/500 near Bashat	Km (11/500) has been selected to get the idea of traffic in homogeneous section from Start of Project Road to Sudhmahadev

0.4.5 Annual Average Daily Traffic (AADT)

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:

Table 0.5: Summary of Annual Average Daily Traffic (AADT)

Sr. No.	Location	Fast Moving Vehicles (PCU)	Slow Moving Vehicles (PCU)	Total AADT (PCU)
1	Bashat (km 11/500)	1253	19	1271

0.4.6 Turning Movement Count

There is one major intersection in the project stretch and TMC count is not conducted at this location as it is the start of the project stretch.

0.4.7 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 identified locations. 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 0.6: Adopted VDF by Homogeneous Sections

SUMMARY of VDF at Bashat Km 11.500	
Vehicle Type	**VDF**
LCV	0.433
2 Axle Truck	1.876
3 Axle Truck	0.377
Multi Axle Truck	0.000
Bus	0.459

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the beginning of year 2021. MSA for the homogeneous sections is worked out for 15 years excluding construction period:

Table 0.7: Summary of MSA

Section		Existing Chainage		Design MSA (2021-2035)
From	To	From	To	
Chenani	Sudhmahadev	0/000	22/713	20

0.4.8 Speed-Delay Survey

Speed and delay survey was carried out to obtain the information on the average journey time, journey speed and running speed of the project road.
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 0.8: 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	Chenani	Sudhmahadev	22.713	45	30	68	20	23	Delay due to traffic conditions

The dominant reason for delay in Chenani - Sudhmahadev section is high vehicular movements during peak hours especially at the start point of the project road i.e. Chenani. At the start point of the stretch, it was observed during speed delay study that many vehicles were parked along the roadside. Such roadside parking caused delay in traffic movement.

0.5 Growth Rate

The various methods specified vide IRC 108: 2015 are taken in to 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:

Table 0.9: Comparative Analysis and Adopted of Growth Rates

S.NO	Vehicle Type	Goods (%)	Bus (%)	Car (%)	3-Wheeler (%)	2-Wheeler (%)
1	Vehicle Growth Criteria Method	22.11	3.22	17.50	1.09	8.42
2	Net State Domestic Method	6.17	4.72	4.79	4.63	4.68
3	As per IRC	5	5	5	5	5
	Adopted Growth Rates	**5**	**5**	**5**	**5**	**5**

Table 0.10: Summary of Projected Total AADT Traffic PCU Volume / day

Homogeneous Section	Year 2017	Year 202	Year 2025	Year 2030	Year 2035
Chenani to Sudhmahadev (Ch.0+000 to km 22+713)	1256	1527	1856	2368	3023

0.6 Capacity Analysis

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 LOSB should be adopted for the design purpose. On other roads under exceptional circumstances, LOSC could also be adopted for design. For LOS C, Design service volume can be taken as 40 % higher than those for LOS B. For augmentation of the facilities and up gradation of the project highway, the design service volume for the mountainous/hilly terrain condition and level of Service B & C is shown in Table:

Table 0.11: Design Service Volume for Different Lane Configurations

Lane Configuration	Design Service Volume (PCUs per day) *Level of Service B*	Design Service Volume (PCUs per day) *Level of Service C*
2-Lane with 1.5m Paved Shoulder	9000	10000
4-Lane with 1.5m Paved Shoulder	10000	20000

0.7 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. Based on the estimated Capacity & Design Service Volume, the number of lanes required for the project road is worked out for LOS B & LOS C which is presented in Table below.

Table 0.12: Lanning Requirement for the Project Corridor

Homogeneous Sections	LOS B	LOS C
	2-Lane with Paved Shoulder	2-Lane with Paved Shoulder
Chenani to Sudhmahadev (Ch.0+000 to km 22+713)	2018	Beyond Analysis Period

It is revealed from the capacity analysis results and considering future traffic growth, the Project road requires Two lane configuration.

0.8 Results of Engineering Surveys and Investigations

0.8.1 Pavement Condition

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.

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.

Table 0.13: Percentage wise distribution of Good Fair and Poor Road

Sr. No.	Condition	Length (Km)	% Condition
1	Good	15.373	67.68
2	Poor	7.340	32.32

0.8.2 Benkelman Beam Deflection

Structural strength of existing pavement has been assessed by conducting Benkelman beam test as per procedure specified vide IRC 81: 1997 and in accordance with TOR set-forth vide consultancy agreement as well as for identified control sections. On an average, characteristic deflection was noticed 0.67 mm for the project stretch.

