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CHAPTER 1: INTRODUCTION

1.1 Project Background

Bangalore is one of the fastest growing cities in Asia and also one of the most sought - after cities in India by people, companies and multinationals. The massive growth that the city has witnessed in the last decade is a clear indication of this city being developed to be at par with the most modern cities in the world. The population of Bangalore has grown enormously on account of migration of people from all corners of India, neighboring countries and from countries in the West. Bengaluru 's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets.

The main arterial roads of Bengaluru coming into the city include Bellary Road in the north, Tumkur Road and Mysore Road in the west, Kanakapura Road, Bannerghatta Road and Hosur Road in the south and Airport Road and Old Madras Road in the east, these high-volume traffic arterial roads are inter connected with Outer Ring Road. Bangalore Commissioner of Police notified these 12 Major Roads connecting inter-districts and inter-states as High Traffic Density Corridors vide Notification dated:03-09-2016, and are named as High-Density Corridors.

Roads, and means of transport, make a crucial contribution to economic development and growth and bring important social benefits. Poorly maintained roads constrain mobility, significantly raise vehicle operating costs, increase accident rates and their associated human and property costs. Deterioration of constructed pavement is natural. It's natural because over time the materials that make up Bitumen begin to break down and become affected by elements such as rain, sunlight and chemicals that come into contact with the pavement surface. The liquid Bitumen binder that is the "glue" of the pavement begins to lose its natural resistance to water, allowing it to penetrate into and underneath the pavement. Once this happens, the surface can quickly fall prey to a number of different types of deterioration.

The construction and maintenance of roads to address the growing traffic in the city has been a challenge to the BDA and the BBMP. To reduce the pressure of hectic maintenance activities for BBMP and to ensure the effective maintenance of high-volume traffic arterial roads it has been proposed to handover the maintenance of High-density corridors to KRDCL.

The decision has been taken in the meeting held on 06-11-2019 under the Chairmanship of Hon'ble Chief Minister, Govt. Of Karnataka for Upgradation and maintenance of 12 High Traffic Density Corridors as per IRC guidelines to be taken by Karnataka Road Development Corporation Ltd.

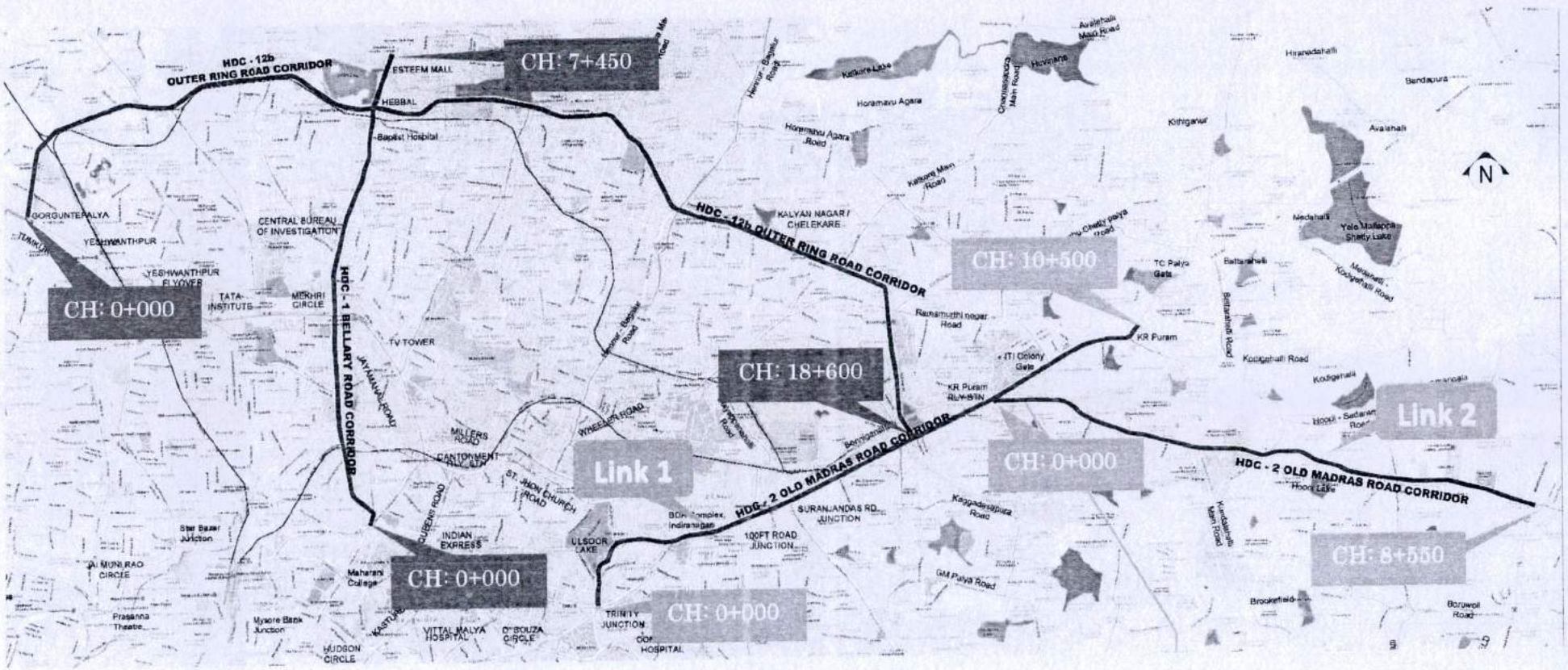
Karnataka Road Development Corporation Limited (KRDCL) was incorporated on 21st of July 1999 as a wholly owned Government of Karnataka Company as per the Provisions of the Company's Act, 1956. The company is managed by a Board of Directors chaired by Principal Secretary to Government, PWP and IWID with Members from other organizations.

KRDCL is a company under the Public Works, Ports & Inland Water Transport Department. This Company was established to promote surface infrastructure by taking up Road Works, Bridges etc., and to improve road network by taking up construction, widening and strengthening of roads, construction of bridges, maintenance of roads etc., and to take up projects on BOT, BOOT, BOLT. With the emerging industrial and economic development of the past few decades, there has been a tremendous growth in terms of the traffic on all the roads

Karnataka Road Development Corporation Limited (KRDCL) has appointed **M/s Infra Support Engineering Consultants Pvt Ltd** (ISECPL) as consultants for Preparation of DPR and Project Management Consultancy (Including Detailed Designs) for High Density Corridors (HDC) Package - 1 in Bengaluru, Karnataka comprising of the following roads: [HDC 1: Bellary Road, HDC 2. Old Madras Road, HDC 12b: Outer Ring Road from Gorguntepalya to Old Madras Road in Bangalore city, Karnataka. Total Length 44.55 Km.

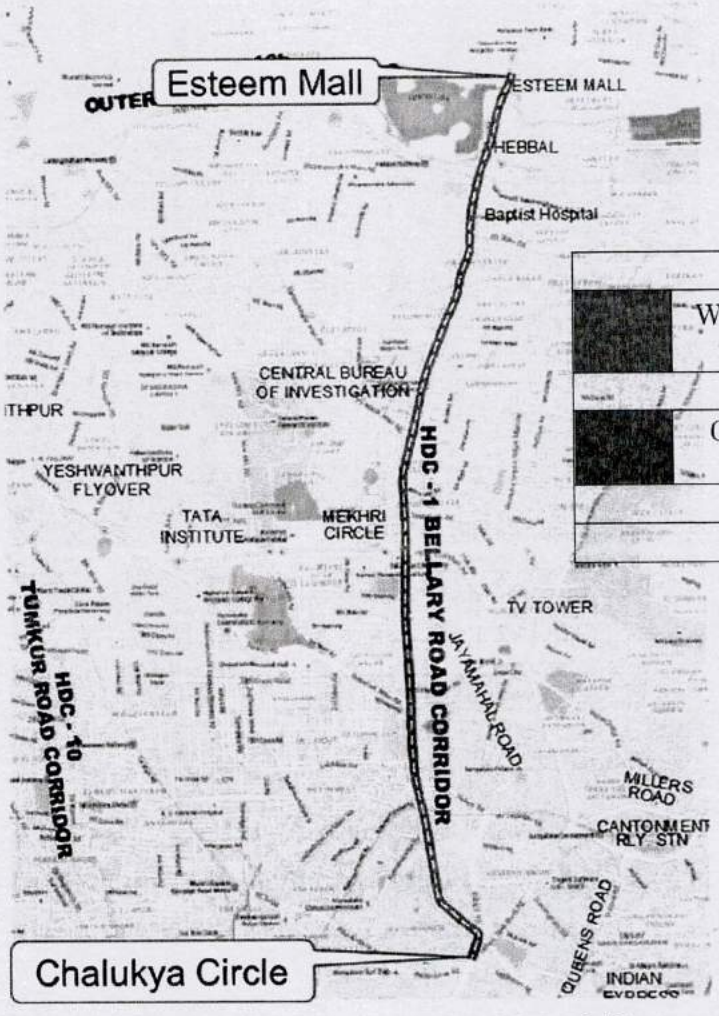
Table 1.1: Length of Project Corridors in Package 1

Sl. No	Name of the Road / Junction	Project length considered in km
1	HDC 1: Bellary Road - from Chalukya Circle to Hebbal up to start of NH limits via Mekhri Circle	7.45
2	HDC 2: Old Madras Road – Link 1: from Trinity Circle to NH limits via Indiranagar, KR Puram Cable stay Bridge, and Link 2: from KR Puram Railway Station to Hope farm on Whitefield Road via Hoodi.	18.50
3	HDC 12b: Outer Ring Road – from Gorguntepalya to Old Madras Road via BEL Circle, Hebbal Junction. Nagavara.	18.60
	Total length	44.55



Index Map of Project Road – Package 1

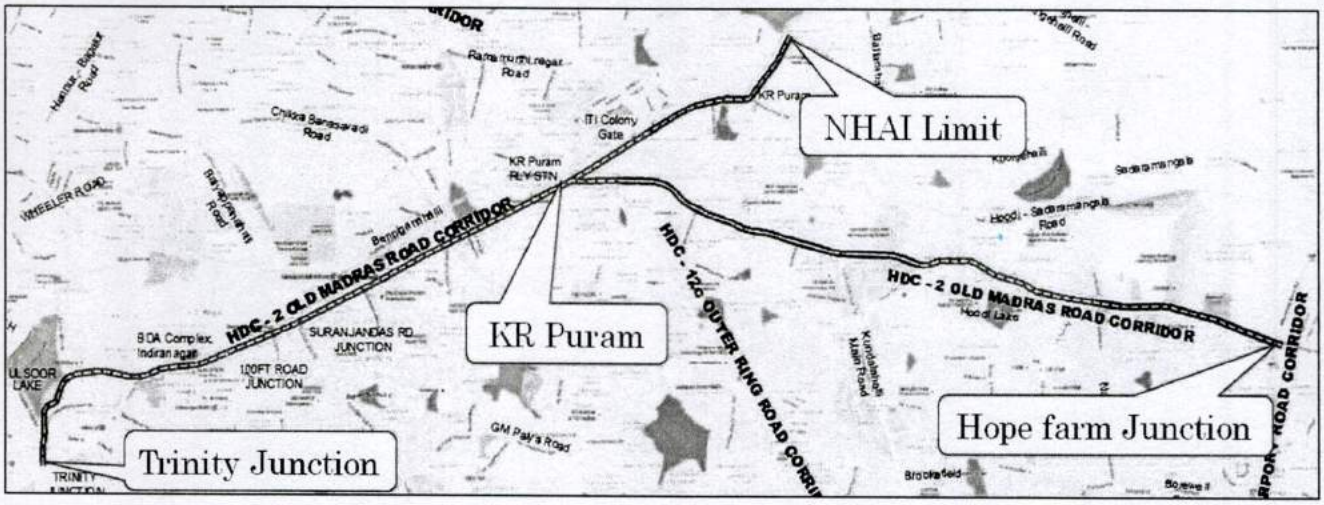
HDC No.1 starts at Chalukya circle in Bellary Road (NH-75) and ends at Hebbal flyover with a total length of approximately 7.45 Kms out of which 5.47 Km is considered for improvements and remaining 1.98 Km road is in ongoing tendered works under BBMP/Smart City/BMRCL.



Index	
Work considered by KRDCL for Initial Improvements	5.47 Km
Ongoing / Tendered works under BBMP	1.98 Km
Total Length	7.45 Km

Figure 1.1 Key Plan of Alignment (Bellary road)

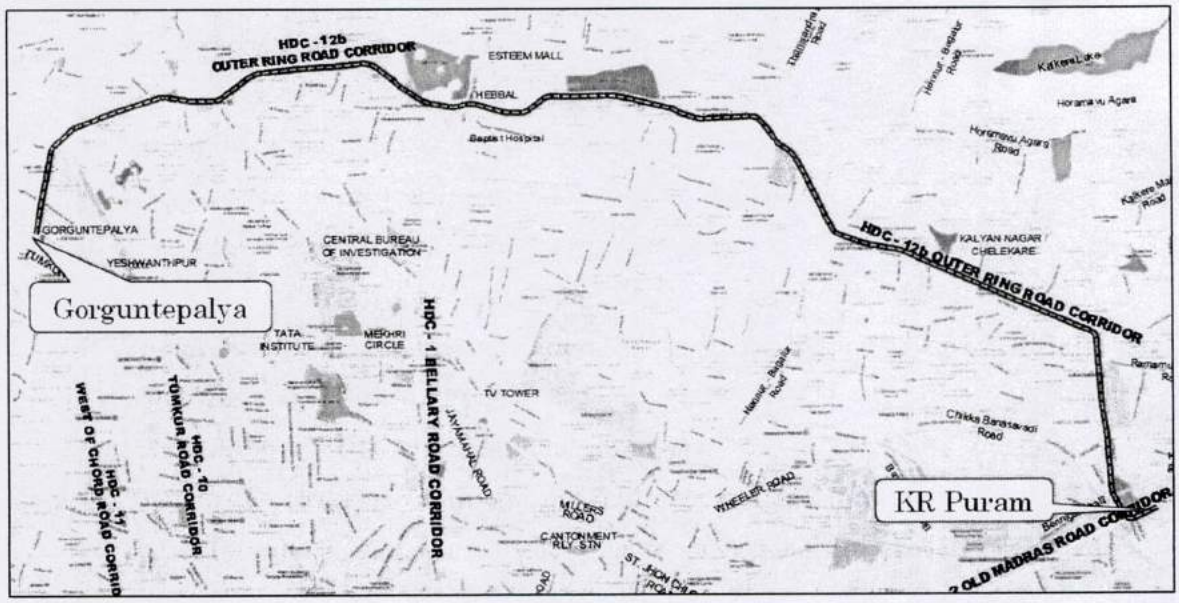
HDC No. 2 Old Madras road consisting of two sections, link road-1 and link road-2. Link road-1 starts at Trinity circle and ends at start of NH-75 limits and link-2 road starts KR Puram Railway station and ends at Hope farm junction with a total length of 18.5 Km out of which 10.0 Km is considered for improvements and remaining 8.5 Km road is in ongoing tendered works under BBMP/Smart City/BMRCL.



Index		
	Work considered by KRDCL for Initial Improvements	10.0 Km
	Ongoing / Tendered works under BBMP	2.65 Km
	Ongoing / Tendered works under BMRCL	5.85 Km
	Total Length	**18.50 Km**

Figure 1.2 Key Plan of Alignment (Old Madras Road)

HDC No. 12B Outer ring road from Gorguntepalya to Old Airport road starts at Gorguntepalya junction and ends at old madras road near Benniganahalli with a total length of 18.6 Km out of which 1.55 Km is considered for improvements and remaining 17.05 Km road is in ongoing tendered works under BBMP/Smart City/BMRCL,



Index		
	Work considered by KRDCL for Initial Improvements	1.55 Km
	Ongoing / Tendered works under BBMP	17.05 Km
	Total Length	**18.60 Km**

Figure 1.3 Key Plan of Alignment (Outer Ring Road)

1.2 Objective of the Project

The objective of the consultancy Services is to provide the required technical services to KRDCL in preparation of Detailed designs, Drawings, Estimations, Assisting in Tender Processes, and Project Management including construction supervision, maintenance supervision of the High-Density Corridors.

The following works are intended to be carried out on the Project Road:

1. Identification of possible improvements in the existing alignment.
2. Improvement of drainage at poor drainage locations and clear identification of the same on the drawings.
3. Rehabilitation /Reconstruction of bridges and culverts where necessary,
4. Improvement to junctions/intersections
5. Improvement of sidewalks with all required appurtenances like bollards, chamber covers, landscaping, access to properties, lighting etc.

6. Improvements to Signage, road markings
7. Street lighting of the corridor
8. Requirement for Provision of pedestrian facilities
9. Requirement for Improvement of junctions/intersections.
10. Assessing the Provision of road furniture and adequate road markings.
11. Assessing the Provision of traffic control devices where appropriate.
12. Preparation of roadway plans, sidewalk, median and all required drawings to be issued for good for construction.
13. Preparation of BOQ, specifications, estimates.
14. Preparation of routine maintenance intervals and specifications.
15. Presentations, meetings and discussions with various stakeholders in city.
16. Assisting in Preparation of bidding documents (schedules, specifications and drawings).
17. Bid processing assistance.

1.3 Scope of the Project

The broad scope of work encompasses

Stage 1: Carrying out surveys, investigations, detailed designs on the project roads, estimation, costing and submission of good for construction drawings

and

Stage 2: Project management including construction supervision, maintenance supervision, progress reports and PMS uploading.

Following is the brief scope of work as extracted from the RFP Document for Stage 1.

- Analysis of Available Reports and data's from KRDCL, BBMP and other departments.
- Survey and investigations of the Project Road
- Traffic Studies and Analysis
- Road safety assessment
- Pavement Structural Strength
- Topographic Survey
- Bridge / Structures Inventory and Condition Survey
- Hydrology and Drainage Investigations
- Pavement crust thickness

- Detailed Design
- Report and Drawings
- Bid process management

1.4 Meetings with Clients and Stakeholders

During the course of preparation of DPR meetings are held with client and Stakeholders for finalization of improvement proposals and other technical aspects. Following Meetings were held with various stakeholders for administration and Technical approval.

Table 1.1 : **Meeting Dates**

Sl No	Meeting held on	Meeting Chaired by	Meeting Location
1	30/11/2020	Additional Chief Secretary, PWD & Home	Vikasa Soudha
2	1/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
3	2/12/2020	DULT Commissioner	DULT office
4	11/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
5	11/12/2020	Additional Chief Secretary, PWD & Home	Vikasa Soudha
6	16/12/2020	Managing Director, KRDCL	KRDCL Office
7	24/12/2020	Chief Secretary	Vidhana Soudha
8	29/12/2020	DULT Commissioner	Online
9	4/1/2021	Chairman, Technical committee	KRDCL Office
10	8/1/2021	Additional Chief Secretary, UDD	Vikasa Soudha
11	12/1/2021	Additional Chief Secretary, UDD	Vikasa Soudha
12	13/1/2021	Additional Chief Secretary, UDD	Vikasa Soudha

1.5 Structure of the Report

The Draft Project Report has been structured as follows.

Volume – 1: Main report

Chapter 1 : Project back ground

Chapter 2 : Surveys and investigations carried out and Interpretation of data

Chapter 3 : Improvement Proposals

Chapter 4 : Cost Estimation

Annexures

Volume – 2: Drawings

Strip Plan

Plan with Sections

Standard Drawings

Volume – 3: Cost Estimation

Bill of Quantities - Package 1

Bill of Quantities – Individual Roads in Package 1

Cost Estimation - Individual Roads in Package 1

Rate Analysis

Volume – 4: Schedules

Schedule A: Existing Features

Schedule B: Initial Improvement Proposals.

Schedule C: Specifications and Standards

Schedule D: Interim Milestones for Initial Improvement Works

Schedule E: Applicable Permits

Schedule F: Maintenance Requirements

Schedule G : Control And Command Centre

Schedule H: Payments Schdule

Schedule I: Safety Requirements

Schedule J: Inter-Departmental Coordination Standard Operating Procedure (Sop) & Support Agreement

Schedule K: Format of Bank Guarantee For Performance Security.

Schedule L: Appoitment of Proejct Management Consultant

Schedule M : Format of Bank Guarantee For Advance Payment

Schedule N : Change of Scope Formats

Schedule O : Work Order Format for Additional Works

CHAPTER 2: SURVEYS AND INVESTIGATIONS

2.1 Introduction

This chapter deals with various surveys and Investigations carried out as per the Terms of Reference and required for quality compliance of the Project design and report preparation.

Major surveys and Investigations carried out are as follows:

- Road Inventory
- Pavement condition survey
- Structural Inventory
- Traffic surveys
- Topographic surveys
- FWD Survey

2.2 Road Inventory and Condition Surveys

2.2.1 Road Inventory

Road Inventory surveys have been conducted. Surveys are carried out as per the standard methodology / IRC guidelines. However brief methodology is given below:

As per the ToR consultants have to propose improvement proposals for the existing roads along the project corridors. Hence, the road and bridge inventory and condition surveys were conducted accordingly.

The road inventory survey involves making visual estimates and actual measurements of geometric and cross-sectional elements of the road and its deficiencies. This survey involves the collection of the data pertaining to the existing road such as the pavement type, width of the carriageway, type of the shoulder and its width, condition of road, type and condition of drain, footpath, median islands, number of CD structures, available land widths etc. Road inventory has been recorded in a standard format.

The team has travelled and walked along the alignments and adjacent roads collected first-hand information on the width and type of carriage way, type and condition of road, junctions, traffic intensity, width of footpath cum drains, Median islands, cross drainage structures, Bus stops/Bus bays/Bus shelters and relevant details of Grade separators, Metro Rail crossings and skywalks comprising in the project corridor are noted.

2.2.2 Right of Way

The Right of way details for the project road is taken by measuring drain to drain or footpath outer edge at regular intervals, RoW vary from 12m to 60 m. Details of RoW is shown in below table.

Table 2.1: Table showing details of RoW along for HDC-01 Bellary Road

From in Kms	To in Kms	Length in m	ROW in m
0+000	0+210	210.00	48.70
0+210	0+840	630.00	25.50
0+840	1+690	850.00	23.20
1+690	1+860	170.00	19.70
1+860	1+980	120.00	40.90
1+980	2+360	380.00	24.50
2+360	2+920	560.00	28.90
2+920	3+100	180.00	36.80
3+100	3+650	550.00	26.50
3+650	4+160	510.00	39.80
4+160	4+430	270.00	27.00
4+430	5+780	1350.00	23.40
5+780	6+450	670.00	34.10

Table 2.2: Table showing details of RoW along for HDC-02 Old Madras Road

From in Kms	To in Kms	Length in m	ROW in m
Link 1 - Trinity to Budigere Cross			
0+000	0+680	680	15
0+680	0+800	120	22
0+800	0+975	175	27
0+975	1+780	805	23
1+780	2+500	720	19
2+500	3+860	1360	26
3+860	4+440	580	32
4+440	4+600	160	29
4+600	4+970	370	24
4+970	5+400	430	29
5+400	6+050	650	37
6+050	6+150	100	30
6+150	8+650	2500	29

From in Kms	To in Kms	Length in m	ROW in m
8+400	9+500	1100	35
9+500	10+370	870	27
7+400	7+500	100	29.1
7+500	7+650	150	19.1
7+650	7+800	150	27
7+800	7+900	100	19.6
7+900	8+500	600	24.9
8+500	8+600	100	15.4
8+600	9+220	620	22.7
9+220	9260	40	19.3
9+260	9620	360	27
9+620	9750	130	29.2
9+750	10520	770	23.7
7+400	7+500	100	29.1
10+520	10660	140	17.8
10+660	11720	1060	24
11+720	12160	440	18.5
12160	13140	980	20.7
13140	13850	710	18.6
13800	14330	530	22.3
14330	14530	200	15.4
14530	15290	760	23.7
15290	16070	780	18.4

Table 2.3: Table showing details of RoW along for HDC-12b Gorguntepalya to KR Puram

From in Kms	To in Kms	Length in m	ROW in m
0+000	0+100	100	21.5
0+100	0+800	700	17.4
0+800	1+400	600	11.9
1+400	1+700	300	13.4
1+700	3+200	1500	16.8
3+200	6+650	3450	24.3
6+650	9+700	3050	22.5
9+700	10+800	1100	26.3
10+800	18+000	7200	27.3

2.2.3 Land use

The largest proportion of land abutting the project corridors are Commercial followed by Residential.

2.2.4 Carriageway and Median

Measurements were taken at locations where the cross-section changes w.r.t Types and widths of Main Carriageway, Service Roads, Footpath, Median, and Drains from beginning to end of the project roads. Along with carriageway measurements and median as a part of inventory survey. The carriageway varies from Three lane divided carriageway to six lane divided carriageway. The pattern of existing carriageway for four lane and six lanes, shoulder and median is given in Table 2.4 to Table 2.6.

2.2.6 Footpath

At some locations drain cum footpath is provided where land availability is limited where sufficient land is available footpaths are provided separately. Details are shown in below table.

Table 2.12: Table showing details of footpath for HDC-01 Bellary Road

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+210	210.00	Paved	1.0	Paved	2.3
0+210	0+790	580.00	-	-	Paved	2.2
0+790	0+840	50.00	-	-	Paved	0.6
0+840	0+890	50.00	-	-	Paved	1.8
0+890	1+160	270.00	-	-	Paved	1.8
1+160	1+410	250.00	-	-	-	-
1+410	1+510	100.00	Paved	2.4	-	-
1+510	1+690	180.00	-	-	Paved	4.1
1+690	1+860	170.00	-	-	Paved	3.1
1+860	1+980	120.00	Paved	1.6	Paved	0.6
1+980	2+250	270.00	Paved	1.7	Paved	2.8
2+250	2+360	110.00	Paved	1.6	-	0.8
2+360	2+860	500.00	Paved	6.7	Paved	0.8
2+860	2+920	60.00	Paved	5.0	-	-
2+920	3+100	180.00	Paved	5.3	Paved	1.0
3+100	3+650	550.00	-	-	Paved	0.8
3+650	3+730	80.00	Paved	1.4	Paved	2.8
3+730	4+160	430.00	Paved	3.9	Paved	0.5
4+160	4+290	130.00	Paved	2.9	-	-
4+290	4+430	140.00	Paved	1.9	-	-
4+430	4+670	240.00	-	-	-	-
4+670	5+060	390.00	-	-	-	-
5+060	5+780	720.00	-	-	-	-
5+780	6+230	450.00	-	-	Paved	1.3
6+230	6+330	100.00	Paved	1.5	-	-
6+330	6+450	120.00	-	-	-	-

Table 2.13: Table showing details of footpath for HDC-02 Old Madras Road

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
Link 1 - Trinity to Budigere Cross						
0+000	0+270	270	-	-	Paved	1.8
0+270	0+380	110	-	-	Paved	0.8
0+380	0+610	230	Paved	1.2	Paved	1.2
0+610	0+680	70	-	-	-	-
0+680	0+800	120	-	-	-	-
0+800	0+870	70	-	-	-	-
0+870	0+975	105	Paved	2.5	-	-
0+975	1+100	125	-	-	-	-
1+100	1+280	180	-	-	-	-
1+280	1+780	500	Paved	2.4	-	-
1+780	2+000	220	Paved	1.2	-	-
2+000	2+280	280	-	-	-	-
2+280	2+500	220	-	-	-	-
2+500	2+750	250	-	-	-	-
2+750	3+050	300	-	-	-	-
3+050	3+100	50	-	-	Paved	1.4+2.8
3+100	3+150	50	-	-	Paved	1.4+2.8
3+150	3+260	110	-	-	Paved	2.7
3+260	3+490	230	-	-	Paved	2.7
3+490	3+690	200	Paved	2.5	Paved	2.7
3+690	3+750	60	-	-	-	-
3+750	3+860	110	Paved	2.5	Paved	2.7
3+860	4+000	140	Paved	2.5	Paved	5.4
4+000	4+440	440	Paved	4.6	Paved	5.4
4+440	4+560	120	Paved	3.0	Paved	5.4
4+560	4+600	40	Paved	3	Paved	6
4600	4830	230	Paved	6.7	Paved	6
4830	4970	140	Paved	6.7	Paved	8.4
4970	5100	130	Paved	6.7	Paved	8.4
5100	5300	200	Paved	6.7	Paved	1.5
5300	5400	100	Paved	6	Paved	1.5
5400	5600	200	Paved	6	Paved	2.9
5600	5800	200	Paved	1.5	Paved	1.3
5800	6050	250	-	-	Paved	1.3
6050	6150	100	-	-	-	-
6150	6300	150	-	-	-	-
6300	8120	1820	Paved	1.5	Paved	1.3
8120	8300	180	-	-	Paved	0.6

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
8300	8400	100	-	-	Paved	1.6
8400	8650	250	-	-	Paved	2.6
8400	8970	570	-	-	Paved	2.6
8970	9000	30	Paved	3	Paved	0.6
9000	9240	240	Paved	3	Paved	-
9240	9500	260	Paved	2.5	Paved	-
9500	9750	250	-	-	-	-
9750	10125	375	-	-	-	-
10125	10370	245	-	-	-	-
10370	10500	130	-	-	-	-
Link 2 - K R Puram to Hope Farm						
11+660	11+720	60	Paved	3.8	Paved	1.6
11+720	11+880	160	Paved	2.6	Paved	2.3
11+880	11+940	60	Paved	2.6	Paved	2.3
11+940	12+150	210	Paved	3.6	Paved	3.3
12+150	12+160	10	Paved	0.8	Paved	5.4
12+160	12+440	280	Paved	0.8	Paved	5.4
12+440	12+570	130	Paved	0.7	Paved	5.4
12+570	12+920	350		-	Paved	5.4
12+920	13+000	80	Paved	4.1	Paved	1.9
13+000	13+050	50	Paved	4.1	Paved	1.9
13+050	13+140	90	Paved	4.1	Paved	2.6
13+140	13+690	550	Paved	3	Paved	2.6
13+690	13+750	60	Paved	3	Paved	2.6
13+750	13+850	100	Paved	3	Paved	2.4

Table 2.14: Table showing details of footpath for HDC-12b Gorguntepalya to KR Puram

Chainage, km		Length, m	Footpath			
			LHS		LHS	
From	To		Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+100	100	-	-	Paved	0.8
0+100	0+200	100	Paved	1.9	Paved	0.9
0+200	0+300	100	-	-	Paved	1.3
0+300	0+400	100	-	-	Paved	0.8
0+400	0+500	100	-	-	Paved	4.8
0+500	0+600	100	-	-	Paved	6.8
0+600	0+700	100	-	-	-	-
0+700	0+800	100	Paved	6.1	-	-
0+800	0+900	100	-	-	Paved	1.1

Chainage, km		Length, m	Footpath			
			LHS		LHS	
From	To		Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+900	1+000	100	-	-	-	-
1+000	1+100	100	-	-	Paved	0.8
1+100	1+200	100	-	-	-	-
1+200	1+300	100	-	-	-	-
1+300	1+400	100	-	-	-	-
1+400	1+500	100	-	-	-	-
1+500	1+600	100	-	-	-	-
1+580	1+630	50	-	-	-	-
1+600	1+700	100	-	-	-	-
1+700	1+750	50	-	-	-	-
1+750	1+800	50	Paved	3.1	Paved	2.9
1+800	1+900	100	Paved	2.1	Paved	2.0
1+900	2+000	100	Paved	2.7	Paved	0.7
2+000	2+100	100	Paved	2.7	Paved	0.9
2+100	2+200	100	Paved	2.0	Paved	1.8
2+200	2+300	100	Paved	2.7	Paved	1.6
2+300	2+400	100	Paved	1.7	Paved	1.3
2+400	2+500	100	Paved	2.3	Paved	1.7
2+500	2+510	10	Paved	1.7	Paved	0.9
2+510	3+200	690	Paved	0.8	-	-
3+200	3+520	320	-	-	-	-
3+500	3+600	100	-	-	-	-
3+600	3+700	100	-	-	-	-
3+700	3+800	100	-	-	-	-
3+800	3+900	100	-	-	-	-
3+900	4+000	100	-	-	-	-
4+000	4+100	100	-	-	-	-
4+100	4+200	100	Paved	0.7	-	-
4+200	4+300	100	Paved	0.8	-	-
4+300	4+400	100	-	-	-	-
4+400	4+500	100	Paved	1.2	Paved	1.2
4+500	4+600	100	Paved	1.2	Paved	1.2
4+600	4+700	100	-	-	-	-
4+700	4+800	100	-	-	-	-
4+800	4+900	100	-	-	-	-
4+900	5+000	100	-	-	-	-
5+000	5+100	100	-	-	-	-
5+100	5+200	100	-	-	-	-
5+200	5+300	100	-	-	-	-
5+300	5+400	100	-	-	-	-
5+400	6+100	700	Paved	1.3	Paved	1.4
6+100	6+650	550	Paved	2.6	Paved	1.1
6+650	6+800	150	-	-	-	-
6+800	7+000	200	Paved	1.7	Paved	1.5
7+000	7+100	100	Paved	-	Paved	1.4

Chainage, km		Length, m	Footpath			
			LHS		LHS	
From	To		Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
7+120	7+200	80	Paved	1.6	Paved	1.8
7+200	7+700	500	Paved	1.6	Paved	1.7
7+700	7+900	200	Paved	1.6	Paved	2.2
7+900	8+500	600	Paved	1.6	Paved	2.2
8+500	8+950	450	Paved	1.5	Paved	3.1
9+010	9+300	290	-	-	-	-
9+330	9+360	30	-	-	-	-
9+400	9+700	300	-	-	-	-
9+750	10+100	350	Paved	0.7	Paved	3.5
10+100	10+200	100	-	-	Paved	2.7
10+200	10+300	100	-	-	Paved	2.4
10+350	10+800	450	-	-	-	-
10+800	11+000	200	-	-	-	-
11+000	11+400	400	Paved	0.6	Paved	1.8
11+400	11+900	500	Paved	0.6	Paved	1.8
11+900	12+000	100	Paved	-	Paved	1.4
12+000	12+600	600	-	-	-	-
12+600	12+750	150	Paved	10.7	Paved	9.7
12+750	13+100	350	Paved	16.2	Paved	12.6
13+100	13+200	100	Paved	8.7	Paved	6.7
13+200	13+800	600	-	-	-	-
13+800	14+800	1000	Paved	12.9	Paved	13.2
14+800	15+300	500	-	-	-	-
15+300	15+550	250	Paved	6.7	Paved	1.5
15+550	15+800	250	Paved	1.6	Paved	1.5
15+800	16+250	450	-	-	-	-
16+250	16+600	350	Paved	0.9	Paved	1.8
16+400	16+600	200	Paved	0.9	Paved	1.8
16+600	17+000	400	Paved	6.0	Paved	2.8
17+000	17+300	300	Paved	1.5	Paved	2.9
17+300	17+800	500	Paved	3.0	Paved	1.6
17+800	17+900	100	Paved	0.8	Paved	0.8
17+900	18+000	100	Paved	0.8	Paved	0.8

2.3 Road Junctions

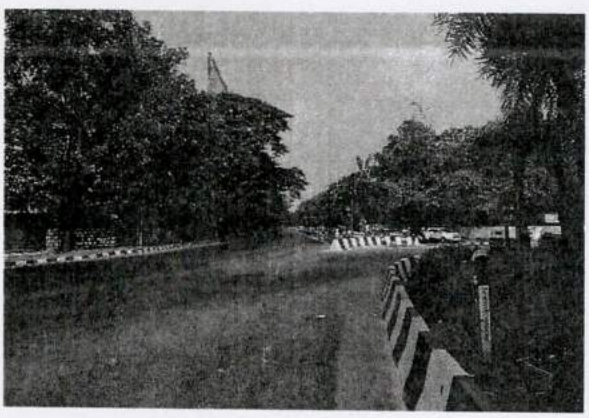
Significant transport benefits, across all modes, can be achieved through junction improvement and management. These improvements will aid free flow of Traffic to and from cross roads, thereby reducing travel time of through traffic. Total number of Major and minor junctions identified during inventory study are presented in the Table 2.4 and the detailed drawings for the junction improvements have been presented in Drawing Volume.

Table 2.15: Table showing details of Major Junctions

Sl. No	Existing chainage	Type of Junction	Location
HDC-01 Bellary Road			
1	0+230	Staggered	High Grounds Old Police station circle
2	1+150	Y	Windsor Manor Circle
3	1+442	T	Railway parallel Road
4	1+590	T	Palace Road Junction
5	2+254	Y	Mahalakshmi Mandir Circle
6	3+435	+	Mekhri Circle
7	4+400	Y	Sanjay Nagar Rad junction
8	4+870	T	CBI Junction
HDC-02 Old Madras Road - Link 1 - Trinity to Budigere Cross			
9	0+214	+	-
10	0+360	Y	Gurudwara Junction
11	1+100	Y	Baskaran Road
12	2+670	T	Paramahamsa Yogananda Road
13	3+042	Y	100 Feet Road Indiranagar
14	3+564	T	Swami Vivekananda Metro Junction
15	3+888	Y	Srujandas Junction
16	3+918	Y	Srujandas Junction
17	4+987	Y	Byappanahalli
18	9+300	T	KR Puram Govt Hospital Jn.
19	10+120	Y	KR Puram Extension
20	10+900	T	T C Palya Gate
21	11+550	Staggered	Bhattarahalli
22	17+000	T	Budigere Cross
Link 2 - K R Puram to Hope Farm			
23	8+970	T	Narayanapura / Singayyanapalya
24	11+400	Y	Hoodi Circle
25	13+850	Y	ITPL
26	15+400	Y	-
HDC 12 b Gorgunte Palya to KR Puram			
27	0+000	T	Gorgunte Palya junction
28	0+400	+	Pipeline Road Jn
29	2+500	+	Pipeline and MES Road Jn
30	2+850	+	Bell Circle flyover Jn

Sl. No	Existing chainage	Type of Junction	Location
HDC-01 Bellary Road			
31	3+300	+	Kuvempu Circle Bell Jn
32	5+000	Staggered	Kodigehalli main Road and Gundappa Road Jn
33	6+750	+	Hebbal Junction
34	9+370	+	Kempapura Main Road Jn
35	10+600	+	Thanisandra Nagawara Road Jn
36	12+270	Staggered	Hennur Junction
37	12+780	T	80 feet Road Jn
38	13+500	+	7Th Main Road Jn Kalyan nagar
39	14+950	+	Horamavu Jn
40	16+030	+	Rammurthy Nagar Jn

From the inventory, it is found that there are 57 minor junctions in Bellary road, 48 minor junctions in old madras road link 1, 25 minor junctions in old madras road link 2 and 109 minor junctions in Gorguntepalya to K R Puram road.



2.4 Bus Shelters / Bus Bays / Bus Stop

There are 64 number of Bus stops are in provided in project corridors, all bus stops are provided with Bus shelters. At some locations Bus bays are provided, details are shown in below table.:

Table 2.16: Table showing Bus Bays / Bus Stops

Sl. No	Chainage	Side		Remarks
		LHS	RHS	
HDC 01 – Bellary road				
1	0+180	Yes	-	Sophia school
2	1+820	-	Yes	Palace guttahalli
3	3+000	-	Yes	Palace grounds
4	3+750	Both		mekhri circle
5	4+100	Yes	-	mekhri circle
6	4+700	Both		CBI
7	5+230	Both		Veternary hospital
8	5+500	Both		Canara bank
9	5+900	Both		Hebbal
HDC 02 – Old Madras Road				
Link 01 Trinity circle to Budigere cross				
10	0+230	Both		-
11	0+350	Yes	-	Gurudwara Junciton
12	1+200	Yes	-	Near Kensington Junction
13	2+400	Both		Kadirayanapalya Junction
14	2+950	-	Yes	-
15	3+550	Yes	-	Near Vivekananda Metro station
16	4+000	Both		-
17	4+150	Both		-
18	4+600	Yes	-	-
19	5+500	Both		-
20	5+750	Both		Near Benniganahalli RUB
21	6+500	Yes	-	-
22	7+350	Both		K R Puram Railway Station
23	7+550	Both		-
24	8+450	Both		ITI Junciton
25	9+600	-	Yes	K R Puram
26	10+100	Both		-
27	10+850	-	Yes	-
Link 02 K R Puram to Hope farm				
28	8+000	Both		-
29	8+200	Both		Mahadevapura
30	9+500	Both		Pheonix Market city

Sl. No	Chainage	Side		Remarks
		LHS	RHS	
31	10+300	Both		Garudacharpalya
32	10+700	Yes	-	-
33	11+900	Both		-
34	12+420	Both		-
35	12+910	Yes	-	-
36	13+330		Yes	-
37	13+750	Both		Big Bazar Junction
38	13+900	Both		ITPL
39	14+300	Both		-
40	15+000	Both		-
41	15+500	-	Yes	-
HDC 12 b Gorguntepalya to KR Puram				
42	1+550	Yes	Yes	BBMP Bus Stop
43	2+440	-	Yes	MES Road Bus Stop
44	2+790	-	Yes	BEL Circle Bus stop
45	3+250	-	Yes	Kuvempu Circle Bus Stop
46	4+330	-	Yes	BBMP Bus Stop
47	4+850	-	Yes	BBMP Bus Stop
48	6+670	-	Yes	Hebbal Outer Ring Road Bus Stop
49	6+810	-	Yes	Hebbal Bus Stop
50	7+340	-	Yes	Bethel Church Bus Stop
51	7+860	-	Yes	Kempapura Bus Stop
52	9+100	-	Yes	Veerannapalya Bus Stop
53	9+900	-	Yes	Manyata Tech Park Bus Stop
54	10+450	-	Yes	Nagavara Junction Bus Stop
55	11+080	-	Yes	HRBR Layout 5th Block Bus Stop
56	11+530	-	Yes	HBR Layout 4th Block Bus Stop
57	11+910	Yes	-	HRBR Layout 3rd Block Bus Stop
58	12+250	Yes	-	Hennur Junction Bus Stop
59	12+690	-	Yes	Kalyan Nagar Bus stop
60	13+960	Yes	Yes	Babusapalya Bus Stop
61	14+800	Yes	-	Hormavu Signal Bus Stop
62	15+480	-	Yes	Vijaya Bank Colony Bus Stop
63	16+190	-	Yes	B.Channasandra Bus stop
64	17+050	Yes	Yes	Kasturi Nagar Bus Stop

2.5 Pavement Condition Survey

The survey regarding road inventory and pavement condition was carried out along the project corridor. The width of the carriageway along the project road varies from 4 lane divided carriage way to six lane divided carriageway. Visual inspection of the road showed

a generally Fair surface condition.

The condition of the pavement has been evaluated based on the field measurements of primary pavement surface distress of cracking (narrow and wide), patching, raveling and potholes, noted for each kilometer length. The extent of each distress has been visually estimated for every kilometer length of the road in terms of percentage area affected and then averaged for one-kilometer road length.

The distress conditions are measured under the following sub-heads:

- Cracking (%)
- Potholes (%)
- Raveling (%)
- Patching (%)
- Settlement & Upheaval (%)

2.5.1 Cracks

Pavement cracking is a typical failure commonly observed in flexible / bituminous pavements occurring predominantly due to the higher number of repetitions of heavier axle loads. Pavement Cracks (%) details along the existing project corridor are in **Annexure 2.1.** The average values of minimum, maximum and average percentage of cracks in the project roads are 0.50%, 5.50%, 2.81% respectively for Bellary road, 2.20%, 5.50%, 3.83% for Old Madaras Road (Link-1), 2.20%, 5.50%, 3.45% for Old Madaras Road (Link-2) and 2.4%, 7.5%, 4.65% for Outer ring Road.

2.5.2 Patching

The variation of Pavement Patching (%) with length is shown in Figure 2.2. Pavement patching (%) details along project corridor is in **Annexure 2.1**. No significant patching is noticed except at few localized spots. The average values of minimum, maximum and average percentage of patching area in the project roads are 0.8%, 7.0 %, 3.98 % respectively for Bellary Road, 2.20%, 7.25%, 4.18% for Old Madaras Road (Link-1), 2.70%, 6.00%, 4.26% for Old Madaras Road (Link-2) and 6.5%, 8.5%, 7.37% for Outer Ring Road.

2.5.3 Ravelling

Disintegration of the pavement surface caused due to failure of binder to hold the material together causing blowing off of fine aggregates leaving behind pock marks and when larger particles are broken free with stripping of aggregates is termed as

Raveling. Pavement raveling (%) details along the project corridor is in **Annexure2.1**. The average values of minimum, maximum and average percentage of raveling in the project roads are 1.50%, 8.50%, 5.59% for Bellary Road, 3.20%, 7.00%, 4.81% for Old Madaras Road (Link-1), 2.65%, 7.50%, 4.25% for Old Madaras Road (Link-2) and 2.5%, 8.5% and 6.00% for Outer Ring Road.

2.5.4 Potholes

Potholes are bowl-shaped holes of varying sizes in the surface layer extending into the base course. Potholes are mainly formed due of loose base course or base course not covered properly with wearing course or due to inadequate bonding between base course and subsequent top layers. Pavement Potholes (%) details along the project corridor are in **Annexure2.1**. The average values of minimum, maximum and average percentage of potholes in the project roads are 0.5%, 3.5%, 1.63% for Bellary Road, 1.50%, 5.50%, 2.70% for Old Madaras Road (Link-1), 1.90%, 4.50%, 3.19% for Old Madaras Road (Link-2) and 6.5%, 8.5%, 7.67% for Outer Ring Road.

2.5.5 Rutting

Rutting is a surface depression in the wheel path. Pavement uplift (shearing) may occur along the sides of the rut. Ruts are particularly evident after a rain when they are filled with water. There are two basic types of rutting: mix rutting and subgrade rutting. Mix rutting occurs when the subgrade does not rut yet the pavement surface exhibits wheel path depressions as a result of compaction/mix design problems. Subgrade rutting occurs when the subgrade exhibits wheel path depressions due to loading. In this case, the pavement settles into the subgrade ruts causing surface depressions in the wheel path. Pavement Rutting (%) details along the project corridor are in Annexure2. 1. The average values of minimum, maximum and average percentage of potholes in the project roads are 0%, 0.09%, 0.02% for Bellary Road, 0%, 0.80%, 0.15% for Old Madaras Road (Link-1), 0.0%, 0.80%, 0.08% for Old Madaras Road (Link-2) and 0%, 0.5%, 0.17% for Outer Ring Road.

2.5.6 Summary of Observations on Pavement Condition

The overall condition of the pavement is in fair to Good condition with around 85.97 % of the pavement area in fair condition for Bellary Road, 84.39% of the pavement area in fair condition for Old Madaras Road and 74.15% of pavement area in fair condition for Outer Ring Road the percentage various of destresses for each road is shown below.