0.8.3 Pavement Investigation

Summary of the layer thickness as recorded from test pits are as under:

Table 0.14: Summary of Crust Thickness in mm

Location	Granular	BT	Old BT	Old Granular	Boulder	Total thickness
5.0	425	75	-	-	-	500
10.0	465	85	-	-	-	550
15.0	510	90	-	-	-	600

0.9 Proposed design standards

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

Table 0.15: Summary of Recommended Design Standard

(i)	Design Speed (Km/hr)		
	Mountainous Terrain	:	60 (Ruling), 40(Minimum)
	Plain Terrain		100 (Ruling), 80(Minimum)
(ii)	Level of Service	:	B
(iii)	Roadway Widths (m) Mountainous Terrain Plain Terrain	:	 11 m for 2-lanes with paved shoulders/ Granular Shoulder 14m for 2-lanes with paved shoulders/ Granular Shoulder
(iv)	Roadway Elements Mountainous Terrain		
	With Retaining wall and parapet	:	Carriageway • 2-lane- 2X3.5m Paved Shoulder • 2-lane with PSS- 2x1.5m
	Without Retaining wall		Carriageway • 2-lane- 2X3.5m Paved Shoulder • 2-lane with PSS- 2x1.5m Unpaved Shoulder • 2-lane with - 1.0m
	Built up Area with retaining wall		Carriageway • 2-lane- 2X3.5m Paved Shoulder • 2-lane with PSS- 2x1.5m
	Plain Terrain		Carriageway • 2-lane- 2X3.5m Paved Shoulder • 2-lane with PSS- 2x1.5m Unpaved Shoulder • 2- lane -2X2.0m
(v)	Camber		**Carriageway** Flexible- 2.50% Rigid - 2.00 % **Paved Shoulder** Flexible- 2.50% Rigid - 2.00 % **Unpaved Shoulder** Flexible- 3.50% Rigid - 3.00 %
(vi)	Right of Way		As per Plan and Profile
(vii)	Embankment/ Cutting		

	Slope Fill height, up to 3.0 m Fill height from 3.0 m to 6.0 m Fill height exceeding 6.0 m		In filling- 1V: 2 H In filling- 1V: 1.5 H To be designed based on soil parameters, (IRC: 75) In cutting- 1V:1H
(viii)	Stopping Sight Distance Intermediate sight distance		 20 m for design speed of 20 km/hr 25 m for design speed of 25 km/hr 30 m for design speed of 30 km/hr 40 m for design speed of 35 Km /hr 45m for design speed of 40km/hr 60 m for design speed of 50km/hr 90 m for design speed of 60km/hr 120m for design speed of 80 km/hr 180m for design speed of 100km/hr 40 m for design speed of 20 km/hr 50 m for design speed of 25 km/hr 60 m for design speed of 30 km/hr 80 m for design speed of 35 Km /hr 90 m for design speed of 40km/hr 120 m for design speed of 50km/hr 180 m for design speed of 60km/hr 240m for design speed of 80km/hr 360m for design speed of 100km/hr
(ix)	Super-elevation Mountainous Terrain Plain Terrain		 Maximum 10% Maximum 5%
(x)	Radii for Horizontal Curves Mountainous Terrain Plain Terrain		 Ruling Minimum 150 m Absolute minimum 75 m Ruling Minimum 400 m Absolute minimum 250 m
(xi)	Ruling Gradient Mountainous Terrain Plain Terrain		 5.0% 2.5%
(xii)	Minimum K- factor Summit Curve Mountainous Terrain Plain Terrain Valley Curve Mountainous Terrain Plain Terrain		 Desirable: 8 Minimum: 5 Desirable: 74 Minimum: 38 Desirable: 10 Minimum: 7 Desirable: 42 Minimum: 28
(xiii)	Bridge Clearance		
	Vehicular underpass		5.5 m
	Cattle and Pedestrian		3.0m
(xiv)	Design Flood Frequency		
	Bridges		100 years

	Sewers and Ditches		60 years

0.10 Improvement Proposals

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

a) Proposal for Widening and Reconstruction
b) Requirement of bypasses and realignment
c) Geometric Improvement Design
d) Proposed Pavement Design
e) Traffic Control and Safety Measures
f) Bridge and Cross Drainage Structures

0.10.1 Proposal for Reconstruction

To meet future traffic requirement, the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety.