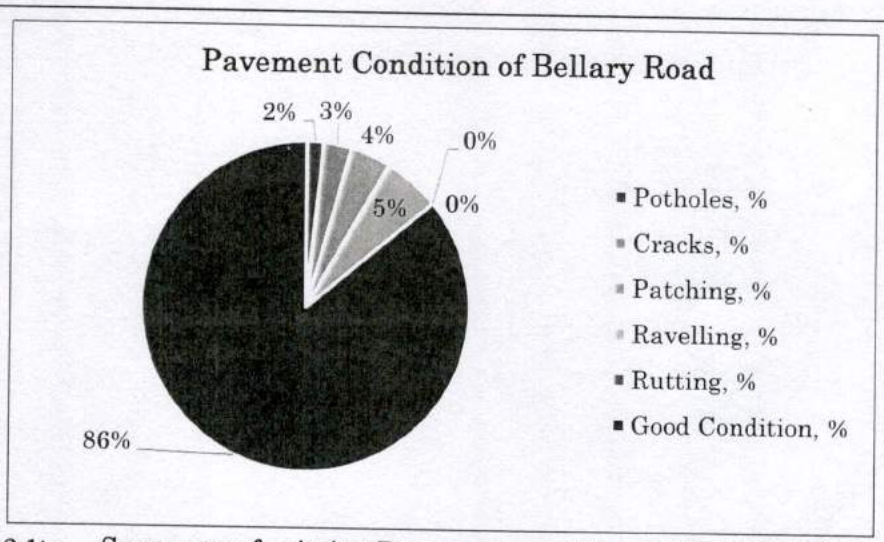


Figure 2.1:- Summary of existing Pavement condition of HDC 01 Bellary Road

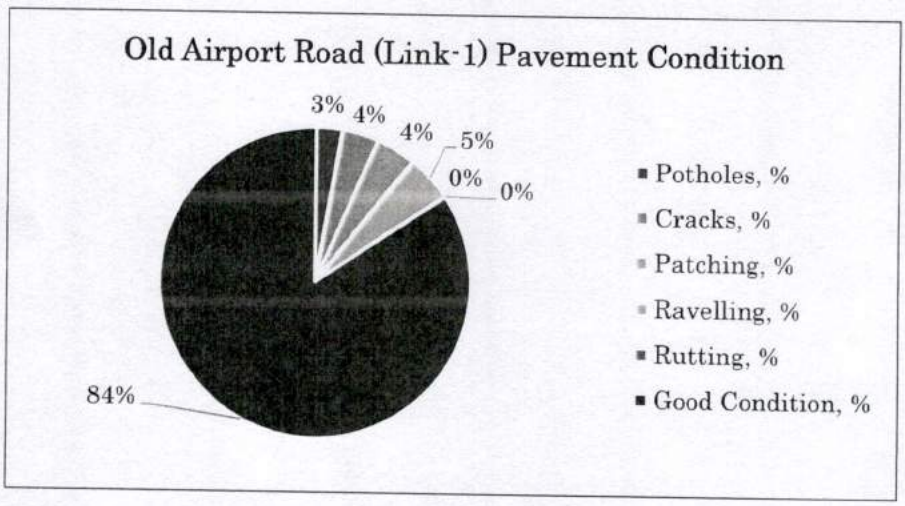


Figure 2.2:- Summary of existing Pavement condition of HDC 02 Old Madras Road (Link-1)

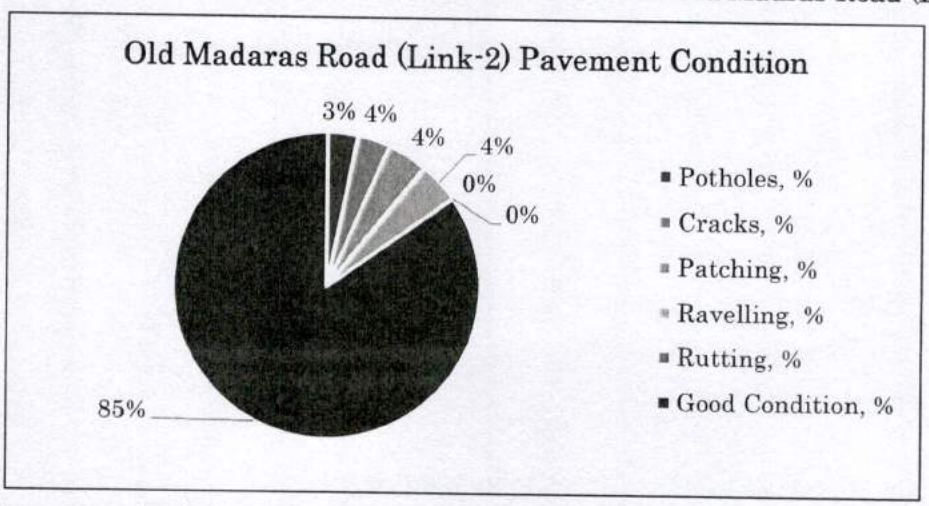


Figure 2.3:- Summary of existing Pavement condition of HDC 02 Old Madras Road (Link-2)

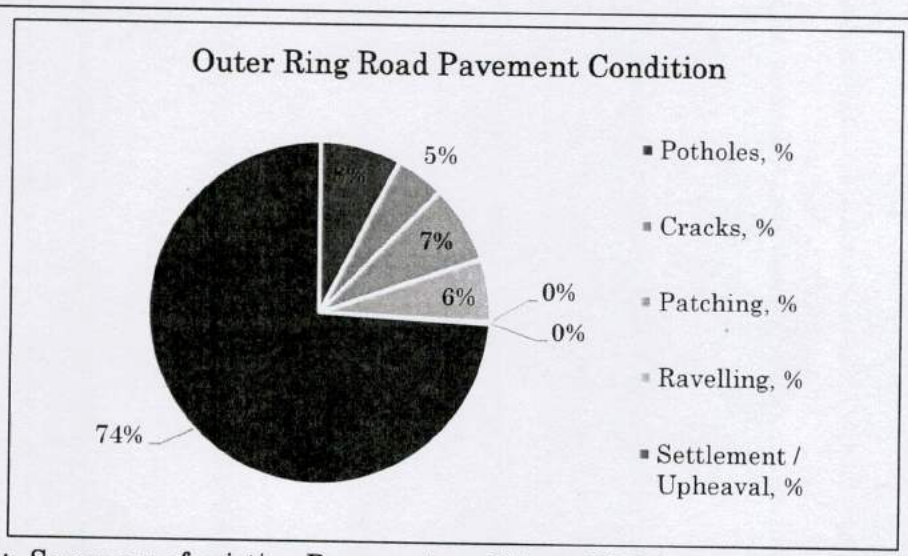


Figure 2.4:- Summary of existing Pavement condition of HDC 12b Outer Ring Road from Gorguntepalya Palya to KR Puram

2.6 Camber

Carriageway camber is checked at intervals to assess the camber at site, the camber is very important for effective drainage of rain water. The standard camber is 2.5% on our roads, but quite often the camber reduces or becomes non uniform during the course of life of road in urban roads due to distress, frequent overlays. Following table represents the camber on the existing roads

Table 2.17: Table showing Camber with Intervals

Sl. No	Chainage, m	Camber, %	
		LHS	RHS
HDC 01 – Bellary Road			
1	0+230	-3.05%	1.54%
2	0+730	-3.05%	1.06%
3	1+230	-0.17%	1.79%
4	1+730	-0.32%	1.36%
5	2+230	3.81%	-0.76%
6	3+700	-0.79%	1.74%
7	4+200	-0.32%	1.19%
8	4+700	-0.24%	0.39%
9	5+200	-2.02%	2.41%
10	5+70C	-1.15%	0.53%
11	6+400	-1.12%	0.76%
12	6+900	-1.19%	0.82%
HDC 02 – Old Madras Road			
13	0+980	3.68%	4.82%
14	1+480	-1.78%	0.66%
15	1+980	-1.23%	2.22%

Sl. No	Chainage, m	Camber, %	
		LHS	RHS
16	2+480	-2.81%	3.58%
17	2+980	0.19%	3.15%
18	3+480	-4.83%	2.56%
19	3+980	0.27%	2.44%
20	4+480	-1.87%	3.23%
21	4+980	-3.16%	2.84%
22	5+480	0.17%	1.94%
23	5+980	-3.02%	2.83%
24	6+480	-0.78%	2.01%
25	6+980	-2.06%	2.59%
26	7+480	-1.57%	1.32%
27	7+980	-1.73%	2.44%
28	8+480	-2.25%	4.32%
HDC 12b – ORR from Gorgunte Palya to K R Puram			
29	0+000	-1.47%	2.04%
30	0+500	0.56%	0.85%
31	1+000	0.19%	2.77%
32	1+500	-0.80%	1.51%
33	2+000	3.39%	4.43%
34	2+500	3.01%	3.96%

2.7 Traffic Survey

Traffic surveys are an integral component of any transport study where appreciation of existing traffic and travel characteristics of the study area are extremely important. However, Traffic surveys are not required in this assignment as no additional widening is proposed beyond available ROW. However, the traffic survey details available with KRDCL are collected for Analysis of pavement Evaluation and overlay design.

At the outset, ISECPL has collated available traffic survey details to establish the base line data for the study.

The classified traffic volume count data available was processed and compiled using Spread Sheet software packages to get Commercial Vehicles per day, which is further utilized to compute the design traffic. Traffic Survey details referred are conducted during the year 2016, and this traffic is projected to Design Base year. The CVPD adopted for each road is shown below:

- CVPD

Table 2.18: CVPD for Bellary Road

Mode	CVPD (2016)	Projected CVPD
Std Bus	3211	4099
LCV	2771	3537
2 Axle	327	418
3 Axle	182	233
Multi Axle	74	95

Table 2.19: CVPD for Old Madras Road (Link-1)

Mode	CVPD (2016)	Projected CVPD
Std Bus	5002	6384
LCV	895	1143
2 Axle	3751	4788
3 Axle	1452	1854
Multi Axle	921	1176

Table 2.20: CVPD for Old Madras Road (Link-2)

Mode	CVPD (2016)	Projected CVPD
Std Bus	1348	1721
LCV	1706	2178
2 Axle	858	1096
3 Axle	350	447
Multi Axle	196	251

Table 2.21: CVPD for Outer Ring Road (Gorguntepalya to K R Puram)

Mode	CVPD (2016)	Projected CVPD
Std Bus	2828	3610
LCV	7207	9199
2 Axle	1860	2374
3 Axle	1711	2184
Multi Axle	1331	1699

- Design life: - Design Life of 5 Years is considered for the overlay design as per IRC: SP: 115 - 2014.
- Growth rate: - Annual Growth rate of 5% is considered for designs.
- VDF: - The adopted vehicle damage factor considered for the overlay design is shown in the table below.

CHAPTER 3: IMPROVEMENT PROPOSALS

3.1 General

The project corridors are studied thoroughly with respect to the existing features on the project roads viz No of lanes, carriageway details, Drains and CDs, Footpaths, Medians, Junctions, Bus bays, sign Boards and other traffic Appurtenances as discussed in Chapter 2. the project corridors under package 1 i.e., **HDC 01: Bellary Road**, **HDC 02: Old Madras Road**, and **HDC 12b: Outer Ring Road from Goraguntepalya Palya to KR Puram** comprise carriageway varying from 4 lane to 6 lanes.

Table 3.1 Lane Configuration

SI No	Road Name	Lane Km			
		4 Lane	6 Lane	For SR Lane	Total Lane Km
1	Bellary Road	10.60 Km	28.80 Km	7.40 Km	**47.00 Km**
2	Old Madras Road	45.92 Km	42.12 Km	2.60 Km	**91.00 Km**
3	Goraguntepalya to KR Puram	13.60 Km	91.20 Km	54.30 Km	**160.00 Km**
	Total	**70.12 Km**	**162.12 Km**	**64.30 Km**	**298.00 Km**

Since the project corridors are under control of BBMP, there are already various improvement works have been carrying out or already tendered by BBMP in the project corridors. Improvement proposals are made for the remaining length which has not been considered for improvement works under BBMP / BMRCL.

The Project Proposals are Prepared in 2 Parts

1. **Initial Improvement Proposals**
2. **Annual Maintenance Proposal**

3.2 Discussions made with various Stake Holders

3.2.1 Assets to be included as part of the maintenance project

KRDCL has informed that several meetings were held on this project at various levels of ACS, CS and it was concluded to include and exclude the following assets as part of maintenance by KRDCL.

Table 3.2 Table of Assets

SL No	Assets Proposed for Maintenance
	Assets Included for Maintenance by KRDCL
1	Carriageway
2	Median
3	Junctions
4	Grade Separators (Flyovers/Underpasses/RoB/RUB)
5	Bus Bays
6	Service Roads / Slip Roads / Parking Lanes
7	Road Markings
8	Sign Boards
9	Footpath
10	Pedestrian Guard Rails
11	Bollards
12	High Raised Pedestrian Crossings
13	Traffic Signals at Junctions
14	Installation of Traffic KIOSK / Umbrella for Policemen
15	Side Drains
16	Cross Drainage Structures
17	Road Sweeping
18	Manhole chamber Improvements
19	Tree Guards
20	Tree pruning
21	Road Cutting and Restoration
23	Removal of Construction and Demolition Debris
	Assets Excluded for Maintenance by KRDCL
1	Bus Shelters
2	Sky Walks
3	Solid Waste Management
4	Encroachment Clearance
5	Street Lighting
6	Land Acquisition for improvements
7	Water Supply and Sanitary lines leakages by BWSSB
8	Faulty Power Lines by BESCOM/KPTCL
9	Gas Leakages in Gas Lines by GAIL

3.2.2 Proposals from Bruhat Bengaluru Mahanagara Palike (BBMP)

Meetings and Discussions are held with BBMP officials regarding the ongoing improvement works or tendered works along the project length of the High-Density corridors. The details of the works which are already considered by BBMP and BMRCL are collected and summary of the same is tabulated below. The stretch wise details of the works considered by BBMP / BMRCL are annexed with the report.

Table 3.3 Tendered length of BBMP and BMRCL

HDC No	Corridor Name	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
1	Bellary Road -	7.45	1.98	0.00
2	Old Madras Road -	18.50	2.65	5.85
12b	Goraguntepalya to K R Puram (ORR)	18.60	17.05	0.00
Package I Length, Km		**44.55**	**21.68**	**5.85**

3.2.3 Proposals from Traffic Police Department

Police department has prepared a corridor wise proposal for the works to be considered in Short Term, Mid Term and Long-Term measures to improve the Traffic discipline, reduce the congestion, and minimize the accidents and fatalities. the detailed report submitted by the department is annexed with this report and the prominent, short term measures, Midterm Measures, and long-Term measures, which are included in the project proposal are Summarized in the table below.

Table 3.4 Police Requirements

SI No	Items Considered in Estimate as per Traffic Police Requirement	Quantity		
		HDC 01	HDC 02	HDC 12b
1	Junction Improvement	12 Nos	7 Nos	12 Nos
2	High Raised Pedestrian Crossing	19 Nos	31 Nos	12 Nos
3	Median Guard Railing	6.0 Km	16.65 Km	16.65 Km
4	Bus Bay	4 Nos	9 Nos	4 Nos
5	Widening of road	300 m	-	600 m
6	Traffic Sign Boards	246 Nos	463 nos	371 Nos
7	Traffic Umbrella/Kiosk	4	4 Nos	6 Nos
8	Traffic Signals	1 No	2 Nos	4 Nos
9	Skywalks	3 Nos	8 Nos	3 Nos
10	Surveillance and Enforcement Cameras installation	16 Nos	56 Nos	24 Nos

Various discussion held with ACS, CS on these issues concluded that the skyalks shall be

taken up on PPP basis separately and cameras will be taken up under separate head, hence these two items are excluded from the current scope of project.

3.2.4 Proposals from DULT

DULT suggested to provide bus lanes and cycle lanes in all roads as per the budgetary announcement made by Hon'ble CM. various discussions held on this at ACS, CS level and following suggested to include bus lanes at roads (preferably Outer Ring Road) where 6 lanes are more exists at present and any other stretches needed will be added alter with proper permission/approval from Govt.

The bus priority lanes are provided at following sections

Table 3.1 Bus Priority Lane

SI No	High Density Corridor	Length of Bus Priority Lane Considered, Km
1	HDC 01 – Bellary road	Nil
2	HDC 02 – Old Madras road	Nil
3	HDC 12 B – ORR from Goraguntepalya to KR Puram	13.55 Km
	Total Length of Bus Lane in Package 1	**13.55 Km**

3.3 Initial Improvement Works

Initial improvement works are proposed in the Balance length of the corridors which are not considered for improvement by BBMP / BMRCL. The summary of the initial improvement lengths of the 3 corridors under Package 1 is represented below.

Table 3.1 Initial Improvement Length

HDC No	Corridor Name	Length Considered for Initial Improvement, Km	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
1	Bellary Road -	5.47	7.45	1.98	0.00
2	Old Madras Road -	10.00	18.50	2.65	5.85
12b	Goragunte Palya to K R Puram (ORR)	1.55	18.60	17.05	0.00
Package I Length, Km		**17.02**	**44.55**	**21.68**	**5.85**

The Proposals have been split into following Major Heads.

(i) Where No works are taken up by BBMP or BMRCL, these stretches the project improvement proposals includes

- Carriageway Improvements
- Junction Improvements
- Footpath Improvement and Construction of Green Hedging
- Median Improvements and Guardrail
- Construction of Bus Bays & Road Widening
- Drain Improvements
- Traffic Signs, Road Markings and Other Appurtenances

(ii) Whereas for the section where, works taken by BBMP / are under progress or already tendered, only the following works are provisioned.

- Median Guardrail Provisioned
- Construction of Green Hedging
- Missing Sign Boards installation
- Selected Junction Improvements

3.3.1 Preliminary Works:

Following works are considered under preliminary works along the project roads under Package 01, viz Bellary Road, Old Madras Road and Outer ring road. Clearing and grubbing is considered for removal and disposal of unwanted plants and waste materials from the project site. The damaged portion of Medians, Kerbs and Footpaths are proposed for Dismantling and refixing.

3.3.2 Carriageway Improvements: -

Uniform lanes: the carriageways are widened over a period of time and there's no standard lane widths at present, the outer lane widths varies and at few places, its less than the standard lane width. Based on tender sure experience, the lane widths are standardized as below, the outer lane shall be of 3.5 m as buses move on this lane, center lane shall be 3.0 m as this is predominately LMV's for and inner lane shall be 3.25 m giving a shyness of 0.25 m for median. This is been done in discussion with DULT and BBMP as per the tender sure experience.

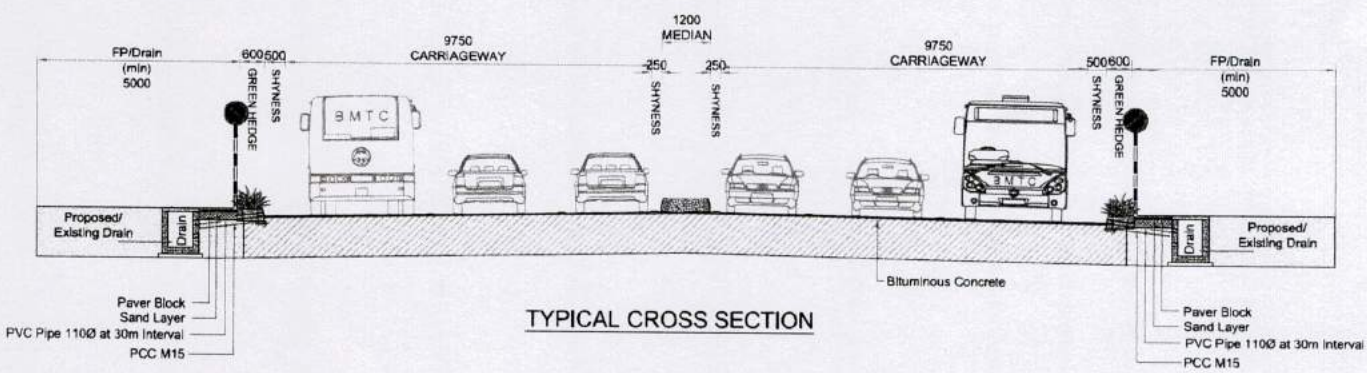
Resurfacing: lanes or Carriageway is proposed with functional overlay or strengthening and Overlay as per the pavement evaluation and overlay design. Prior to laying overlay, **milling of existing bituminous surface is considered in order to achieve required camber and to reduce profile correction course.** The carriage way is proposed

with uniform lane markings, and installation of raised pavement markers. Carriageway improvements are represented in volume 3 – Drawings.

Table below shows the resurfacing proposed through FWD studies:

Table 3.1 Overlay Proposal

Sl No	Corridor Name	Chainage		Overlay Thickness, mm	
		From	To	DBM	BC
1	HDC 01: Bellary Road	0+230	1+700	0	40
2		3+450	7+450		
3	HDC 02: Old Madras Road Link 1	0+000	3+100	50	40
4		3+100	8+400	0	40
5	HDC 02: Old Madras Road Link 1	0+000	0+500	0	40
6		6+250	8+450		
7	HDC 02: ORR (from Goragunte Palya to KR Puram)	1+050	2+600	50	40



TYPICAL CROSS SECTION

3.3.3 Junction Improvements:

The selected junctions along the corridor are proposed with carriageway improvements, road markings, sign board installations, construction or modification of traffic channelizing islands. provision for precast new jersey barrier to guide the traffic. the junctions are redesigned in order to ensure safe maneuvering of vehicles and pedestrians. In coordination with police department few selected junctions which are not in initial improvement section are also considered for improvement. Junctions considered for

improvement are tabulated below.

Bellary Road: -

SI No	Junction Chainage	Junction Name
1	0+200	Balbrooi junction
2	1+100	Windsor Yield circle
3	1+800	Ramanujan junction
4	2+200	Kaveri junction
5	3+450	Mekhri junction
6	4+400	Sanjaynagar
7	1+500	5th main road
8	1+600	Palace cross road
9	3+750	Taralabalu road
10	3+980	Binny mill road
11	4+850	CBI road
12	6+100	4th main road

Old Madras Road: -

SI No	Junction Chainage	Junction Name
Link-1		
1	1+100	Kensington Junction
2	1+700	Thamarai Kannan Jn
3	2+000	Anjaneya Junction
4	2+390	Kadirayanpalya Jn
5	2+670	Double Road Junction
6	3+050	100ft Road Junction
7	3+270	Kalahalli Junction
8	3+950	Suranjandas Junction
9	5+020	Cross Road
10	8+420	ITI Junction
Link-2		
1	7+400	KR Puram Railway station
2	10+230	Cross Road
3	11+800	Hoodi Junction
4	13+620	Big Bazar Junction

Outer Ring Road: -

SI No	Junction Chainage	Junction Name
1	1+750	Mutyala Nagara Junction
2	2+850	BEL circle
3	1+900	Cross road
4	1+950	Cross road
5	2+100	Cross road
6	2+120	Cross road

SI No	Junction Chainage	Junction Name
7	2+200	Cross road
8	2+250	Cross road
9	2+310	Cross road
10	2+450	Cross road
11	2+500	Cross road
12	6+750	Hebbal

3.3.4 Footpath and Kerb

Footpath proposal includes construction of new walkways with interlocking paver blocks, where space is available or where existing footpath is in poor condition. In addition, replacement of damaged Kerbs and paver blocks are also considered.

Bellary Road: -

SL No	From	To	Length in m (including both sides)
1	0+250	1+150	1800
2	1+170	1+590	840
3	4+430	4+640	420
4	4+780	5+030	500
5	4+870	4+970	200
6	5+450	5+550	200
7	4+310	4+380	140

Old madras Road: -

SL No	From	To	Length in m (including both sides)
Link-1			
1	1+150	2+000	1700
2	2+200	2+650	900
3	2+700	3+000	600
4	6+000	6+300	600
5	9+350	9+650	600
6	9+700	10+350	1300
Link-2			
1	11+900	12+800	1800
2	13+700	13+800	200

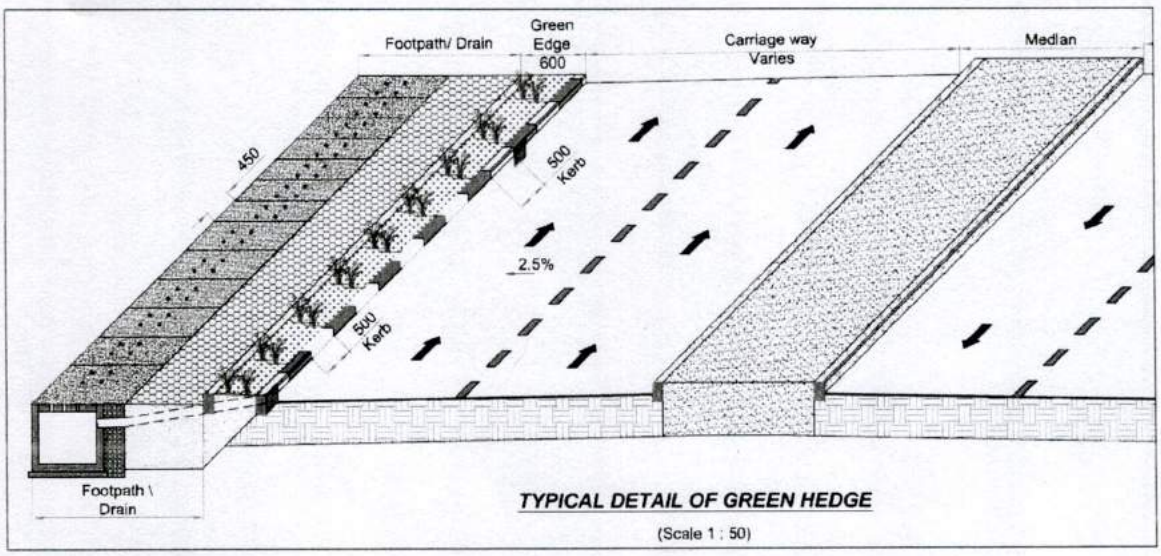
Outer Ring Road: -

Footpath construction is considered from chainage 1+750 to 2+650 on both sides.

3.3.5 Green Hedging: -

With the intention to improve the aesthetics of the high-density corridors, Green Hedging

is proposed on the footpath sides of the carriageway. the proposal includes installation of additional kerb line and supplying and spreading of farm yard Manure to support planting of permanent hedges. Green hedging is proposed at all feasible locations which are being improved by both BBMP or KRDCL. in addition, provision for chute drains is made along the Kerb line to guide the carriageway runoff to the drain. Cross sections indicating green hedging is represented below.



3.3.6 Median and Guard rail: -

Two types of median are considered for improvement one is the conventional median with both side Kerb with grassing and the other is 900mm standard new Jersey barrier. This is proposed in consultation with Traffic police department. The first type is considered where there is already existing conventional median but in poor condition and the second type is considered as per the police requirement in places where there is existing low height concrete median or at specified places by the police department. Similarly, Guard rail is also proposed in two designs, one is to install over conventional median and the second type is proposed to install over new jersey barrier in such a way to maintain uniform height. Typical section of median with guard rail is represented below.

Bellary Road: -

Sl No	From	To	Length in m
1	0+230	1+300	1070
2	1+490	3+450	1960
3	3+680	4+420	740
4	4+450	4+680	230

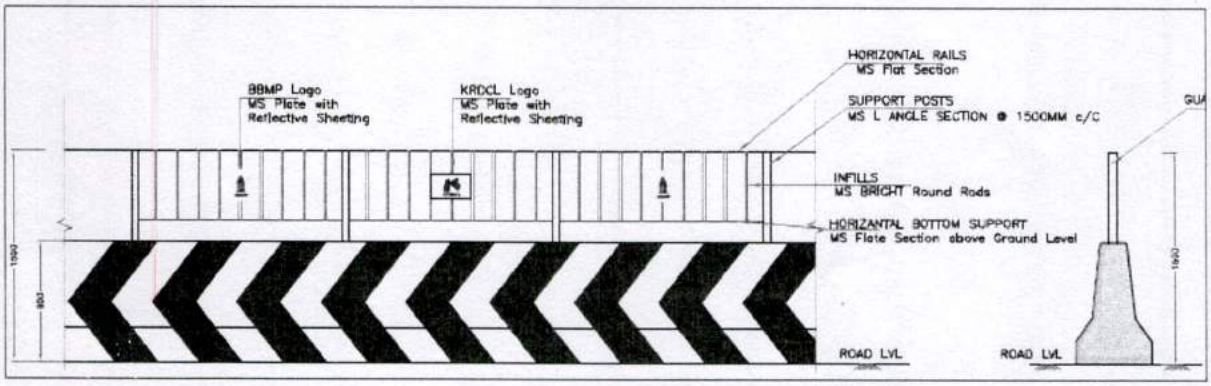
Sl No	From	To	Length in m
5	4+950	6+340	1390
6	6+340	6+600	260
7	7+100	7+450	350

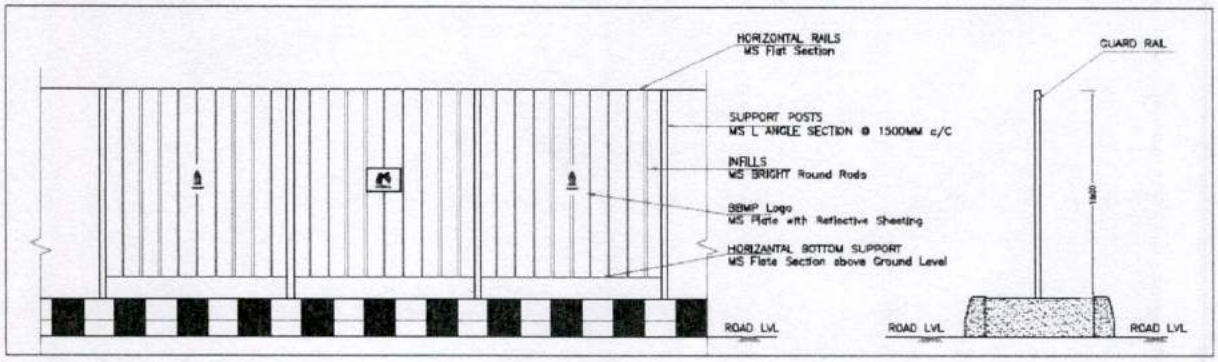
Old madras Road: -

Sl No	From	To	Length in m
Link-1			
1	0+350	1+050	700
2	1+150	2+000	850
3	2+050	2+650	600
4	2+700	3+000	300
5	3+100	3+880	780
6	3+950	4+950	1000
7	5+030	6+050	1020
8	6+500	9+350	2850
9	9+390	10+500	1110
Link-2			
1	7+400	7+650	250
2	8+000	11+200	3200
3	11+550	11+750	200
4	11+850	13+600	1750
5	13+650	13+800	150
6	14+000	15+600	1600
7	15+800	15+940	140

Outer Ring Road: -

SI No	From	To	Length, m
1	0+000	1+200	1200
2	1+650	2+870	1220
3	3+450	4+800	1350
4	5+270	6+730	1460
5	6+850	9+000	2150
6	9+700	10+530	830
7	10+850	12+000	1150
8	12+670	13+230	560
9	13+870	14+700	830
10	15+200	15+950	750
11	16+250	17+750	1500
12	18+300	18+600	300





3.3.7 Bus Bays: -

Improvement proposal of Existing bus bays includes pavement overlay in case of Flexible Pavement, Pavement Markings, and Sign Board installations. in Bellary road Existing bus bays are proposed for improvements as discussed. But, with respect to Old Madras road and Outer ring road project reaches new bus bays are proposed as required by traffic police department.

Bellary Road

SI No	Bus bay Chainage	Location
1	4+046	Mekhri circle
2	4+776	Ganganagar
3	5+238	Veterinary college
4	6+166	Hebbal

Old Madras Road

SI No	Bus Bay Chainage	Location
Link-1		
1	1+200	Near Kensington Junction
2	2+400	Kadirayanapalya Junction
3	3+700	Near Vivekananda Metro station
4	5+750	Near Benniganahalli RUB

SI No	Bus Bay Chainage	Location
5	7+200	K R Puram Railway Station
Link-2		
1	10+200	Garudacharpalya
2	13+550	Big Bazar Junction
Additional Provision		2 Nos

Outer Ring Road

SI No	Bus bay Chainage	Location
1	1+750	Mutyala Nagara
2	1+760	Mutyala Nagara
3	2+250	Opposite to Mother Teresa Public school
4	2+260	Opposite to Mother Teresa Public school

3.3.8 Drainage and Structural Improvements: -

Existing Drainage facility is studied along the project corridors, for availability and functioning, based on which it is proposed for construction of New Drain with coverslab and replacement of damaged cover slab. in addition, it is also provisioned for any emergency repairs of RE Wall portions of the Grade Separators.

Bellary Road: -

Sl No	From	To	Length in m
1	0+230	1+040	810
2	3+700	4+220	1040 (Both Side)
3	7+100	7+450	350
4	7+100	7+450	350

Old Madaras Road: -

Sl No	From	To	Length in m
1	1+150	1+950	800
2	2+050	2+650	600
3	2+700	3+000	300
4	6+100	6+250	150
5	9+350	9+650	300
6	9+700	9+800	100
Link-2			
1	7+400	7+900	500

Outer Ring Road: -

Drainage improvement is considered from chainage 1+750 to 2+650 on both sides.

3.3.9 Utility and Ducts: -

There are no proposals for shifting of utilities in these stretches, further the initial

improvements are taken only for a part length of 191 kms, the provision of utility ducts are not considers as there will be no continuity of ducts if provided. Further it was decided in various meetings that the current project is of maintenance nature and utilities are in the scope of respective utility departments and KRDCL will focus on maintenance of road assets.

3.3.10 Road Markings, Traffic Signboards and other Appurtenances: -

Road Markings viz Edge lines, Centre lines, Pedestrian Crossings, Directional Arrows are proposed as per the standard requirements and as indicate in the drawings. Similarly raised pavement markers or Road studs are proposed along road markings, at Junctions, at HRPCs as per standards and as indicated in the Drawings. Different Type of Sign boards are provisioned for the project corridors and Appropriate Type & number of sign boards shall be Installed as per the Good for Construction Drawings. The provisions under this head also includes Road Delineators, Hazard markers, Bollards, Single arrow directional sign Boards, overhead gantry sign boards, Traffic Umbrella / KIOSK for Traffic Policemen, Traffic Signals, and Gratings at VUPs. Road Delineators are provided to demarcation of the Bus priority lane, turning demarcation and at edges of the islands. Hazard markers are provisioned for installation at approaches of all structures, at Median openings, etc. Single Arrow directional signboards are provisioned to aid in identification of cross roads, where the board is not available. Over Head Gantry Sign Boards, Traffic KIOSKs and Traffic Signals are all included for costing as per the requirements of the traffic police department.

3.4 Annual Maintenance Proposals

As part of maintenance proposals, government has decided to go for a 5 years long term maintenance and during which the road has to be kept in the good condition for easy and safe movement of traffic and pedestrians at all time. **Road Maintenance** includes routine Maintenance, preventive Maintenance, periodic Maintenance, disaster Maintenance, exigencies and inspections.

- Periodic Maintenance: works such as re-surfacing of pavements may be required to restore the functional deficiencies that have developed over a time period. Which shall be decided based on functional and structural valuation studies.
- Routine Maintenance: Contractor shall carry out day-to-day site inspection of the designated road stretches and note done the damages that have occurred due to natural or artificial causes, they should take immediate steps to correct or rectify

the damages. Routine Maintenance are undertaken by the maintenance staff almost round the year.

- Preventive Maintenance: The preventive maintenance is performed to improve or extend the functional life of pavement surface while in good condition. This may defer the need of periodic maintenance and rehabilitation
- Disaster Maintenance: Occasionally several damages are caused to roads cross drainage and other road assets. structures by floods or very heavy down pour or rains, though these may not occur every year. Under such circumstances works are to be completed as early as possible and the road infrastructure shall be restored so as to minimised the inconvenience to road users.
- Safety & Traffic Management – this includes enforcement of regulations together with the relevant authorities. Keep project roads safer, this also includes hazard response and Road patrols
- Asset management – this includes daily, routine and periodic inspections, Maintenance, repairs, housekeeping and emergency Maintenance

following are the maintenance activities suggested with Time limits for rectification.

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
A	**Carriageway/Road surface, Hard shoulders, Drains and Cross Drainage works, Bridges / Interchanges / Grade Separators (Fly Overs/ RUB/ ROB/ Under Pass / any other Road structure).**	
1	Maintaining a public relations unit to interface with and attend to suggestions from the Users, government agencies, media and other agencies and deploying the required staff. Equipment Installation and Office setup (Large TV, Computers, Printers and other equipment), deploying Three non-technical and two technical staff	On or before 30 days from LOA
2	all surplus construction machinery and materials, waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project in a clean, tidy and orderly condition, and in conformity with Applicable Laws, Applicable Permits and Good Industry Practice.	Daily
3	Carriageway Sweeping using mechanical sweepers and footpath manual cleaning Minimum 4 vehicle mounted sweeping machines to be deployed all the debris/dust/litter shall be safely carried and disposed away at designated	Daily

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
	places.	
4	Breach or blockade (the item of works shall be removal of fallen concrete wall, trees, electric pole etc.	Temporary restoration of traffic within 3 hours' permanent restoration within 7 days
5	Roughness not more than 2600mm/km for each lane in a km length (as measured by a standardized rough meter/bump integrator).	**As indicated in the Work order, for this work.**
6	Skid Resistance (Skid Number, SN, minimum Desirable shall be 55 SN	**As indicated in the Work order, for this work**
7	Potholes	24 hours
8	Cracking all types in less than 5% of road surface for each lane in a km length	3 (Three) days
9	Ravelling/Stripping of bitumen and all types in less than 5% of road surface for each lane in a km length	3 (Three) days
10	Settlement all types in less than 5% of road surface for each lane in a km length	3 (Three) days
11	Rutting exceeding 5 mm in more than 2% of road surface for each lane in a km length (measured ROMDAS or equivalent technology)	7 (Seven) days
12	Bleeding	3 (Three) days
13	Damage to pavement edges exceeding 100 mm	24 hours
14	Painting of Kerb, railing, parapets, crash barriers,	Twice every year
15	All types of Road Marking	Retro reflectivity mcd/m2/lux of 150 during the contract period / Twice every year
16	Joint Sealing in concrete pavement	7 (Seven) days
17	Replacement of Pavement Quality Concrete slabs	15 (fifteen) days
18	Rain cuts/gullies in slope	3 (Three) days
19	Damage to or silting of culverts and side drains during and immediately preceding the rainy season	3 (Three) days
20	Desilting of drains in Road side Drains	3 (Three) days
21	Cracks - Temporary measures	Within 48 hours
22	Spalling/scaling	3 (Three) days
23	Foundations-cavitation	3 (Three) days
24	Piers, abutments, return walls, RE-walls Cracks and damages including settlement and tilting Temporary measures	30 (Thirty) days

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
25	Bearings All type- Replacements	As indicated in the Work order, for this work
26	Joints in bridges: Loosening and malfunctioning of joints	As indicated in the Work order, for this work
27	Deforming of pads in elastomeric bearings	As indicated in the Work order, for this work
28	Gathering of dirt in bearings and joints or clogging of spouts, weep holes and vent-holes	3 (Three) days
29	Damage or deterioration in parapets and handrails	3 (Three) days
30	Rain-cuts or erosion of banks of the side slopes of approaches	3 (Three) days
31	Resurfacing of wearing coat	As indicated in the Work order, for this work
32	Damage or deterioration in approach slabs	3 (Three) days
33	Growth of vegetation affecting the structure or obstructing the waterway	3 (Three) days
B	**Foot Path/Medians/Drains**	
34	Manual cleaning of footpaths, all the debris/dust/litter shall be safely carried and disposed away at designated places	Daily
35	Damage to paver blocks or concrete surface or tiles of footpath	3 (Three) days
36	Damage to Kerbs, bollards, tree guards, pedestrian railings	3 (Three) days
37	Road side Drains and inlets	Should be Clean at all times
38	Damage to drain cover, walls	3 (Three) days
C	**Road safety and furniture including all road sign boards and pavement raised marking (road studs)**	
39	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
40	Damaged/missing road signs requiring replacement	7 (seven) days
41	Painting of railing, parapets, crash barriers	Once every year
42	Reflective Pavement Markers (Road Studs) Numbers and Functionality as per specification in IRC :SP:84-2014 and IRC :35-2015, unless specified	At all times
43	Pedestrian Guard rail : Functionality: Functioning of guardrail as intended	At all times
44	Traffic Safety Barriers: Functionality: Functioning of Safety Barriers as intended	At all times
45	Overhead Sign Structures shall be structurally and functionally adequate	At all times
D	**Miscellaneous Works (Trees and Plantation, Road Patrol, Road Cutting Restoration, Road lighting**	
46	Obstruction in a minimum head-room of 5 m above	24 hours

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
	carriageway or obstruction in visibility of road signs	
47	Deterioration in health of trees and bushes	Timely watering and treatment
48	Replacement/replanting of plants and bushes on medians, islands, footpaths and green edges	3 (Three) days
49	Removal of vegetation affecting sight line and road structures	3 (Three) days
50	Patrolling of roads by a vehicle of Bolero or equivalent with a driver, assistant and a supervisor at all times - 2 vehicles and two teams	All through the day
51	Restoration of road cutting as per IRC specifications Temporary Permanent	**As indicated in the Work order, for this work**
52	Road lighting	Not Included.
E	**Emergency Works**	
53	Removal of Fallen Trees	3 hours
54	Towing of Accident vehicle / Breakdown vehicle / Abandoned vehicle, mandatory deployment of: • LMV Towing vehicle –for towing of light commercial vehicles and below – 1 nos • HCV Towing vehicle –for towing of buses/ heavy commercial vehicles - 1 nos	1 hour
55	Water logging / Ponding on road surface / grade separators, mandatory deployment of Tippers, pumps, sucking machines, etc., as needed	1 hour
56	Fallen Street pole / Sign Boards / any other structure	1 hour

3.4.1 Traffic Incident Management

As a part of maintenance proposals, The Project corridors are required to Patrol continually through dedicated staff and Vehicle, to monitor any possible hindrance for the free flow of traffic and to ensure good condition of all Road Assets. Two patrol vehicles with staff are provided for each package of work

During the discussions with the police department, provision of cranes for toeing was asked to toe away the vehicles stranded, met in accident or illegally parked on HDC's. provision of two toeing vehicles one for heavy vehicles like buses and trucks and another for LMV's is proposed.

Water logging at selected locations is a perennial issue during rainy season, especially at

underpasses. In the even of water logging, the provision of sucking machines, pumps and Labour is also provisioned in the maintenance work.

4.1 General

The Project cost is worked out based on estimated quantities from the detailed engineering design including road works, drainage works, pavement, culverts, road furniture, road safety appurtenances etc.

4.2 Construction Items

The following factors have been considered to arrive at the unit rates for various construction items.

The project cost estimates have been prepared separately for initial improvement works and Annual Maintenance works based on various items of works considered for the upgradation and annual maintenance of the project roads. The Major items rates are considered from **PWP IWTD SoR 2018-19, Bangalore Circle,** Govt. of Karnataka along with latest issue rates, and for few items derived rates are adopted.

Table 4.1 Adopted Unit Rates for Some of the Major Items (Excluding Area Weight Factor)

Sl. No.	Items	Unit	Rate
1	Milling of Existing Bituminous Layer	Sqm	70.00
2	Granular Sub base	Cum	1882.00
3	Wet Mix Macadam	Cum	1888.00
4	Dense Bituminous Macadam (DBM)	Cum	6045.00
5	Bituminous Concrete (BC)	Cum	6939.00
6	Interlocking Paver Blocks	Sqm	1110.00
7	M15 for Kerb Laying	Cum	5422.00
8	Kerb	Nos	450.00
9	Painting two Coats for Kerb	Sqm	82.00
10	Yard Manure	Cum	204.00
11	Planting permanent hedge	Mt	296.00
12	Tree Guard / Grating and Median guard Rail	Quintal	7187.00
13	Providing and Laying M20 for Drain	Cum	6670.00
14	Steel Reinforcement	Tonnes	61365.00
15	Road Marking- Thermoplastic	Sqm	429.00
16	Moulded Shank Raised Pavement Markers	Nos	337.00

4.3 Project Costing

Quantification

The quantification of various items of work is based upon the proposals recommended in the previous chapters. The quantities have been worked out separately for different items of work. The construction cost has been sub - divided into Preliminary Works, Carriageway improvement, Junction Improvement, Footpath and Kerbs, Medians and guard rails, Bus bays and Road Widening Works, Drainage Improvement and other structural Works, Traffic signs, Marking and other Appurtenances.

The following are the Bill wise of works, which have been estimated:

Preliminary Works including Dismantling, Clearance and Earthworks: The area considered for Site Clearance is the area within the proposed Right of Way width. and the damaged portions of Median Kerbs, and Footpath are proposed for dismantling.

Carriageway Improvements: Carriageway improvements costs includes Milling of existing bituminous surface, Strengthening and overlay as per the structural evaluation and Pavement design.

Junction Improvements: Junction improvement cost includes overlay for carriageway, Road markings, installation of sign Boards, High raised pedestrian crossings, construction of channelization islands as per the requirement.

Footpath and Kerbs: Footpath works cost includes removal of damaged paver blocks, kerb stones, etc and replacement with the new ones. In addition, the costing also includes the Green Hedging provision along the footpath

Median and Guardrail: The estimation of quantities for Median construction were based on site inventory, and Median Guard rails for pedestrian safety as per police department instruction is considered.

Bus Bays and Road Widening Works: The estimation of quantities for Bus bays and road widening works were based on the police department requirements, detailed design and drawings.

Drainage Improvement and Structural Works: Provision under this sub-head has been made for cost for construction of side drains, and repairs of RE wall.

Traffic Sign, Markings and Other Appurtenances: Proper traffic signs were selected at required locations along the project corridor. It is reviewed considering the traffic, pedestrian safety, and modified if required. Centre line and edge markings required

from safety point of view were considered in the quantity estimate.

4.4 Total Project Cost

The total project cost of **package 1** is **142.17 Crores**, which includes Initial Improvement cost of **86.48 Crores**, Annual maintenance cost of **23.30 Crores**, 12% for GST, 5% Administration Charges, 3% for DPR and PMC charges, 10% Contingencies. The summary of the project is given in **Table 4.2** below for Total Project Cost along with Road Wise Cost Summary.

The detailed rate analysis and quantity estimation is given in Volume-3: Cost Estimate.

Table 4.2: Summary of Cost for the Project

Sl. No	Description	HDC 01	HDC 02	HDC 12B	Package I
		Amount (Crores)	Amount (Crores)	Amount (Crores)	Amount (Crores)
1	Preliminary Works including Dismantling, Clearance and Earthworks	0.26	0.44	0.08	0.78
2	Carriageway Improvements	8.87	14.39	3.12	26.38
3	Junction Improvements	0.53	0.67	1.00	2.21
4	Footpath and Kerbs	4.62	7.25	6.60	18.48
5	Median and Guardrail	1.91	5.37	5.26	12.55
6	Bus Bays and Road Widening Works	0.87	0.34	1.10	2.31
7	Drainage Improvement and Structural Works	2.95	6.47	2.45	11.86
8	Traffic Sign, Markings and Other Appurtenances	1.69	2.92	7.30	11.91
A.	**Initial Improvement Cost**	21.70	37.85	26.92	**86.48**
B.	**Annual Maintenance Cost**	3.67	8.37	11.26	**23.30**
C.	**GST @ 12% of (A+B)**	3.05	5.55	4.58	**13.17**
D.	**Administrative Charges @ 5% on (A+B)**	1.27	2.31	1.91	**5.49**
E.	**DPR & PMC Charges @ 3% on (A+B)**	0.65	1.62	1.63	**3.90**
F.	**Contingencies @ 10%**	1.90	3.82	4.07	**9.79**
G.	**Miscellaneous and Rounding off**	0.01	0.01	0.01	**0.03**
H.	**Total Project Cost (A+B+C+D+E+F+G)**	**32.26**	**59.53**	**50.38**	**142.17**

4.5 Implementation Plan

An implementation plan refers to a detailed description of actions that demonstrate how to implement an activity within the project in the context of achieving the objectives, addressing the requirements, and meeting the expectations. The above project is to be implemented in two forms.