Table 0.16: Proposed Cross Section

Sr. No.	Design Chainage		Length (Km)	TCS Type	Remarks
	From (Km)	To (Km)			
1	0.000	0.800	0.800	3	One side Valley & One side Built up or open area
2	0.800	0.840	0.040	6	Realignment
3	0.840	0.890	0.050	4	Approach to Bridge
4	0.890	0.965	0.075	Bridge	Bridge
5	0.965	1.015	0.050	4	Approach to Bridge
6	1.015	1.274	0.259	2	One side Hill & One side Valley (Drain on Hill Side)
7	1.274	1.466	0.192	2	One side Hill & One side Valley (Drain on Hill Side)
8	1.466	2.400	0.934	6	Realignment
9	2.400	2.450	0.050	4	Approach to Bridge
10	2.450	2.700	0.250	Bridge	Bridge

Sr. No.	Design Chainage		Length (Km)	TCS Type	Remarks
	From (Km)	To (Km)			
11	2.700	2.750	0.050	4	Approach to Bridge
12	2.750	3.050	0.300	1	One side Hill & One side Valley (Breast Wall on hill side)
13	3.050	3.300	0.250	6	Realignment
14	3.300	4.100	0.800	1	One side Hill & One side Valley (Breast Wall on hill side)
15	4.100	4.167	0.067	6	Realignment
16	4.167	4.217	0.050	4	Approach to Bridge
17	4.217	4.223	0.006	Bridge	Bridge
18	4.223	4.273	0.050	4	Approach to Bridge
19	4.273	4.900	0.627	6	Realignment
20	4.900	5.400	0.500	1	One side Hill & One side Valley (Breast Wall on hill side)
21	5.400	5.558	0.158	6	Realignment
22	5.558	5.700	0.142	1	One side Hill & One side Valley (Breast Wall on hill side)
23	5.700	6.000	0.300	6	Realignment
24	6.000	6.185	0.185	1	One side Hill & One side Valley (Breast Wall on hill side)
25	6.185	6.400	0.215	6	Realignment
26	6.400	6.600	0.200	1	One side Hill & One side Valley (Breast Wall on hill side)
27	6.600	6.825	0.225	6	Realignment
28	6.825	7.400	0.575	1	One side Hill & One side Valley (Breast Wall on hill side)
29	7.400	7.447	0.047	6	Realignment

Sr. No.	Design Chainage		Length (Km)	TCS Type	Remarks
	From (Km)	To (Km)			
30	7.447	7.497	0.050	4	Approach to Bridge
31	7.497	7.503	0.006	Bridge	Bridge
32	7.503	7.553	0.050	4	Approach to Bridge
33	7.553	7.700	0.147	6	Realignment
34	7.700	8.677	0.977	1	One side Hill & One side Valley (Breast Wall on hill side)
35	8.677	8.727	0.050	4	Approach to Bridge
36	8.727	8.733	0.006	Bridge	Bridge
37	8.733	8.783	0.050	4	Approach to Bridge
38	8.783	8.800	0.017	6	Realignment
39	8.800	8.897	0.097	1	One side Hill & One side Valley (Breast Wall on hill side)
40	8.897	8.947	0.050	4	Approach to Bridge
41	8.947	8.953	0.006	Bridge	Bridge
42	8.953	9.003	0.050	4	Approach to Bridge
43	9.003	9.254	0.251	6	Realignment
44	9.254	9.304	0.050	4	Approach to Bridge
45	9.304	9.364	0.060	Bridge	Bridge
46	9.364	9.414	0.050	4	Approach to Bridge
47	9.414	10.200	0.786	5	One side Hill & One side Valley (Breast Wall and Gabion Box Protection on hill side)