1. Initial Improvement and
2. Maintenance

Initial Improvement: Initial improvement is to be done within first nine months of the project tenure year for carriage way, Junctions improvements, Footpath and Drain improvements, Traffic lane markings and sign boards, median island improvements and providing green edge in ongoing BBMP Tender works.

Maintenance: The proposed project roads are to be maintained periodically by clearing of pavement, Repair of traffic signs and road markings, Repair of damage caused by traffic accidents. The project corridors is to be maintained for 5 years as per decision of Govt.

4.6 Packaging

The Total Length of the all the high-density corridor is 191 Km which is spreaded over the entire Bengaluru city. this will make the task of maintaining the road very cumbersome, as it will be very difficult to accesses, Monitor and control the activities over entire length. Hence the Total 15 roads of high-density corridors are grouped in to four packages, such that it will be convenient to Access, Monitor and control the different activities running along the corridor within each package.

4.7 Time Schedule.

The duration for the initial improvement works is 270 days covering various stages of work. The time schedule of the Project along with work programme of activities is given below.

Table 4.3 Time Schedule of Project

SL NO	DESCRIPTION	DURATION	START DATE	END DATE
A	**INITIAL IMPROVEMENT WORKS**	270 DAYS	01-04-2021	31-12-2021
1	Strengthening/Resurfacing, Road Marking, Traffic Signs for priority stretches	90 Days	01-04-2021	30-06-2021
2	Drainage and Utility works	90 Days	01-04-2021	30-06-2021
3	Footpath and Kerbs	90 Days	01-05-2021	31-07-2021
4	Median and Guardrails	60 Days	01-07-2021	31-08-2021
5	Junction Improvements	60 Days	01-09-2021	31-10-2021
6	Strengthening/Resurfacing, Road Marking, Traffic signs Road Appurtenances for other stretches	90 Days	01-10-2021	31-12-2021

The Annual Maintenance works needs to be executed continually throughout the year for the project duration of 5 Years.

Infra Support
Your complete Engineering partner

Annexures 3.1
Details from BBMP

MAINTENANCE OF HIGH DENSITY CORRIDORS IN BENGALURU CITY.

Summary of Works Under HDC No. 1 - Bellary Road Corridor

Sl. No.	Chainage in km		Location		BBMP Department	Ongoing Works / Completed Works Implemented By	Works Considered by KRDCL for Initial Improvement	Maintenance Proposal
	From	To	From	To				
1	Ch.0.000	Ch.0.230	Chalukya Circle	Balabrooie Jn.	RI-East	Proposed Improvement by Smart City	-	1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch.0.230	Ch.1.700	Balabrooie Jn.	BDA Fly Over (Palace Rd Cross)		-	Proposed Improvement by KRDCL	
3	Ch.1.700	Ch.3.450	BDA Fly Over (Palace Rd Cross)	Mekhri Circle Underpass		Proposed Improvement by RI-Road Widening	-	
4	Ch.3.450	Ch.5.500	Mekhri Circle Underpass	UAS Quarters		-	Proposed Improvement by KRDCL	
	Ch.5.500	Ch.6.300	UAS Quarters	Start of Hebbal Flyover		Proposed partial Resurfacing of LHS reach by RI-East	Proposed Improvement by KRDCL	
5	Ch.6.300	Ch.7.450	Start of Hebbal Flyover	End of Hebbal Flyover		-	Proposed Improvement by KRDCL	

EE (RI-East)

EE (RI-Road Widening)

EE (RI-TEC)

EE (KRDCL-NORTH)

SE

MAINTENANCE OF HIGH DENSITY CORRIDORS IN BENGALURU CITY.

Summary of Works Under HDC No. 2 - Old Madras Road Corridor

Sl. No.	Chainage in km		Location		BBMP Department	Ongoing Works / Completed Works Implemented By	Works Considered by KRDCL for Initial Improvement	Maintenance Proposal
	From	To	From	To				
Link o1 - Trinity Circle to Medahalli Junction								
1	Ch.0.000	Ch.1.100	Trinity Circle	Kensington Road Junction	RI-East	Proposed White Topping Work by Central Project (BBMP)	-	1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch.1.100	Ch.3.100	Kensington Road Junction	Indira Nagar 100ft Road Junction	RI-East	Footpath partially developed near Swami Vivekananda Road Junction	Proposed Improvement by KRDCL	
3	Ch.3.100	Ch.5.900	Indira Nagar 100ft Road Junction	Benniganahalli RUB	RI-East	Partial Impprovement Considered under Single Free Corridor by Central Project (BBMP)	Proposed Improvement by KRDCL for Untackled reaches	
4	Ch.5.900	Ch.8.400	Benniganahalli RUB	End of Cable Stayed Bridge	RI-KR Puram	Except Metro Reaches	Proposed Improvement by KRDCL	
5	Ch.8.400	Ch.10.500	End of Cable Stayed Bridge	Start of NH 75 Limits	RI-KR Puram	Proposed Improvement by RI ~~KR Puram~~ TEC.	-	
6	Ch.10.500	Ch.17.000	Start of NH 75 Limits	Budigere Cross	NHAI Limits	-	-	

EE (RI-East)

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MAINTENANCE OF HIGH DENSITY CORRIDORS IN BENGALURU CITY.

Summary of Works Under HDC No. 2 - Old Madras Road Corridor

Sl. No.	Chainage in km		Location		BBMP Department	Ongoing Works / Completed Works Implemented By	Works Considered by KRDCL for Initial Improvement	Maintenance Proposal
	From	To	From	To				
Link o2 - K R Puram Railway Station to Hope Farm Junction								
4	Ch.0.000	Ch.0.500	KR Puram Railway Station	Lowry Junction	RI - KR Puram	-	Proposed Improvement by KRDCL	1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch.0.500	Ch.4.250	Lowry Junction	Hoodi Junction	RI - Mahadevpura	Work under progress by BMRCL	-	
3	Ch.4.250	Ch.6.450	Hoodi Junction	Big Bazar Junction	RI - Mahadevpura	Grade Separators are Proposed at Hoodi Junction and Big Bazar Junction by Project Central. **Work is yet to Start**	Proposed Improvement by KRDCL	
4	Ch.6.450	Ch.8.550	Big Bazar Junction	Hope Farm Junction	RI - Mahadevpura	Work under progress by BMRCL	-	

EE (RI-KR Puram) EE (RI-Mahadevapura) EE (Project-Central) EE (KRDCL-South)

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MAINTENANCE OF HIGH DENSITY CORRIDORS IN BENGALURU CITY.

Summary of Works Under HDC No. 12(b) - Outer Ring Road Corridor (Tumkur Road to Old Madras Road)

Sl. No.	Chainage in km		Location		BBMP Department	Ongoing Works / Completed Works Implemented By	Works Considered by KRDCL for Initial Improvement	Maintenance Proposal
	From	To	From	To				
1	Ch.0.000	Ch.1.050	Gorguntepalya (Tumkur Road)	Start of ROB	RI-RR Nagar	Proposed Improvement by RI-TEC	-	1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch.1.050	Ch.1.700	Start of ROB	End of ROB		-	Proposed Improvement by KRDCL	
3	Ch.1.700	Ch.2.600	End of ROB	Start of **BEL Circle** Underpass		-		
4	Ch.2.600	Ch.3.450	Start of **BEL Circle** Underpass	End of **BEL Circle** Underpass	RI-East	-		
5	Ch.3.450	Ch.6.750	End of **BEL Circle** Underpass	Hebbal Flyover		White Topping Work in progress by Central Project (BBMP)	-	
6	Ch.6.750	Ch.10.600	Hebbal Flyover	Nagavara Jn.				
7	Ch.10.600	Ch.18.600	Nagavara Jn.	Old Madras Road (Benniganahalli)				
	Length of Corridor: 18.600km				**Total Cost**		**Rs.14.67 Crores**	**Rs.11.99 Crores / year**

EE (RI-RR Nagar) EE (RI-East) EE (RI-TEC) EE (Project-Central)

EE (KRDCL-NORTH)

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CHAPTER 1: INTRODUCTION

1.1 Project Background

Bangalore is one of the fastest growing cities in Asia and also one of the most sought - after cities in India by people, companies and multinationals. The massive growth that the city has witnessed in the last decade is a clear indication of this city being developed to be at par with the most modern cities in the world. The population of Bangalore has grown enormously on account of migration of people from all corners of India, neighboring countries and from countries in the West. Bengaluru 's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets.

The main arterial roads of Bengaluru coming into the city include Bellary Road in the north, Tumkur Road and Mysore Road in the west, Kanakapura Road, Bannerghatta Road and Hosur Road in the south and Airport Road and Old Madras Road in the east, these high-volume traffic arterial roads are inter connected with Outer Ring Road. Bangalore Commissioner of Police notified these 12 Major Roads connecting inter-districts and inter-states as High Traffic Density Corridors vide Notification dated:03-09-2016, and are named as High-Density Corridors.

Roads, and means of transport, make a crucial contribution to economic development and growth and bring important social benefits. Poorly maintained roads constrain mobility, significantly raise vehicle operating costs, increase accident rates and their associated human and property costs. Deterioration of constructed pavement is natural. It's natural because over time the materials that make up Bitumen begin to break down and become affected by elements such as rain, sunlight and chemicals that come into contact with the pavement surface. The liquid Bitumen binder that is the "glue" of the pavement begins to lose its natural resistance to water, allowing it to penetrate into and underneath the pavement. Once this happens, the surface can quickly fall prey to a number of different types of deterioration.

The construction and maintenance of roads to address the growing traffic in the city has been a challenge to the BDA and the BBMP. To reduce the pressure of hectic maintenance activities for BBMP and to ensure the effective maintenance of high-volume traffic arterial roads it has been proposed to handover the maintenance of High-density corridors to KRDCL.

The decision has been taken in the meeting held on 06-11-2019 under the Chairmanship of Hon'ble Chief Minister, Govt. of Karnataka for Upgradation and maintenance of 12 High Traffic Density Corridors as per IRC guidelines to be taken by Karnataka Road Development Corporation Ltd.

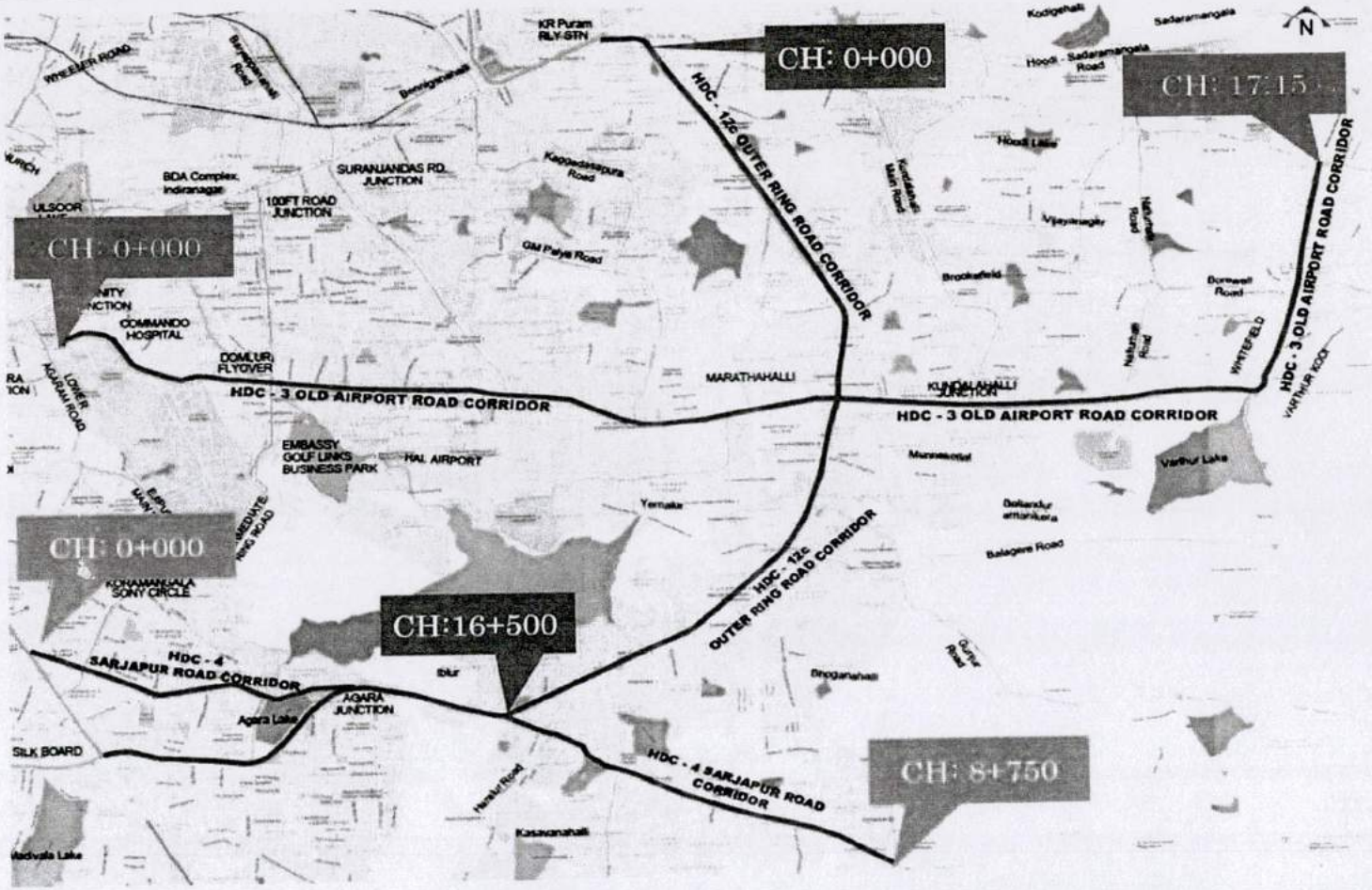
Karnataka Road Development Corporation Limited (KRDCL) was incorporated on 21st of July 1999 as a wholly owned Government of Karnataka Company as per the Provisions of the Company's Act, 1956. The company is managed by a Board of Directors chaired by Principal Secretary to Government, PWP and IWID with Members from other organizations.

KRDCL is a company under the Public Works, Ports & Inland Water Transport Department. This Company was established to promote surface infrastructure by taking up Road Works, Bridges etc., and to improve road network by taking up construction, widening and strengthening of roads, construction of bridges, maintenance of roads etc., and to take up projects on BOT, BOOT, BOLT. With the emerging industrial and economic development of the past few decades, there has been a tremendous growth in terms of the traffic on all the roads

Karnataka Road Development Corporation Limited (KRDCL) has appointed ***M/s Infra Support Engineering Consultants Pvt Ltd*** (ISECPL) as consultants for Preparation of DPR and Project Management Consultancy (Including Detailed Designs) for High Density Corridors (HDC) Package - 2 in Bengaluru, Karnataka comprising of the following roads: [HDC 3: Old Airport Road, HDC 4: Sarjapura Road, HDC HDC 12c: Outer Ring Road K R Puram to Sil Board. Total Length 42.40 Km (Approximate).".

Table 1.1: Length of Project Corridors in Package 2

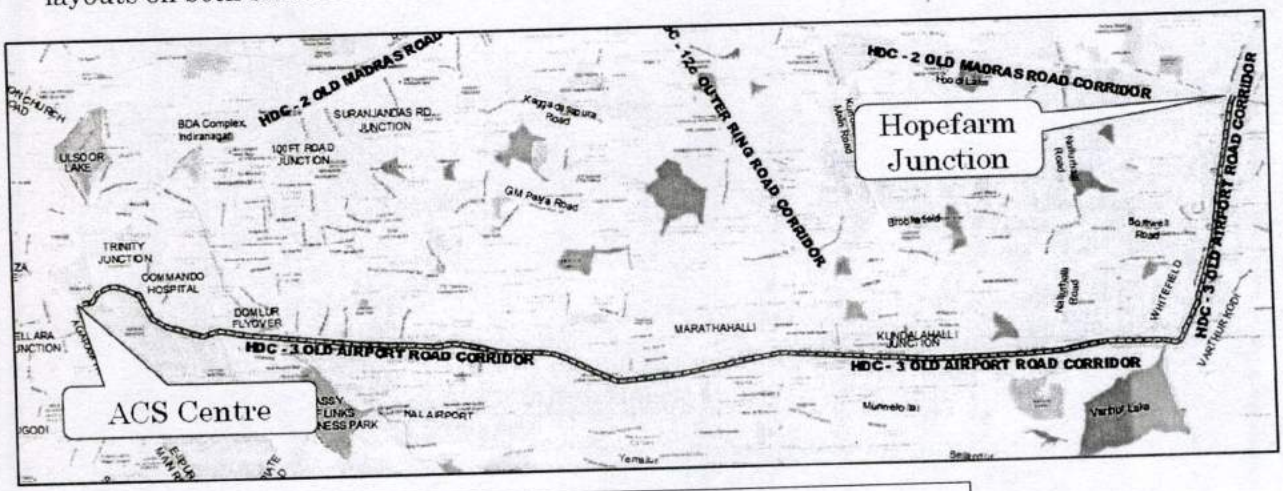
Sl. No	Name of the Road / Junction	Project length considered in km
Package - 2		
1	HDC 3: Old Airport Road - from ASC Center to Kadugodi via HAL, Hope farm on Whitefield Road.	17.15
2	HDC 4: Sarjapur Road - from Hosur Road to Caremelram Bridge via Jakkasandra, Iblur.	8.75
6	HDC 12c Part 2: Outer Ring Road – K R Puram to Silk Board	16.5
	Total length in Km	42.40



Index Map of Project Road – Package 2

HDC 3: Old Airport Road - from ASC Center to Kadugodi via HAL, Hopefarm on Whitefield Road.

The scope of work for the stretch starts at ASC Centre on HAL Old Airport Road and ends at Hopefarm on Whitefield Road with a total length of approximately 17.15 Kms. This road has 4 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below.

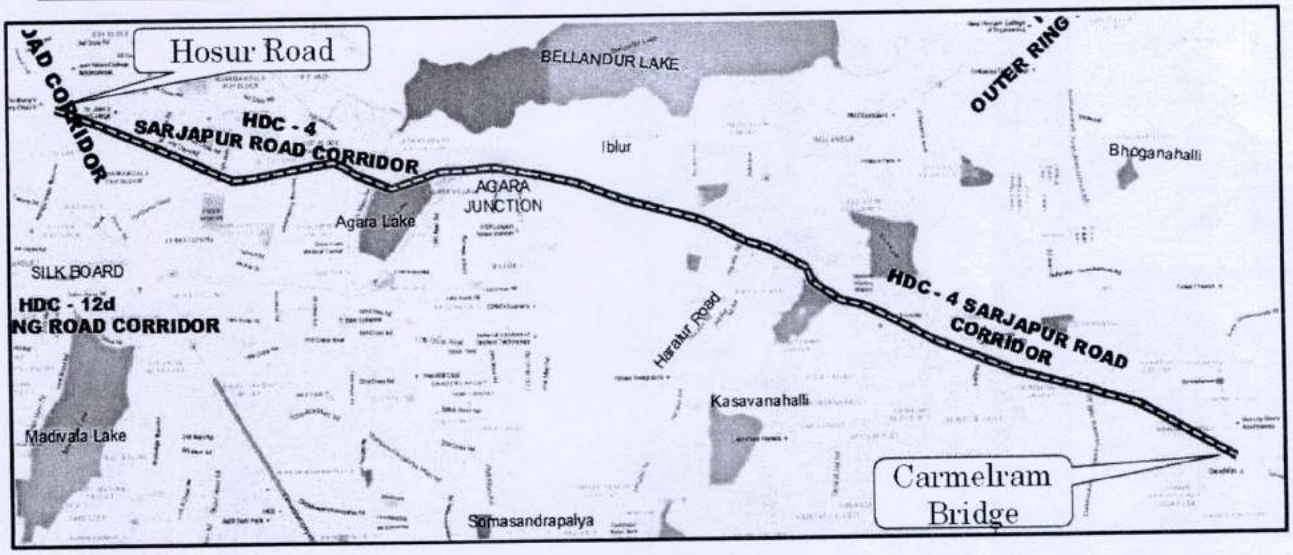


Index	
Work considered by KRDCL for Initial Improvements	14.00 Km
Ongoing / Tendered works under BBMP	3.15 Km
Total Length	**17.15 Km**

Figure 1.1 Key Plan of Alignment (Old Airport Road)

HDC 4: Sarjapur Road - from Hosur Road to Caremelram Bridge via Jakkasandra, Iblur.

The scope of work for the stretch HDC No. 4 starts from Hosur Road and ends at Caremelram Bridge Via Jakkasandra, Iblur with a total length of 8.75 Km. This road has 4 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below.



Index	
Work considered by KRDCL for Initial Improvements	1.10 Km
Ongoing / Tendered works under BBMP	7.65 Km
Total Length	8.75 Km

Figure 1.2 Key Plan of Alignment (Sarjapur Road)

HDC 12c: Outer Ring Road – from K R Puram to Silk Board

The scope of work for the stretch HDC No.12c Outer Ring Road starts at K R Puram and ends at Silkboard with a total length of 16.500 Km. This road has 6 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below.

Index	
Work considered by KRDCL for Initial Improvements	11.9 Km
Ongoing / Tendered works under BBMP	4.6 Km
Total Length	16.5 Km

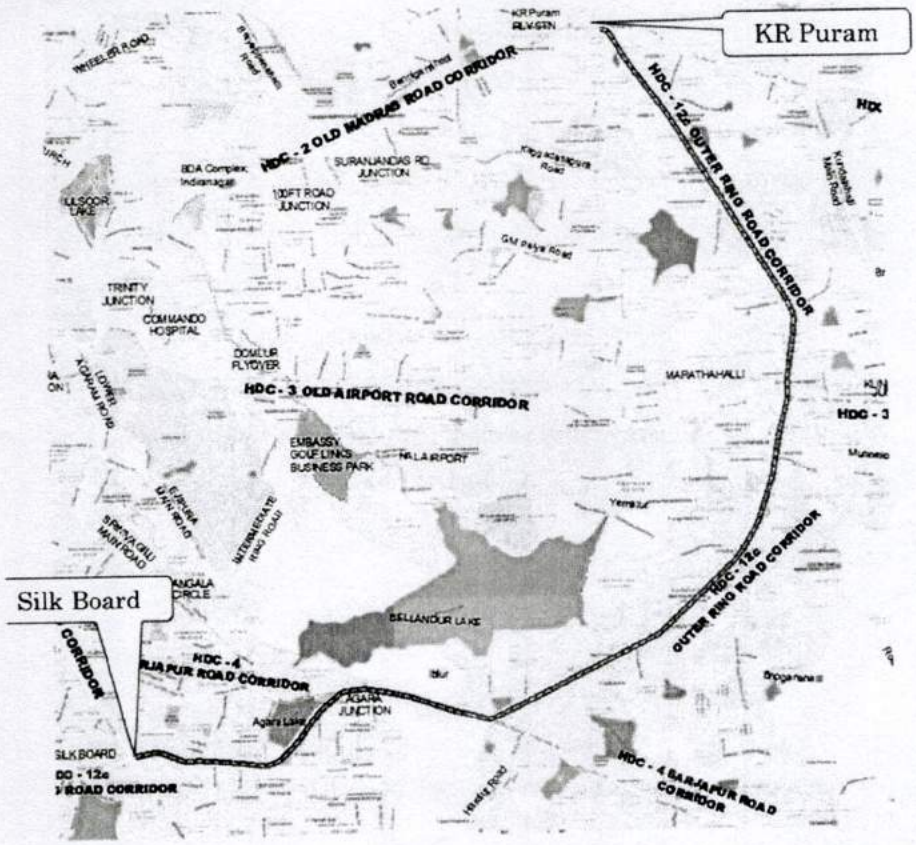


Figure 1.3 Key Plan of Alignment (Outer Ring Road)

1.2 Objective of the Project

The objective of the consultancy Services is to provide the required technical services to KRDCL in preparation of Detailed designs, Drawings, Estimations, Assisting in Tender Processes, and Project Management including construction supervision, maintenance supervision of the High-Density Corridors.

The following works are intended to be carried out on the Project Road:

1. Identification of possible improvements in the existing alignment.
2. Improvement of drainage at poor drainage locations and clear identification of the same on the drawings.
3. Rehabilitation /Reconstruction of bridges and culverts where necessary,
4. Improvement to junctions/intersections
5. Improvement of sidewalks with all required appurtenances like bollards, chamber covers, landscaping, access to properties, lighting etc.
6. Improvements to Signage, road markings
7. Street lighting of the corridor

8. Requirement for Provision of pedestrian facilities
9. Requirement for Improvement of junctions/intersections.
10. Assessing the Provision of road furniture and adequate road markings.
11. Assessing the Provision of traffic control devices where appropriate.
12. Preparation of roadway plans, sidewalk, median and all required drawings to be issued for good for construction.
13. Preparation of BOQ, specifications, estimates.
14. Preparation of routine maintenance intervals and specifications.
15. Presentations, meetings and discussions with various stakeholders in city.
16. Assisting in Preparation of bidding documents (schedules, specifications and drawings).
17. Bid processing assistance.

1.3 Scope of the Project

The broad scope of work encompasses

Stage 1: Carrying out surveys, investigations, detailed designs on the project roads, estimation, costing and submission of good for construction drawings

and

Stage 2: Project management including construction supervision, maintenance supervision, progress reports and PMS uploading.

Following is the brief scope of work as extracted from the RFP Document for Stage 1.

- Analysis of Available Reports and data's from KRDCL, BBMP and other departments.
- Survey and investigations of the Project Road
- Traffic Studies and Analysis
- Road safety assessment
- Pavement Structural Strength
- Topographic Survey
- Bridge / Structures Inventory and Condition Survey
- Hydrology and Drainage Investigations
- Pavement crust thickness
- Detailed Design
- Report and Drawings

- Bid process management

1.4 Meetings with Clients and Stakeholders

During the course of preparation of DPR meetings are held with client and Stakeholders for finalization of improvement proposals and other technical aspects. Following Meetings were held with various stakeholders for administration and Technical approval.

Sl No	Meeting held on	Meeting Chaired by	Meeting Location
1	30/11/2020	Additional Chief Secretary, PWD	Vikasa Soudha
2	1/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
3	2/12/2020	DULT Commissioner	DULT office
4	11/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
5	11/12/2020	Additional Chief Secretary, PWD	Vikasa Soudha
6	16/12/2020	Managing Director, KRDCL	KRDCL Office
7	24/12/2020	Chief Secretary	Vidhana Soudha
8	29/12/2020	DULT Commissioner	Online
9	4/1/2021	Chairman, Technical committee	KRDCL Office
10	8/1/2021	ACS, UDD	Vikasa Soudha
11	12/1/2021	ACS, UDD	Vikasa Soudha
12	13/1/2021	ACS, UDD	Vikasa Soudha

1.5 Structure of the Report

The Draft Project Report has been structured as follows.

Volume – 1: Main report

Chapter 1 : Project back ground

Chapter 2 : Surveys and investigations carried out and Interpretation of data

Chapter 3 : Improvement Proposals

Chapter 4 : Cost Estimation

Annexures

Volume – II: Drawings

Strip Plan

Plan with Sections

Standard Drawings

Volume – III: Cost Estimation

Bill of Quantities - Package 2

Bill of Quantities – Individual Roads in Package 2

Cost Estimation - Individual Roads in Package 2

Rate Analysis

Volume – IV: Schedules

Schedule A: Existing Features

Schedule B: Initial Improvement Proposals.

Schedule C: Specifications and Standards

Schedule D: Interim Milestones for Initial Improvement Works

Schedule E: Applicable Permits

Schedule F: Maintenance Requirements

Schedule G: Control and Command Centre

Schedule H: Payments Schedule

Schedule I: Safety Requirements

Schedule J: Inter-Departmental Coordination Standard Operating Procedure (Sop) & Support Agreement

Schedule K: Format of Bank Guarantee for Performance Security.

Schedule L: Appointment of Project Management Consultant

Schedule M: Format of Bank Guarantee for Advance Payment

Schedule N: Change of Scope Formats

Schedule O: Work Order Format for Additional Works

CHAPTER 2: SURVEYS AND INVESTIGATIONS

2.1 Introduction

This chapter deals with various surveys and Investigations carried out as per the Terms of Reference and required for quality compliance of the Project design and report preparation.

Major surveys and Investigations carried out are as follows:

- Road Inventory
- Pavement condition survey
- Structural Inventory
- Traffic surveys
- Topographic surveys
- FWD Survey

2.2 Road Inventory and Condition Surveys

2.2.1 Road Inventory

Road Inventory surveys have been conducted. Surveys are carried out as per the standard methodology / IRC guidelines. However brief methodology is given below:

As per the ToR consultants have to propose improvement proposals for the existing roads along the project corridors. Hence, the road and bridge inventory and condition surveys were conducted accordingly.

The road inventory survey involves making visual estimates and actual measurements of geometric and cross-sectional elements of the road and its deficiencies. This survey involves the collection of the data pertaining to the existing road such as the pavement type, width of the carriageway, type of the shoulder and its width, condition of road, type and condition of drain, footpath, median islands, number of CD structures, available land widths etc. Road inventory has been recorded in a standard format.

The team has travelled and walked along the alignments and adjacent roads collected first-hand information on the width and type of carriage way, type and condition of road, junctions, traffic intensity, width of footpath cum drains, Median islands, cross drainage structures, Bus stops/Bus bays/Bus shelters and relevant details of Grade separators, Metro Rail crossings and skywalks comprising in the project corridor are noted.

2.2.2 Right of Way

The Right of way details for the project road is taken by measuring drain to drain or footpath outer edge at regular intervals, RoW vary from 12m to 60 m. Details of RoW is shown in below table

Table 2.1: Table showing details of RoW along for HDC-03 Old Airport Road

From in Kms	To in Kms	Length in m	ROW in m
0+000	0+310	310	22
0+310	0+390	80	18
0+390	0+810	420	22
0+810	0+880	70	18
0+880	1+450	570	21
1+450	1+880	430	27
1+880	3+420	1540	23
3+420	3+850	430	26
3+850	4+220	370	21
4+220	4+400	180	24
4+400	4+670	270	27
4+670	4+930	260	33
4+930	5+220	290	26
5+220	5+980	760	23
5+980	6+500	520	20
6+500	6+920	420	24
6+920	7+860	940	28
7+860	8+290	430	31
8+290	9+230	940	22
9+230	9+420	190	29
9+420	10+130	710	24
10+130	10+230	100	28
10+230	10+960	730	25
10+960	12+500	1540	22
12+500	13+000	500	19
13+000	13+980	980	25
13+980	14+180	200	21
14+180	14+360	180	26
14+360	15+100	740	22
15+100	15+740	640	27
15+740	16+280	540	23
16+280	16+630	350	21
16+630	17+000	370	24
17+000	17+150	150	20

Table 2.2: Table showing details of RoW along for HDC-04 Sarjapur Road

From in Kms	To in Kms	Length in m	ROW in m
3+000	3+120	120.00	31
3+120	3+220	100.00	27
3+220	3+270	50.00	31
3+270	3+520	250.00	27
3+520	3+620	100.00	27
3+620	3+870	250.00	26
3+870	3+950	80.00	26
3+950	4+100	150.00	26

Table 2.3: Table showing details of RoW along for HDC-Outer Ring Road KR Puram to Silk Board

From in Kms	To in Kms	Length in m	ROW in m
0+000	1+730	1730.00	26
1+730	3+440	1710.00	24
3+440	4+410	970.00	28
4+410	4+630	220.00	35
4+630	7+530	2900.00	26
7+530	8+850	1320.00	26
8+850	8+930	80.00	34
8+930	12+770	3840.00	28
12+770	16+500	3730.00	24

2.2.3 Land use

The largest proportion of land abutting the project corridors are Commercial followed by Residential.

2.2.4 Carriageway and Median

Measurements were taken at locations where the cross-section changes w.r.t Types and widths of Main Carriageway, Service Roads, Footpath, Median, and Drains from beginning to end of the project roads. Along with carriageway measurements and median as a part of inventory survey. The carriageway varies from Three lane divided carriageway to six lane divided carriageway. The pattern of existing carriageway for four lane and six lanes, shoulder and median is given in Table 2.4 to Table 2.6.




2.2.6 Footpath

At some locations drain cum footpath is provided where land availability is limited where sufficient land is available footpaths are provided separately. Details are shown in below table.

Table 2.11: Table showing details of footpath for HDC-03 Old Airport Road

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+250	250	Paved	2.2	Paved	1.5
0+250	0+310	60	Paved	2.2	Paved	0.6
0+310	0+350	40	Paved	1.1	Paved	0.6
0+350	0+390	40	Paved	1.1	Paved	0.5
0+390	0+460	70	Paved	2.8	Paved	0.5
0+460	0+650	190	Paved	1.4	Paved	0.5

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+250	250	Paved	2.2	Paved	1.5
0+250	0+310	60	Paved	2.2	Paved	0.6
0+310	0+350	40	Paved	1.1	Paved	0.6
0+350	0+390	40	Paved	1.1	Paved	0.5
0+390	0+460	70	Paved	2.8	Paved	0.5
0+460	0+650	190	Paved	1.4	Paved	0.5
0+650	0+660	10	Paved	1.4	Paved	3.0
0+660	0+730	70	Paved	1.9	Paved	3.0
0+730	0+810	80	Paved	3	Paved	3.0
0+810	0+820	10	Paved	0.4	Paved	3.0
0+820	0+880	60	Paved	0.4	Paved	1.5
0+880	0+950	70	Paved	3.2	Paved	1.5
0+950	1+190	240	Paved	3.2	Paved	1.6
1+190	1+240	50	Paved	2.2	Paved	1.6
1+240	1+290	50	Paved	0.7	Paved	1.6
1+290	1+300	10	Paved	2.8	Paved	1.6
1+300	1+450	150	Paved	2.8	Paved	0.9
1+450	1+520	70	Paved	2.8	Paved	2.0
1+520	1+690	170	Paved	4.3	Paved	2.0
1+690	1+750	60	Paved	2.1	Paved	2.0
1+750	1+880	130	Paved	2.1	Paved	0.6
1+880	1+900	20	Paved	2.7	Paved	0.6
1+900	2+050	150	Paved	2.7	Paved	2.3
2+050	2+090	40	Paved	2.7	Paved	2.4
2+090	2+350	260	Paved	3.2	Paved	2.4
2+350	2+390	40	Paved	3.2	Paved	1.9
2+390	2+500	110	Paved	3.0	Paved	1.9
2+500	2+630	130	Paved	3.0	Paved	1.4
2+630	2+680	50	Paved	1.4	Paved	1.4
2+680	2+800	120	Paved	1.4	Paved	
2+800	2+900	100	Paved	1.6	Paved	
2+900	2+970	70	Paved	1.6	Paved	2.0
2+970	3+150	180	Paved	1.8	Paved	2.0

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
3+150	3+230	80	Paved	1.8	Paved	2.7
3+230	3+420	190	Paved	2.9	Paved	2.7
3+420	3+450	30	Paved	2.9	Paved	3.5
3+450	3+550	100	Paved	1.4	Paved	3.5
3+550	3+600	50	Paved	2.7	Paved	3.5
3+600	3+740	140	Paved	1.3	Paved	3.5
3+740	3+850	110	Paved	1.3	Paved	3.5
3+850	3+970	120			Paved	3.5
3+970	4+190	220				
4+190	4+220	30			Paved	0.7
4+220	4+280	60	Paved	0.6	Paved	0.7
4+280	4+320	40	Paved	0.6	Paved	2.5
4+320	4+400	80	Paved	0.6	Paved	2.5
4+400	4+500	100	Paved	0.6	Paved	6.1 - 1.5
4+500	4+550	50	Paved	1.5	Paved	6.1 - 1.5
4+550	4+650	100	Paved	1.5	Paved	1.4
4+650	4+670	20	Paved	1.5	Paved	1.9
4+670	4+800	130	Paved	4.1	Paved	1.9
4+800	4+880	80	Paved	4.1	Paved	2.2
4+880	4+930	50	Paved	3.3	Paved	2.2
4+930	5+050	120	Paved	3.3	Paved	2.3
5+050	5+100	50	Paved	2.2	Paved	2.3
5+100	5+200	100	Paved	2.2	Paved	2.2
5+200	5+220	20	Paved	2.2	Paved	2.3
5+220	5+600	380	Paved	1.9	Paved	2.3
5+600	5+650	50	Paved	3.1	Paved	2.8
5+650	5+690	40	Paved	3.1	Paved	3.0
5+690	5+810	120	Paved	3.2	Paved	3.0
5+810	5+850	40	Paved	3.2	Paved	3.1
5+850	5+980	130	Paved	3.1	Paved	3.1
5+980	6+060	80	Paved	3.1	Paved	1.5
6+060	6+230	170	Paved	1.8	Paved	1.5
6+230	6+440	210	Paved	1.8	Paved	1.5

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
6+440	6+500	60	Paved	2.2	Paved	1.5
6+500	6+530	30	Paved	2.2	Paved	2.2
6+530	6+550	20	Paved	2.0	Paved	2.2
6+550	6+920	370	Paved	2.0	Paved	2.2
6+920	7+000	80	Paved	2.0	Paved	3.0
7+000	7+100	100			Paved	3.0
7+100	7+200	100	Paved	3.2	Paved	3.0
7+200	7+300	100	Paved	3.2	Paved	2.2
7+300	7+360	60	Paved	2.9	Paved	2.2
7+360	7+480	120	Paved	2.9	Paved	2.5
7+480	7+780	300	Paved	3.0	Paved	2.5
7+780	7+860	80	Paved	3.0	Paved	1.8
7+860	7+980	120	Paved	2.8	Paved	1.8
7+980	8+050	70	Paved	2.8	Paved	1.7
8+050	8+130	80	Paved	3.6	Paved	1.7
8+130	8+250	120	Paved	3.6	Paved	1
8+250	8+290	40			Paved	1.5
8+290	8+490	200			Paved	1.5
8+490	8+520	30			Paved	1.1
8+520	8+650	130			Paved	1.1
8+650	8+700	50			Paved	0.5
8+700	8+860	160			Paved	0.5
8+860	8+970	110			Paved	1.0
8+970	9+000	30			Paved	1.0
9+000	9+040	40			Paved	1.0
9+040	9+210	170				
9+210	9+230	20	Paved	2.5		
9+230	9+400	170	Paved	2.5		
9+400	9+420	20	Paved	3.5		
9+420	9+510	90	UP Paved	1.0		
9+510	9+520	10	UP Paved	1.0		
9+520	10+110	590	UP Paved	1.0		
10+110	10+130	20				

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
10+130	10+200	70	Paved	3.0		
10+200	10+230	30	Paved	3.0	Paved	2.3
10+230	10+370	140			Paved	2.3
10+370	10+480	110	Paved	1.8	Paved	2.3
10+480	10+550	70	Paved	1.8		
10+550	10+620	70	Paved	1.2		
10+620	10+960	340	Paved	1.2	Paved	1.8
10+960	11+030	70			Paved	1.8
11+030	11+130	100	Paved	1.7	Paved	1.8
11+130	11+250	120	Paved	1.7		
11+250	11+400	150	Paved	3.2		
11+400	11+560	160	Paved	2.9		
11+560	11+800	240	Paved	1.6		
11+800	11+880	80	Paved	1.9	Paved	1.8
11+880	12+390	510	Paved	1.9	Paved	1.8
12+390	12+500	110	Paved	1.9	Paved	1.8
12+500	12+600	100			Paved	1.8
12+600	12+780	180			Paved	2
12+780	13+000	220	Paved	0.9	Paved	2
13+000	13+100	100	Paved	2.3	Paved	3.4
13+100	13+380	280	Paved	2.3	Paved	2.4
13+380	13+810	430	Paved	2.3	Paved	1.6
13+810	13+820	10	Paved	4.1	Paved	1.6
13+820	13+980	160	Paved	4.1	Paved	1.8
13+980	13+990	10	Paved	2	Paved	1.8
13+990	14+140	150	Paved	2	Paved	0.5
14+140	14+180	40	Paved	2		
14+180	14+200	20	Paved	1.2		
14+200	14+250	50	Paved	1.2	Paved	2.6
14+250	14+350	100	Paved	2.4	Paved	2.6
14+350	14+360	10	Paved	2.4	Paved	1.6
14+360	14+450	90	Paved	3.1	Paved	1.6
14+450	14+680	230	Paved	3.1	Paved	1.6

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
14+680	14+730	50	Paved	3.1	Paved	2.0
14+730	14+750	20	Paved	2.0	Paved	2.0
14+750	14+850	100	Paved	2.0	Paved	3.4
14+850	15+030	180	Paved	2.0		
15+030	15+050	20				
15+050	15+100	50	Paved	1.8		
15+100	15+280	180	Paved	1.8	Paved	5.4
15+280	15+350	70	Paved	2.9	Paved	3.2
15+350	15+550	200	Paved	2.9	Paved	3.2
15+550	15+670	120	Paved	2.9	Paved	3.2
15+670	15+740	70	Paved	2.1	Paved	3.2
15+740	15+800	60			Paved	3.2
15+800	15+840	40			Paved	4.1
15+840	15+870	30			Paved	4.4
15+870	15+990	120	Paved	2.3	Paved	4.4
15+990	16+100	110	Paved	2.4	Paved	4.4
16+100	16+280	180			Paved	3.3
16+280	16+370	90			Paved	2.5
16+370	16+450	80	Paved	4.0	Paved	2.5
16+450	16+480	30			Paved	2.5
16+480	16+630	150			Paved	2.5
16+630	16+750	120	Paved	2.7	Paved	2.5
16+750	16+860	110	Paved	2.7	Paved	2.3
16+860	17+000	140	Paved	0.8	Paved	2.3
17+000	17+080	80	Paved	0.8	Paved	1.8
17+080	17+110	30	Paved	1.0	Paved	1.8
17+110	17+150	40	Paved	1.0	Paved	3.5

Table 2.12: Table showing details of footpath for HDC-04 Sarjapur Road

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
3+000	3+120	120	Un Paved	2	Paved	1.8

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
3+120	3+220	100			Paved	1.3
3+220	3+270	50			Paved	1.5
3+270	3+520	250			Paved	1.2
3+520	3+620	100			Paved	1.5
3+620	3+870	250				
3+870	3+950	80				
3+950	4+100	150				

Table 2.13: Table showing details of footpath for HDC-12c Outer Ring Road

Chainage, km		Length, m	Footpath			
			LHS		LHS	
From	To		Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+240	240	Paved	1.00	Paved	2.00
0+240	0+530	290	Paved	1.00	Paved	1.00
0+530	1+330	800	Paved	0.80	Paved	1.00
1+130	1+230	100	Paved	0.80		
1+230	1+730	500				
1+730	1+830	100	Paved	1.00		
1+830	2+530	700			Paved	1.20
2+530	2+630	100				
2+630	3+340	710	Paved	1.00		
3+340	3+440	100	Paved	1.20		
3+440	3+530	90	Paved	3.40	Unpaved	1.20
3+530	3+800	270	Paved	1.20	Unpaved	1.20
3+800	4+320	520	Paved	1.20	Paved	1.00
4+320	4+410	90			Paved	1.00
4+410	4+450	40			Paved	1.20
4+450	4+630	180	Paved	1.20	Paved	1.20
4+630	5+350	720			Paved	1.20
5+350	5+980	630				
5+980	6+120	140			Paved	1.00
6+120	6+400	280			Paved	1.00
6+400	6+910	510			Paved	1.00
6+910	6+960	50			Paved	1.00
6+960	7+530	570				
7+530	7+620	90				
7+620	7+860	240				
7+860	8+000	140			Paved	1.00
8+000	8+170	170	Paved	0.50	Paved	1.00
8+170	8+230	60	Paved	1.00	Paved	1.00
8+230	8+850	620	Paved	1.20	Paved	1.00
8+850	8+880	30	Paved	1.20	Paved	1.00

Chainage, km		Length, m	Footpath			
			LHS		LHS	
From	To		Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
8+880	8+910	30	Paved	1.20		
8+910	8+930	20				
8+930	9+010	80				
9+010	9+640	630				
9+640	9+920	280	Paved	3.00		
9+920	10+600	680				
10+600	10+660	60			Paved	1.50
10+660	11+350	690	Paved	1.00	Paved	1.20
11+350	11+450	100	Paved	1.00	Paved	1.00
11+450	11+800	350			Paved	1.20
11+800	11+960	160				
11+960	12+770	810	Paved	2.00	Paved	2.00
12+770	12+850	80	Paved	2.00		
12+850	12+900	50				
12+900	13+630	730				
13+630	13+680	50				
13+680	14+620	940	Paved	2.00		
14+620	14+740	120				
14+740	15+310	570				
15+310	15+360	50				
15+360	16+000	640	Paved	1.50	Paved	1.20
16+000	16+500	500	Paved	2.00		

2.3 Road Junctions

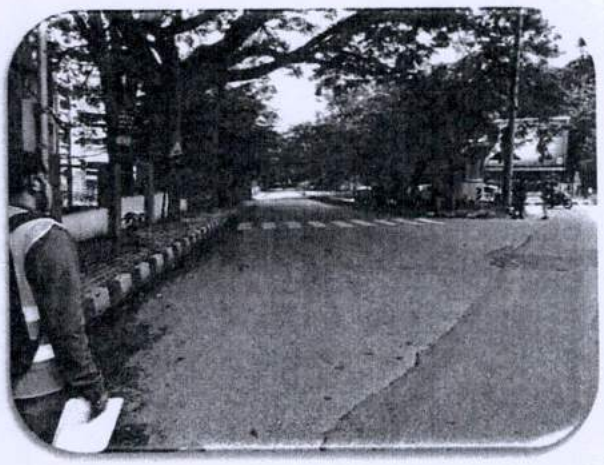
Significant transport benefits, across all modes, can be achieved through junction improvement and management. These improvements will aid free flow of Traffic to and from cross roads, thereby reducing travel time of through traffic. Total number of Major and minor junctions identified during inventory study are presented in the Table 2.4 and the detailed drawings for the junction improvements have been presented in Drawing Volume.

Table 2.14: Table showing details of Major Junctions

Sl. No	Existing chainage	Type of Junction	Location
HDC-03 Old Airport Road			
1	0+150	T	ASC Junction
2	0+520	Y	Cambridge Road Jn
3	2+370	+	Junction with 7th cross road and Prof U R Road
4	2+560	+	Junction with 100 feet Road
5	5+260	T	HAL Circle
6	6+810	T	HAL Junction

Sl. No	Existing chainage	Type of Junction	Location
7	8+110	T	Doddanekundi Road Jn
8	9+150	+	Ring Road Junction
9	10+640	+	Kundalahalli Gate Jn
10	12+390	+	Pattandur Agrahara Main Road Jn
11	15+260	T	Borewell Road Jn
12	15+540	T	Immadihalli Main Road Jn
13	15+750	T	-
HDC-04 Sarjapur Road			
14	0+660	+	100 Feet Road Junction
15	1+370	T	11th Main Road Junction
16	1+580	T	Madiwala Road Jn
17	2+120	T	80 feet Road Jn
18	2+850	T	100 Feet Road Indiranagar
19	4+180	T	14th Main Road Junction
20	5+680	T	Iblur Junction
21	6+110	T	Haralur main Road Jn
22	7+250	+	-
23	9+350	+	Doddakanelli Road Jn
HDC 12 c Outer Ring Road KR Puram to Silk Board			
24	1+700	T	MahadevpuraJn
25	2+750	T	-
26	3+400	Staggered	Doddanekundi Maiin Road Jn
27	3+550	Y	-
28	5+000	Y	-Chinnapanahalli Main Road Jn
29	6+350	Staggered	
30	7+500	+	
31	7+700	+	
32	8+050	T	
33	8+250	Staggered	
34	9+000	+	
35	11+050	+	
36	13+750	Staggered	
37	16+500	Y	

From the inventory, it is found that there are 145 minor junctions in Old airport road, 156 minor junctions in Sarajapura road and 39 minor junctions in K R Puram to Silk Board road.