Sr. No.	Design Chainage		Length (Km)	TCS Type	Remarks
	From (Km)	To (Km)			
48	10.200	10.600	0.400	6	Realignment
49	10.600	10.900	0.300	5	One side Hill & One side Valley (Breast Wall and Gabion Box Protection on hill side)
50	10.900	11.100	0.200	6	Realignment
51	11.100	11.400	0.300	5	One side Hill & One side Valley (Breast Wall and Gabion Box Protection on hill side)
52	11.400	11.625	0.225	6	Realignment
53	11.625	11.700	0.075	1	One side Hill & One side Valley (Breast Wall on hill side)
54	11.700	12.100	0.400	6	Realignment
55	12.100	13.217	1.117	1	One side Hill & One side Valley (Breast Wall on hill side)
56	13.217	13.267	0.050	4	Approach to Bridge
57	13.267	13.273	0.006	Bridge	Bridge
58	13.273	13.323	0.050	4	Approach to Bridge
59	13.323	13.555	0.255	6	Realignment
60	13.555	14.180	0.625	1	One side Hill & One side Valley (Breast Wall on hill side)
61	14.180	14.447	0.267	6	Realignment
62	14.447	14.497	0.050	4	Approach to Bridge
63	14.497	14.503	0.006	Bridge	Bridge
64	14.503	14.553	0.050	4	Approach to Bridge
65	14.553	14.700	0.147	6	Realignment

Sr. No.	Design Chainage		Length (Km)	TCS Type	Remarks
	From (Km)	To (Km)			
66	14.700	14.787	0.087	1	One side Hill & One side Valley (Breast Wall on hill side)
67	14.787	14.837	0.050	4	Approach to Bridge
68	14.837	14.843	0.006	Bridge	Bridge
69	14.843	14.893	0.050	4	Approach to Bridge
70	14.893	15.055	0.162	6	Realignment
71	15.055	16.300	1.245	1	One side Hill & One side Valley (Breast Wall on hill side)
72	16.300	16.700	0.400	6	Realignment
73	16.700	16.990	0.290	5	One side Hill & One side Valley (Breast Wall and Gabion Box Protection on hill side)
	Total Length		**16.990**		

0.10.2 Typical Cross-sections

Proposed cross-sections are shown in table given below.

Table 0.17: Summary of TCS

Summary of TCS				
Sr. No.	Detail	TCS	Length	
			(m)	(Km)
1	One side Hill & One side Valley (Breast Wall on hill side)	1	6.902	6902
2	One side Hill & One side Valley (Drain on Hill Side)	2	0.451	451
3	One side Valley & One side Built up or open area	3	0.800	800
4	Approach to Bridge	4	1.000	1000
5	One side Hill & One side Valley (Breast Wall and Gabion Box Protection on hill side)	5	1.676	1676

Summary of TCS				
Sr. No.	Detail	TCS	Length	
			(m)	(Km)
6	Realignment	6	5.734	5734
7	Bridge		0.427	427
	Total Length		**16990.00**	**16.990**

0.10.3 Requirement of Bypasses

No bypass is proposed in the project stretch.

0.10.4 Pavement Design

Flexible pavement is proposed new carriageway and reconstruction. Design period of 15 years considered for new carriageway. The Pavement improvement proposal for entire project road is presented in **Table 0.18**.

Table 0.18 Improvement Proposal for New Pavement

Crust Composition for New Pavement as per IRC 37 – 2012										
Homogeneous Section	Design Chainage		CBR	MSA	Crust				S.Grade	Total Thickness
	From	To			BC	DBM	WMM	GSB		
1	0/000	16/990	10	20	40	80	250	200	500	**1070**

0.10.5 Traffic Control and Safety Measures

0.10.5.1 Road Marking & Traffic Signs

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.
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.

0.10.5.2 Proposal for Truck Lay byes/Parking cum Rest Area

As per the detailed field surveys and reconnaissance, there is no requirement of truck lay bye/ Parking cum rest areas proposal.

Table 0.19 Truck lay byes/ Parking cum Rest Area Location

Sr. No.	Existing Chainage
Nil	

0.10.6 Major Bridge/ Minor Bridge & Cross Drainage Structures

0.10.6.1 Bridges

There are 3 minor bridges which crosses either River, Nalla or small streams. Photographic representations are some of minor bridges are described as below.