2.4 Bus Shelters / Bus Bays / Bus Stop

There are 64 number of Bus stops are in provided in project corridors, all bus stops are provided with Bus shelters. At some locations Bus bays are provided, details are shown in below table.:

Table 2.15: Table showing Bus Bays / Bus Stops

Sl. No	Chainage	Side		Remarks
		LHS	RHS	
HDC 03 – Old Airport road				
1	0+880	Yes	-	-
2	9+400	Yes	-	-
3	11+000	Yes	-	Kundanahalli Busstop
4	11+396	-		Yes
5	11+530	Yes	-	Thubaranahalli Busstop
6	12+510	-		Yes
7	13+350	-		Yes
8	13+550	Yes		-
9	14+050	-		Yes
10	14+360	Yes		-
11	15+030	Yes		-
12	15+050	Yes		-
13	15+100	-		Yes
14	15+740	Yes		-
15	15+780	-		Yes
16	15+870	Yes		-
17	16+110	Yes		-
18	16+280	-		Yes
19	16+450	Yes		-
HDC 04 – Sarjapur Road				
20	0+050	Both		St Johns hospital

Sl. No	Chainage	Side		Remarks
		LHS	RHS	
21	0+640	Both		Koramangal water tank
22	1+100	Both		CPWD quarters
23	1+650	Yes	Kripanidi college	Kadirayanapalya Junction
24	1+800	Both		John Fowler
25	2+150	Both		Koramangala
26	2+630	Both		Jakkasandra
27	2+880	Yes	Bhagini	-
28	3+950	Yes	Agara	-
29	5+730	Yes	Jn of sarjapura	-
30	6+180	Both		Bellandur gate
31	7+250	Both		Kaikondrahalli stop
32	8+070	Yes	Junnasandra gate	K R Puram Railway Station
33	9+340	Both		Doddakannahalli
34	10+350	Both		Carmelram Gate
HDC 12 c Part-2 Outer Ring Road				
35	2+650	-	Yes	Silk board
36	3+240	-	Yes	HSR apartment
37	4+160	Yes	-	HSR 14th main
38	4+180	-	Yes	HSR 14th main
39	4+900	-	Yes	Hsr mantri
40	5+920	Yes	-	Agara
41	7+210	-	Yes	Iblur
42	7+270	-	Yes	Iblur
43	7+330	Yes	-	Iblur
44	8+230	Yes	-	Bellandur petrol bunk
45	8+875	-	Yes	Bellandur
46	9+310	Yes	-	Eco space
47	9+475	-	Yes	Eco space
48	9+888	-	Yes	Devarabeesanahalli
49	10+150	Yes	-	Devarabeesanahalli
50	10+780	Yes	-	New horizon college
51	10+860	-	Yes	New horizon college
52	11+450	Yes	-	Kadubeesanahalli
53	11+795	-	Yes	Kadubeesanahalli
54	11+830	Yes	-	JP morgon
55	12+930	Yes	-	Innovative multiplex
56	13+030	-	Yes	Innovative multiplex
57	13+910	Yes	-	Kalamandir
58	14+850	-	Yes	Karthik nagar

Sl. No	Chainage	Side		Remarks
		LHS	RHS	
59	16+195	-	Yes	Doddenekudi
60	17+780	Yes	-	Mahadevpura
61	18+485	Yes	-	B Narayanapura

2.5 Pavement Condition Survey

The survey regarding road inventory and pavement condition was carried out along the project corridor. The width of the carriageway along the project road varies from 4 lane divided carriage way to six lane divided carriageway. Visual inspection of the road showed a generally Fair surface condition.

The condition of the pavement has been evaluated based on the field measurements of primary pavement surface distress of cracking (narrow and wide), patching, raveling and potholes, noted for each kilometer length. The extent of each distress has been visually estimated for every kilometer length of the road in terms of percentage area affected and then averaged for one-kilometer road length.

The distress conditions are measured under the following sub-heads:

- Cracking (%)
- Potholes (%)

- Raveling (%)
- Patching (%)
- Settlement & Upheaval (%)

2.4.1 Cracks

Pavement cracking is a typical failure commonly observed in flexible / bituminous pavements occurring predominantly due to the higher number of repetitions of heavier axle loads. Pavement Cracks (%) details along the existing project corridor are in **Annexure 2.2.** The average values of minimum, maximum and average percentage of cracks in the project roads are 2.5%, 5.50%, 3.58% respectively for Old Airport road, 3.25%, 5.50%, 3.94% for Old Sarjapur Road and 1.5%, 4.5%, 2.73% for Outer ring Road.

2.4.2 Patching

The variation of Pavement Patching (%) with length is shown in Figure 2.2. Pavement patching (%) details along project corridor is in **Annexure 2.1.** No significant patching is noticed except at few localized spots. The average values of minimum, maximum and average percentage of patching area in the project roads are 1.5%, 8.5 %, 3.76 % respectively for Old Airport Road, 2.20%, 7.25%, 4.18% for Sarjapur Road, and 1.05%, 4.5%, 2.27% for Outer Ring Road.

2.4.3 Ravelling

Disintegration of the pavement surface caused due to failure of binder to hold the material together causing blowing off of fine aggregates leaving behind pock marks and when larger particles are broken free with stripping of aggregates is termed as Raveling. Pavement raveling (%) details along the project corridor is in **Annexure2.1.** The average values of minimum, maximum and average percentage of raveling in the project roads are 3.15%, 7.60%, 4.46% for Old Airport Road, 3.50%, 8.50%, 6.00% for Sarjapur Road and 6.65% and 4.16% for Outer Ring Road.

2.4.4 Potholes

Potholes are bowl-shaped holes of varying sizes in the surface layer extending into the base course. Potholes are mainly formed due of loose base course or base course not covered properly with wearing course or due to inadequate bonding between base course and subsequent top layers. Pavement Potholes (%) details along the project corridor are in **Annexure2.1.** The average values of minimum, maximum and average percentage of potholes in the project roads are 1.5%, 7.0%, 4.06% for Old Airport Road, 0.65%, 2.60%,

1.90% for Sarjapur Road (Link-1 and 1.75%, 3.5%, 2.52% for Outer Ring Road.

2.4.5 Rutting

Rutting is a surface depression in the wheel path. Pavement uplift (shearing) may occur along the sides of the rut. Ruts are particularly evident after a rain when they are filled with water. There are two basic types of rutting: mix rutting and subgrade rutting. Mix rutting occurs when the subgrade does not rut yet the pavement surface exhibits wheel path depressions as a result of compaction/mix design problems. Subgrade rutting occurs when the subgrade exhibits wheel path depressions due to loading. In this case, the pavement settles into the subgrade ruts causing surface depressions in the wheel path. Pavement Rutting (%) details along the project corridor are in Annexure2. 1. The average values of minimum, maximum and average percentage of potholes in the project roads are 0%, 0.10%, 0.02% for Old Airport Road, 0%, 0.09%, 0.2% for Sarjapur Road and 0%, 0.2%, 0.3% for Outer Ring Road.

2.4.6 Summary of Observations on Pavement Condition

The overall condition of the pavement is in fair to Good condition with around 85.97 % of the pavement area in fair condition for Bellary Road, 84.39% of the pavement area in fair condition for Old Madaras Road and 74.15% of pavement area in fair condition for Outer Ring Road the percentage various of destresses for each road is shown below.

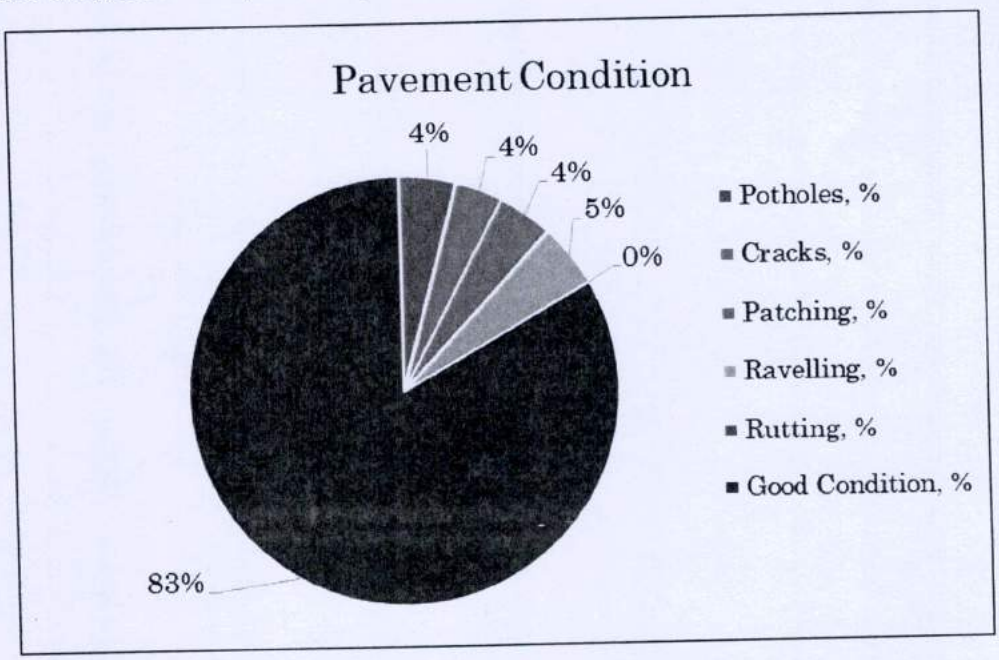


Figure 2.1:- Summary of existing Pavement condition of HDC 03 Old Airport Road

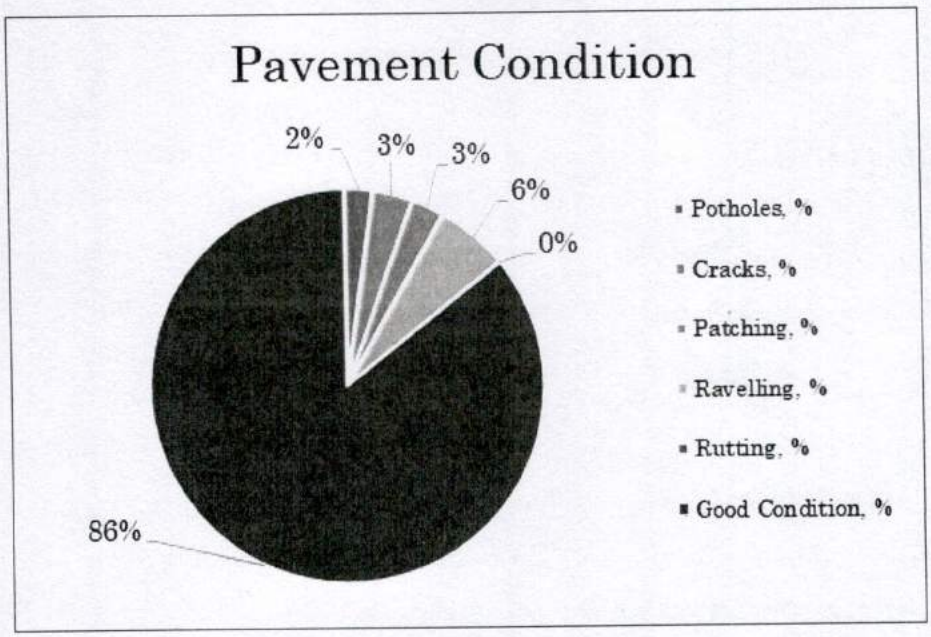


Figure 2.2:- Summary of existing Pavement condition of HDC 04 Sarjapur Road

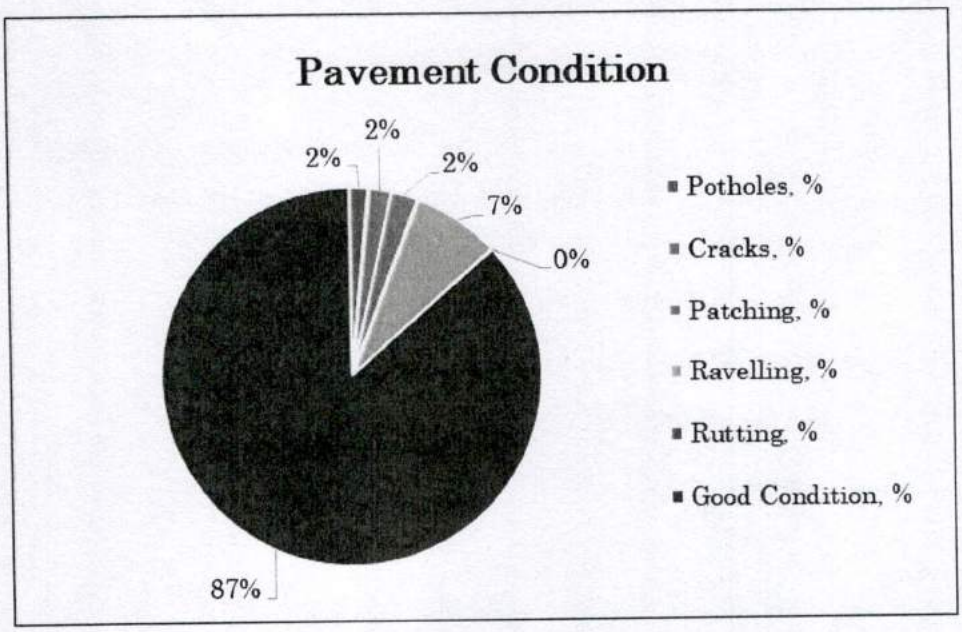


Figure 2.3:- Summary of existing Pavement condition of HDC 12c Outer Ring Road

2.6 Camber

Carriageway camber is checked at intervals to assess the camber at site, the camber is very important for effective drainage of rain water. The standard camber is 2.5% on our roads, but quite often the camber reduces or becomes non uniform during the course of life of road in urban roads due to distress, frequent overlays. Following table represents

1.90% for Sarjapur Road (Link-1 and 1.75%, 3.5%, 2.52% for Outer Ring Road.

2.4.5 Rutting

Rutting is a surface depression in the wheel path. Pavement uplift (shearing) may occur along the sides of the rut. Ruts are particularly evident after a rain when they are filled with water. There are two basic types of rutting: mix rutting and subgrade rutting. Mix rutting occurs when the subgrade does not rut yet the pavement surface exhibits wheel path depressions as a result of compaction/mix design problems. Subgrade rutting occurs when the subgrade exhibits wheel path depressions due to loading. In this case, the pavement settles into the subgrade ruts causing surface depressions in the wheel path. Pavement Rutting (%) details along the project corridor are in Annexure2. 1. The average values of minimum, maximum and average percentage of potholes in the project roads are 0%, 0.10%, 0.02% for Old Airport Road, 0%, 0.09%, 0.2% for Sarjapur Road and 0%, 0.2%, 0.3% for Outer Ring Road.

2.4.6 Summary of Observations on Pavement Condition

The overall condition of the pavement is in fair to Good condition with around 85.97 % of the pavement area in fair condition for Bellary Road, 84.39% of the pavement area in fair condition for Old Madaras Road and 74.15% of pavement area in fair condition for Outer Ring Road the percentage various of destresses for each road is shown below.

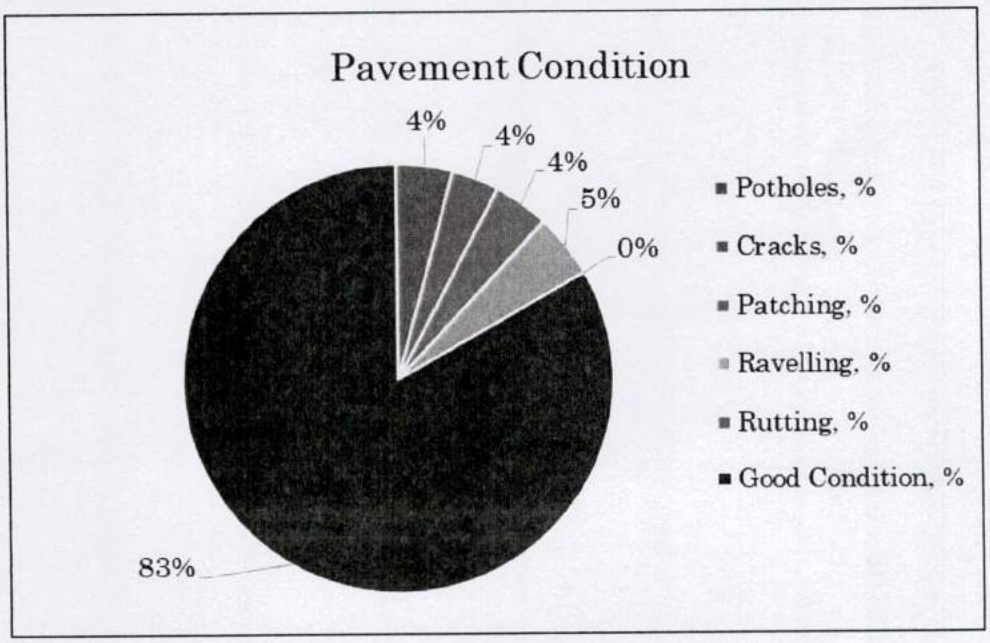


Figure 2.1:- Summary of existing Pavement condition of HDC 03 Old Airport Road

the camber on the existing roads

Table 2.16: Table showing Camber with Intervals

Sl. No	Chainage, m	Camber, %	
		LHS	RHS
HDC 01 – Old Airport Road			
1	500	-3.04%	1.29%
2	1000	-3.04%	1.46%
3	1500	-2.78%	0.59%
4	2000	-2.45%	1.42%
5	2500	-3.29%	2.84%
6	3000	3.14%	3.45%
7	3500	-3.17%	3.27%
8	4000	2.08%	2.86%
9	4500	-2.78%	2.97%
10	5000	-1.99%	2.09%
11	5500	1.79%	0.86%
12	6000	-1.42%	4.78%
13	6500	-1.86%	2.44%
14	7000	-1.88%	0.86%
15	7500	0.79%	2.24%
16	8000	-3.25%	2.03%
17	8500	-1.41%	3.22%
18	9000	-1.58%	2.64%
19	9500	-2.97%	3.68%
20	10000	-2.99%	2.02%
21	10500	-3.45%	3.27%
22	11000	-2.47%	2.52%
23	11500	-2.84%	1.95%
24	12000	-0.62%	3.13%
25	12500	-1.26%	3.22%
26	13000	-2.58%	2.79%
27	13500	-1.80%	2.41%
28	14000	-2.19%	4.52%
29	14500	-3.17%	2.99%
30	15000	-3.65%	3.31%
31	15500	-3.27%	2.85%
32	16000	-5.38%	3.76%
33	16500	-3.71%	1.56%
34	17000	-2.97%	4.46%
HDC 04 – Sarjapura Road			
35	0+000	2.84%	2.24%

Sl. No	Chainage, m	Camber, %	
		LHS	RHS
36	0+500	3.61%	2.74%
37	1+000	-2.73%	3.23%
38	1+500	3.15%	2.15%
HDC 12c – ORR from K R Puram to Silkboard			
39	0+000	1.01%	-0.72%
40	0+500	-2.12%	-0.68%
41	1+000	2.35%	2.41%
42	1+500	-1.65%	2.21%
43	2+000	1.38%	0.44%
44	2+500	2.84%	2.24%
45	3+000	3.61%	2.74%
46	3+500	-2.73%	3.23%
47	4+000	3.15%	3.53%
48	4+500	2.38%	2.15%
49	5+000	-0.88%	2.48%
50	5+500	2.28%	2.01%
51	6+000	3.14%	2.26%
52	6+500	1.74%	2.46%
53	7+000	2.03%	2.39%
54	7+500	-4.75%	5.48%
55	8+500	3.18%	9.37%
56	9+000	2.21%	2.91%
57	9+500	-4.18%	5.16%
58	10+000	2.87%	2.36%
59	10+500	2.51%	2.13%
60	11+000	2.34%	3.23%
61	11+500	3.78%	2.99%
62	11+900	-2.96%	2.55%

2.7 Traffic Survey

Traffic surveys are an integral component of any transport study where appreciation of existing traffic and travel characteristics of the study area are extremely important. However, Traffic surveys are not required in this assignment as no additional widening is proposed beyond available ROW. However, the traffic survey details available with KRDCL are collected for Analysis of pavement Evaluation and overlay design.

At the outset, ISECPL has collated available traffic survey details to establish the base line data for the study.

The classified traffic volume count data available was processed and compiled using Spread Sheet software packages to get Commercial Vehicles per day, which is further utilized to compute the design traffic. Traffic Survey details referred are conducted during the year 2016, and this traffic is projected to Design Base year. The CVPD adopted for each road is shown below:

Table 2.17: CVPD for Old Airport Road

Mode	CVPD (2016)	Projected CVPD
Std Bus	1297	1656
LCV	1233	1574
2 Axle	428	547
3 Axle	359	459
Multi Axle	63	81

Table 2.18: CVPD for Sarjapur Road

Mode	CVPD (2016)	Projected CVPD
Std Bus	889	1135
LCV	1723	2200
2 Axle	234	299
3 Axle	224	286
Multi Axle	4	6

Table 2.19: CVPD for Outer Ring Road (K R Puram to Silk Board)

Mode	CVPD (2016)	Projected CVPD
Std Bus	2831	3614
LCV	2911	3716
2 Axle	1140	1455
3 Axle	584	746
Multi Axle	162	207

- Design life: - Design Life of 5 Years is considered for the overlay design of Flexible Pavement Design as per IRC: SP: 115 - 2014.
- Growth rate: - Annual Growth rate of 5% is considered for designs.
- VDF: - The adopted vehicle damage factor considered for the overlay design is 1.0 for Buses & LCV, and 5.0 for other HCVs.
- Lane Distribution factor: - Lane distribution factor is adopted as indicated in IRC 37 - 2018.
- The Design Traffic obtained for a design period of 5 Years as per IRC 37 2018 is

Tabulated below.

Road	HDC 03- Old Airport Road	HDC 04 – Sarjapura Road	HDC 12c – ORR from KR Puram to Silk Board
Design Traffic, msa	13	10	23

2.8 Existing Pavement Structure

The bituminous layers contribute the major part of the strength of the flexible pavement structure. Hence pavement investigation is carried out to know the Existing Bituminous Thickness without disturbing the surrounding area of test pit, the existing bituminous layer thickness is measured by cutting a bituminous core cutting equipment. The core samples are taken on all the project roads at an effective interval of 2 Km. The photographs taken during core cutting in project stretch are given in following paragraphs.

Table 2.20: Bituminous Crust Thickness by Core Cutter

Sl. No	Chainage	Pavement Crust Thickness in (mm)		Total Thickness in (mm)
		Bituminous Layer	Granular Layer	
HDC-3 Old Airport Road				
1	1+750	210	280	490
2	8+500	220	280	500
HDC-4 Sarjapur Road				
1	3+250	220	290	510
HDC-12c Outer Ring Road KR Puram to Silk Board				
1	3+900	220	300	520
2	7+300	220	290	510

2.9 Pavement structural Evaluation using Falling Weight Deflectometer Studies

Falling Weight Deflectometer (FWD) applies dynamic load on the pavement, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads. The FWD test was carried out in accordance with IRC: 115-2014 "Guidelines for structural evaluation and strengthening of flexible road pavements using Falling Weight Deflectometer (FWD) Technique. FWD readings were taken along the wheel path. Readings were taken at 250m interval, with test points staggered on both sides. Adjustments to reading locations were made to avoid culverts, bridge decks and locally damaged areas. Pavement and air temperatures were recorded for the purpose of

temperature correction. Subgrade moisture data was also obtained from field moisture measurements for applying seasonal corrections to deflection measurements.