Out of 3 minor bridges, all 3 are to be abandoned and 10 new bridges are proposed. The Brief details of improvement proposal for existing bridges are given in Table no. 0.20. The details of improvement proposal for bridges are given in **Annexure-8.2.**

Details of bridges are provided in **Annexure-4.10.**

0.10.6.2 Culverts

There are 71 Pipe culverts, 16 Slab culverts, 12 Stone Masonry Culverts, 2 Blocked culverts and 3 Causeways on project road. Improvement proposal for culvert are given in Table no. 0.20. Details of culverts are provided in **Annexure-4.11**.
The details of improvement proposal for culverts are given in **Annexure-8.3**

Table 0.20: Summary of structures proposed

SL.NO.	DESCRIPTION	No. Of Structures	REMARKS
1	**PIPE CULVERTS**		
	Causeway -PQC		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction Pipe Culvert with Box Culvert	2	
(iii)	New Proposals	0	
(iv)	Abandoned	1	
	Pipe Culverts		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction Pipe Culvert with Box Culvert	37	
(iii)	New Proposals	0	
(iv)	Abandoned	34	
2	**SLAB CULVERTS**		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction Slab Culvert with Box Culvert	12	

SL.NO.	DESCRIPTION	No. Of Structures	REMARKS
(iii)	New Proposals	0	
(iv)	Abandoned	4	
3	**BOX CULVERTS**		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction	0	
(iii)	New Proposals	30	
(iv)	Abandoned	0	
4	**SLAB CULVERTS**		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction	8	
(iii)	New Proposals	0	
(iv)	Abandoned	4	
4	**Blocked Culverts**		
(i)	Retaining & Widening	0	
(ii)	Dismantling & Reconstruction	1	
(iii)	New Proposals	0	
(iv)	Abandoned	1	
5	**UNDERPASSES**		
(a)	Vehicular underpasses	0	
(b)	Cattle underpasses	0	
6	**MINOR BRIDGES**		
(i)	Abandoned	3	
(ii)	Dismantling & Reconstruction	0	
(iii)	Retained	0	
(iv)	New proposals	8	
7	**MAJOR BRIDGES**		
(i)	To be widened	0	
(ii)	Dismantling & Reconstruction	0	
(iii)	Retained	0	
(iv)	New proposals	2	

0.11 Cost Estimate

Preliminary cost estimate for the project Road is finalised based on the improvement proposed. The preliminary cost estimate is worked out based on the quantities calculated for major items of work to be executed in the project and rates derived after detail analysis

Table 0.21 Cost of Civil Works

Section	Ex. Length (km)	Design Length (km)	Civil Cost in Crore
Chenani-Sudhmahadev	22.713	16.990	174.34

0.12 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 demarked 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. 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.

0.12.1 Social screening

The project road falls within one district of Jammu and Kashmir i.e. Udhampur. During the initial social screening period, primary consultations were conducted at village Bashat town 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.

0.13 List Clearances required for the Project

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 0.22: 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

0.14 Results of Financial Analysis

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. To qualify the project in terms of attractive financial returns, the following criteria have been 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

0.14.1 Recommendation & Conclusion on Type of Financing:

- Project road is financially not viable based on the forecasted traffic and MoRT&H user fee with 40% government subsidy and maximum concession period of 15 years.
- Therefore, under EPC contract option proposed for the entire project section with single package and 15 years concession period is adopted.

0.15 Results of Economic Analysis

0.15.1 Economics Internal Rate of Return

The EIRR and NPV at 12% discount rate for construction package as worked out with and without benefits due to travel time savings are summarized as under:

Table 0.23: Results of Economic Analysis

Homogeneous Sections	Option	Net Economic Benefit (NPV @ 12%)	Economic Internal Rate of Return (12 %)
Chenani-Sudhmahadev	With time saving	(58.88)	(6.93%)

0.15.2 Recommendation & Conclusion

The proposed road in required for alternate route in future from Chenani to Srinagar via Sudhmahdev, Goha, Khelani, Khanbal.

0.16 Recommendations

- Based on the lane 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 15 years i.e. horizon year 2035.

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

- The process of land acquisition must be initialised immediately after the approval of the alignment, to expedite construction of widening sections.

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

Table 0.25: Base Cost

Section	Proposed Length (km)	Base Cost In Cr
Chenani-Sudhmahadev	Existing Length: 22/713 Design Length: 16/990	174.34

- 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 15 years concession period is adopted.