Principle of Pavement evaluation using FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as subgrade strength, pavement thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. The resulting load-deflection data can be interpreted through appropriate analytical `techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are, in turn, used for (i) the strength evaluation of different layers of in-service pavements (ii) the estimation of the remaining life of in-service pavement (iii) determination of strengthening requirement, if any and (iv) evaluation of different rehabilitation alternatives (overlay, recycling, partial reconstruction, etc.

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate. Trailer mounted as well as vehicle mounted FWD models are available commercially. The working principle of all these FWD models is essentially the same. A mass of weights is dropped from a pre-determined height onto a series of springs/ buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.

FWD is non-destructive test equipment for pavements. It applies a dynamic load to a pavement structure which simulates a moving load, unlike in case of BBD where static load is applied, which does not simulate moving load. FWD provides fast, non-destructive

evaluation of pavements and is safe in operating with traffic. It evaluates the condition of underlying pavement layers and can trace the complete shape of bowl formed under dynamic loading.

The survey has been carried out by conducting deflection studies over the existing carriageway along the wheel paths at an effective interval of 250 m alternatively on both lanes of carriageway on each side. The deflections are measured by lowering the loading plate in proper contact with the pavement surface along with the required number of geophones placed at known distance from the loading plate. A target load of 40KN is achieved by dropping the mass from predetermined height. At each study point the load is applied once as seating load and the corresponding deflection is need not be recorded. After seating load, Raise the mass and drop minimum 3 times and record load and deflection data into the computer through data acquisition system on all 3 drops. While peak load and peak deflections at different selected radial positions must be recorded. After that the loading plate and Geophone frames are raised to original position and vehicle is moved to next test point. Temperatures are recorded at an interval of half hour and it has ensured FWD studies are not carried with pavement temperature greater than 45°C.

Temperature Correction

Back calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. Hence the back calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected. For areas in India having a tropical climate, the standard pavement temperature is recommended **as 35°C.**

Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular subbase/base layers. The extent to which the strength is affected will depend on the nature of subgrade soil, gradation and nature of fines in the granular layers, etc. For applying these guidelines, it is intended that the pavement layer moduli values should pertain to the period when the subgrade is at its weakest condition. In India, this period occurs during the recession of monsoon. It is, therefore, desirable to conduct deflection measurements during this period. Where the same is not feasible, a correction procedure should be adopted.

The deflection measurement results with due temperature, seasonal corrections and

characteristic deflections are presented in **Annexure 2.2**.

The Summar of Normalized deflection are presented in Table 2.17 to Table 2.20 and the summary for FWD analysis and pavement overlay design is presented in Table 2.21 to the completed details of FWD analysis and overlay design is Annexed with this report.

Table 2.21: Summary of Normalized Deflection for Old Airport Road

Station ID	Load, KN	Contact Pressure	Normalized Deflections, mm						
			D1	D2	D3	D4	D5	D6	D7
0	40	0.56	0.151	0.13	0.115	0.096	0.069	0.059	0.041
250	40	0.56	0.23	0.198	0.178	0.149	0.114	0.094	0.069
500	40	0.56	0.12	0.107	0.097	0.083	0.064	0.055	0.042
750	40	0.56	0.111	0.095	0.084	0.072	0.056	0.049	0.036
1000	40	0.56	0.135	0.113	0.098	0.082	0.062	0.053	0.04
1250	40	0.56	0.134	0.114	0.103	0.087	0.066	0.057	0.041
1500	40	0.56	0.097	0.081	0.074	0.063	0.049	0.042	0.031
1750	40	0.56	0.125	0.107	0.095	0.082	0.063	0.054	0.041
2000	40	0.56	0.099	0.082	0.073	0.061	0.046	0.039	0.028
2250	40	0.56	0.178	0.157	0.141	0.118	0.087	0.072	0.05
2500	40	0.56	0.119	0.1	0.09	0.078	0.061	0.053	0.04
2750	40	0.56	0.155	0.126	0.11	0.09	0.065	0.054	0.037
3000	40	0.56	0.149	0.128	0.113	0.093	0.067	0.056	0.042
3250	40	0.56	0.16	0.132	0.114	0.094	0.07	0.059	0.043
3500	40	0.56	0.16	0.132	0.114	0.095	0.069	0.062	0.047
3750	40	0.56	0.127	0.108	0.097	0.082	0.059	0.052	0.039
3800	40	0.56	0.187	0.146	0.123	0.1	0.073	0.063	0.046
4100	40	0.56	0.063	0.06	0.059	0.059	0.054	0.051	0.04
4350	40	0.56	0.262	0.213	0.178	0.131	0.082	0.063	0.041
4600	40	0.56	0.085	0.063	0.052	0.04	0.02	0.015	0.008
4850	40	0.56	0.129	0.1	0.081	0.065	0.049	0.043	0.034
5100	40	0.56	0.28	0.239	0.203	0.157	0.103	0.082	0.055
5200	40	0.56	0.216	0.186	0.165	0.134	0.1	0.082	0.06
5500	40	0.56	0.331	0.27	0.226	0.174	0.104	0.083	0.048
5750	40	0.56	0.233	0.197	0.169	0.136	0.094	0.079	0.055
6000	40	0.56	0.238	0.203	0.177	0.139	0.097	0.079	0.056
6250	40	0.56	0.266	0.222	0.191	0.151	0.105	0.086	0.059
6500	40	0.56	0.36	0.298	0.26	0.208	0.146	0.122	0.072
6750	40	0.56	0.319	0.275	0.246	0.209	0.162	0.134	0.098
7000	40	0.56	0.431	0.361	0.306	0.238	0.16	0.133	0.086
7250	40	0.56	0.352	0.311	0.278	0.232	0.177	0.147	0.099
7500	40	0.56	0.384	0.328	0.29	0.236	0.168	0.14	0.096

CHAPTER 3: IMPROVEMENT PROPOSALS

3.1 General

The project corridors are studied thoroughly with respect to the existing features on the project roads viz No of lanes, carriageway details, Drains and CDs, Footpaths, Medians, Junctions, Bus bays, sign Boards and other traffic Appurtenances as discussed in Chapter 2. the project corridors under package 1 i.e., **HDC 03: Old Airport Road, HDC 02: Sarjapur Road**, and **HDC 12c: Outer Ring Road from Old Airport Road to Silk Board** comprise carriageway varying from 4 lane to 6 lanes.

Table 3.1 Lane Configuration

SI No	Road Name	Lane Km			
		4 Lane	6 Lane	For SR Lane	Total Lane Km
1	Old Airport Road	68.60 Km	-	-	**68.60 Km**
2	Sarjapur Road	35.00 Km	-	-	**35.00 Km**
3	K R Puram to Silk Board	-	99.00 Km	66.00 Km	**165.00 Km**
	Total	**103.6 Km**	**99.00 Km**	**66.00 Km**	**268.60 Km**

Since the project corridors are under control of BBMP, there are already various improvement works have been carrying out or already tendered by BBMP in the project corridors. Improvement proposals are made for the remaining length which has not been considered for improvement works under BBMP / BMRCL.

The Project Proposals are Prepared in 2 Parts

1. **Initial Improvement Proposals**
2. **Annual maintenance Proposal**

3.2 Discussions made with various Stake Holders

3.2.1 Assets to be included as part of the maintenance project

KRDCL has informed that several meetings were held on this project at various levels of ACS, CS and it was concluded to include and exclude the following assets as part of maintenance by KRDCL

Table 3.2 Table of Assets

SL No	Assets Proposed for Maintenance
Assets Included for Maintenance by KRDCL	
1	Carriageway
2	Median
3	Junctions
4	Grade Separators (Flyovers/Underpasses/RoB/RUB)
5	Bus Bays
6	Service Roads / Slip Roads / Parking Lanes
7	Road Markings
8	Sign Boards
9	Footpath
10	Pedestrian Guard Rails
11	Bollards
12	High Raised Pedestrian Crossings
13	Traffic Signals at Junctions
14	Installation of Traffic KIOSK / Umbrella for Policemen
15	Side Drains
16	Cross Drainage Structures
17	Road Sweeping
18	Manhole chamber Improvements
19	Tree Guards
20	Tree pruning
21	Road Cutting and Restoration
23	Removal of Construction and Demolition Debris
Assets Excluded for Maintenance by KRDCL	
1	Bus Shelters
2	Sky Walks
3	Solid Waste Management
4	Encroachment Clearance
5	Street Lighting
6	Land Acquisition for improvements
7	Water Supply and Sanitary lines leakages by BWSSB
8	Faulty Power Lines by BESCOM/KPTCL
9	Gas Leakages in Gas Lines by GAIL

3.2.2 Proposals from Bruhat Bengaluru Mahanagara Palike (BBMP)

Meetings and Discussions are held with BBMP officials regarding the ongoing improvement works or tendered works along the project length of the High-Density corridors. The details of the works which are already considered by BBMP and BMRCL are collected and summary of the same is tabulated below. The stretch wise details of the works considered by BBMP / BMRCL are annexed with the report.

Table 3.3 Tendered length of BBMP and BMRCL

HDC No	Corridor Name	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
3	Old Airport Road	17.15	3.15	0.00
4	Sarjapur Road	8.75	7.65	0.00
12c	KR Puram to Silk Board	16.5	4.60	0.00
Package II Length, Km		**42.40**	**15.40**	**0.00**

3.2.3 Proposals from Traffic Police Department

Police department has prepared a corridor wise proposal for the works to be considered in Short Term, Mid Term and Long-Term measures to improve the Traffic discipline, reduce the congestion, and minimize the accidents and fatalities. the detailed report submitted by the department is annexed with this report and the prominent, short term measures, Midterm Measures, and long-Term measures, which are included in the project proposal are Summarized in the table below.

Table 3.4 Proposals considered as per Traffic Police Department

SI No	Items Considered in Estimate as per Traffic Police Requirement	Quantity		
		HDC 03	HDC 04	HDC 12c
1	Junction Improvement	10 Nos	2 Nos	6 Nos
2	High Raised Pedestrian Crossing	21 Nos	15 Nos	30 Nos
3	Median Guard Railing	15.45 Km	7.5 Km	12.5 Km
4	Bus Bay	5 Nos	1 No	2 Nos
5	Widening of road	70 m	Nil	100 m
6	Traffic Sign Boards	244 Nos	107 Nos	256 Nos
7	Traffic Umbrella/Kiosk	8 Nos	4 Nos	6 Nos
8	Traffic Signals	4 Nos	1 No	2Nos
9	Skywalks	2 Nos	4 Nos	4 Nos
10	Surveillance and Enforcement Cameras installation	58 Nos	15 Nos	24 Nos

Various discussion held with ACS, CS on these issues concluded that the skyalks shall be

taken up on PPP basis separately and camers will be taken up under separate head, hence these two items are excluded from the current scope of project.

3.2.4 Proposals from DULT

DULT suggested to provide bus lanes and cycle lanes in all roads as per the budgetary announcement made by Hon'ble CM. various discussions held on this at ACS, CS level and following suggested to include bus lanes at roads (preferable Outer Ring Road) where 6 lanes are more exists at present and any other stretches needed will be added alter with proper permission/approval from Govt. In Package 2 – length of ORR is around 16.5 Km, where Bus Priority lane is already executed, Hence no provision is made for creating Bus Priority lane in this Package.

Table 3.5 Proposals of DULT

SI No	High Density Corridor	Length of Bus Priority Lane Considered, Km
1	HDC 03 – Old Airport Road	Nil
2	HDC 04 – Sarjapur Road	Nil
3	HDC 12 C – ORR from KR Puram to Silk Board	Already Executed
	Total Length of Bus Lane in Package 2	**0.00 Km**

3.3 Initial Improvement Works

Initial improvement works are proposed in the Balance length of the corridors which are not considered for improvement by BBMP / BMRCL. The summary of the initial improvement lengths of the 3 corridors under Package 1 is represented below.

Table 3.6 Table below shows the Length of Initial Improvement Works

HDC No	Corridor Name	Length Considered for Initial Improvement, Km	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
3	Old Airport Road	14.00	17.15	3.15	0.00
4	Sarjapur Road	1.10	8.75	7.65	0.00
12c	KR Puram to Silk Board	11.9	16.5	4.6	0.00
Package I Length, Km		**27.0**	42.4	15.40	0.00

The Proposals have been split into following Major Heads.

(i) Where No works are taken up by BBMP or BMRCL, these stretches the project improvement proposals includes

- Carriageway Improvements
- Junction Improvements
- Footpath Improvement and Construction of Green Hedging
- Median Improvements and Guardrail
- Construction of Bus Bays & Road Widening
- Drain Improvements
- Traffic Signs, Road Markings and Other Appurtenances

(ii) Whereas for the section where, works taken by BBMP / are under progress or already tendered, only the following works are provisioned.

- Median Guardrail Provisioned
- Construction of Green Hedging
- Missing Sign Boards installation
- Selected Junction Improvements.

3.3.1 Preliminary Works:

Following works are considered under preliminary works along the project roads under Package 02, viz Old Airport Road, Sarjapura Road and Outer ring road from KR Puram to Silk Board. Clearing and grubbing is considered for removal and disposal of unwanted plants and waste materials from the project site. The damaged portion of Medians, Kerbs and Footpaths are proposed for Dismantling and refixing.

3.3.2 Carriageway Improvements: -

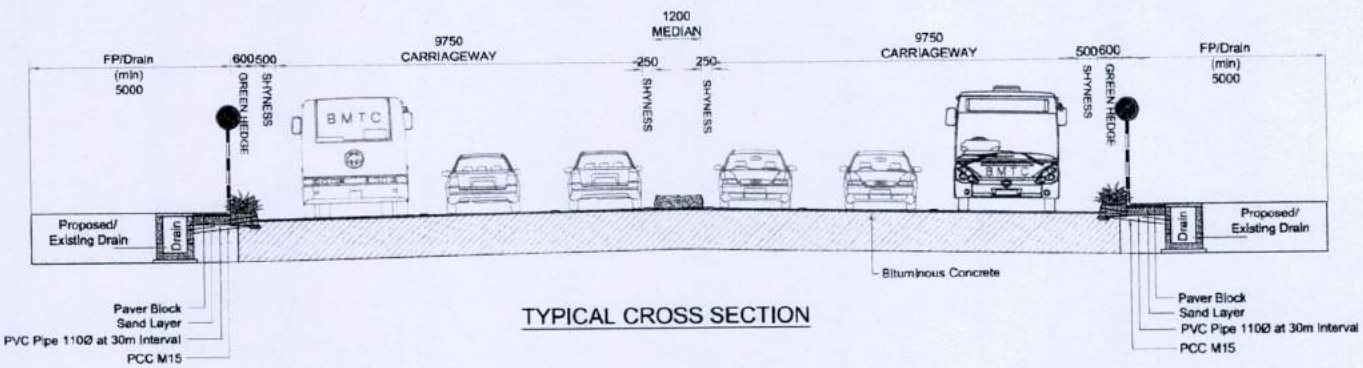
Uniform lanes: the carriageways are widened over a period of time and there's no standard lane widths at present, the outer lane widths varies and at few places, its less than the standard lane width. Based on tender sure experience the lane widths are standardized as below, the outer lane shall be of 3.5 m as buses move on this lane, center lane shall be 3.0 m as this is predominately LMV's for and inner lane shall be 3.25 m giving a shyness of 0.25 m for median. This is been done in discussion with DULT and BBMP as per the tender sure experience.

Resurfacing: Carriageway is proposed with functional overlay or strengthening and Overlay as per the pavement evaluation and overlay design. Prior to laying overlay, **milling of existing bituminous surface is considered in order to achieve required camber and to reduce profile correction course.** The carriage way is proposed

with uniform lane markings, and installation of raised pavement markers. Carriageway improvements are represented in volume 3 – Drawings.

Table 3.7 Table below shows resurfacing proposed

Sl No	Corridor Name	Chainage		Overlay Thickness, mm	
		From	To	DBM	BC
1	HDC 03: Old Airport Road	0+000	3+800	0	40
2		4+100	5+200		
3		5+500	10+800		
4		13+350	17+150		
5	HDC 04: Sarjapur Road	3+000	4+100	0	40
6	HDC 12c: ORR (KR Puram to Silk Board)	0+000	11+900	0	40



TYPICAL CROSS SECTION

3.3.3 Junction Improvements:

The selected junctions along the corridor are proposed with carriageway improvements, road markings, sign board installations, construction or modification of traffic channelizing islands. provision for precast new jersey barrier to guide the traffic. the junctions are redesigned in order to ensure safe maneuvering of vehicles and pedestrians. In coordination with police department few selected junctions which are not in initial improvement section are also considered for improvement. Junctions considered for improvement are tabulated below.

Old Airport Road: -

SI No	Junction Chainage	Junction Name
1	0+150	ASC Junction
2	0+650	Cambridge Road junction
3	1+250	ASC centre & College junction

with uniform lane markings, and installation of raised pavement markers. Carriageway improvements are represented in volume 3 – Drawings.

Table 3.7 Table below shows resurfacing proposed

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		From	To	DBM	BC
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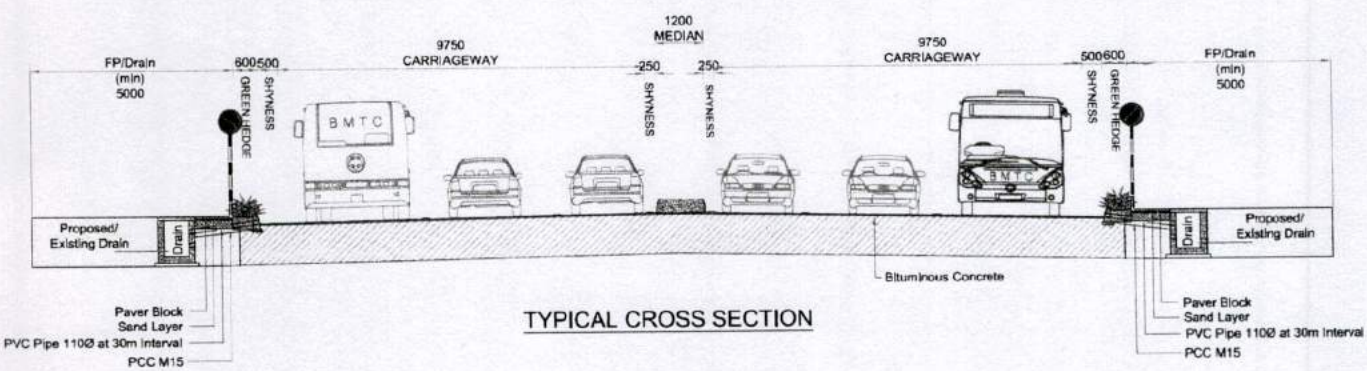
3		5+500	10+800		
4		13+350	17+150		
5	HDC 04: Sarjapur Road	3+000	4+100	0	40
6	HDC 12c: ORR (KR Puram to Silk Board)	0+000	11+900	0	40



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Old Airport Road: -

SI No	Junction Chainage	Junction Name
1	0+150	ASC Junction
2	0+650	Cambridge Road junction
3	1+250	ASC centre & College junction

SI No	Junction Chainage	Junction Name
4	2+400	Near Domlur flyover junction
5	3+500	80feet road junction
6	4+100	NAL wind tunnel road junction
7	8+000	Yamalur Junction
8	8+250	Doddanekundi main road junction
9	15+650	Immadihalli junction
10	16+500	Ambedkar Nagar road junction
11	0+150	ASC Junction
12	0+650	Cambridge Road junction

Sarjapur Road: -

SI No	Junction Chainage	Junction Name
Link-1		
1	3+800	Sarjapura-ORR junction
2	3+000	Cross road

Outer Ring Road KR Puram to Silk Board: -

SI No	Junction Chainage	Junction Name
1	2+800	Doddanekundi junction
2	6+550	Cross Road junction
3	8+300	New horizon college junction
4	9+050	Devarabeesanahalli Junction
5	10+250	Bellandur Junction

3.3.4 Footpath and Kerb

Footpath proposal includes construction of new walkways with interlocking paver blocks, where space is available or where existing footpath is in poor condition. In addition, replacement of damaged Kerbs and paver blocks are also considered.

Old Airport Road: -

SL No	From	To	Length in m (including both sides)
1	10+600	10+800	200

Sarjapur Road: -

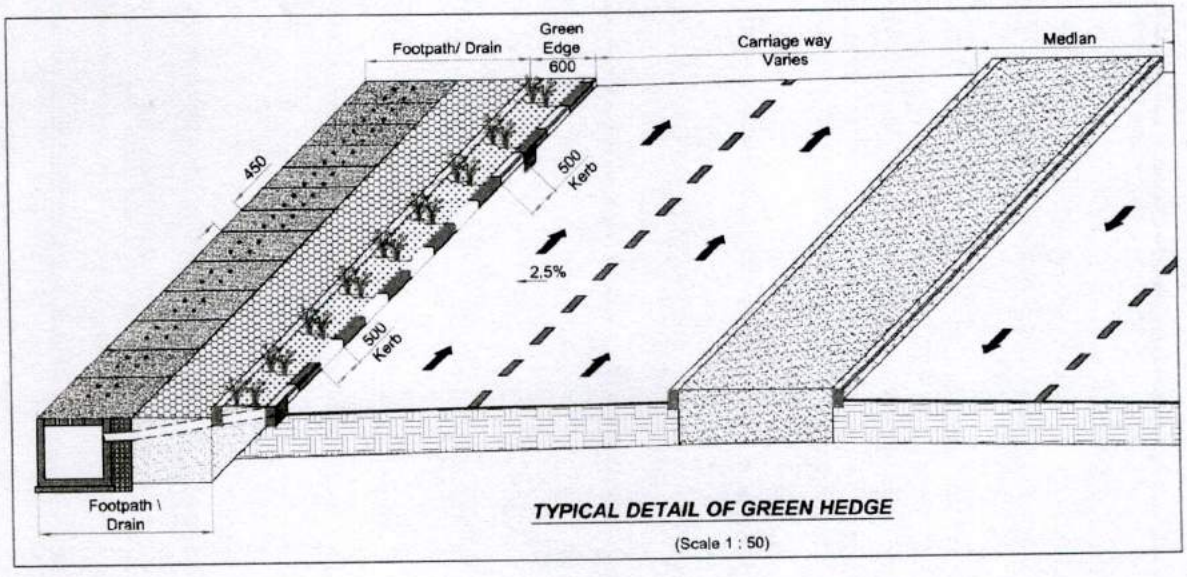
Provision is kept for 600m in the entire stretch for damaged or discontinued sections

Outer Ring Road KR Puram to Silk Board: -

SL No	From	To	Length in m (including both sides)
1	6+100	6+400	300
2	7+200	7+450	250
3	8+770	8+900	130
4	12+150	12+770	620
5	13+600	14+400	800
6	15+400	16+000	600
7	15+500	15+900	400

3.3.5 Green Hedging: -

With the intention to improve the aesthetics of the high-density corridors, Green Hedging is proposed on the footpath sides of the carriageway. the proposal includes installation of additional kerb line and supplying and spreading of farm yard Manure to support planting of permanent hedges. Green hedging is proposed at all feasible locations which are being improved by both BBMP or KRDCL. in addition, provision for chute drains is made along the Kerb line to guide the carriageway runoff to the drain. Cross sections indicating green hedging is represented below.



3.3.6 Median and Guard rail: -

Two types of median are considered for improvement one is the conventional median with both side Kerb with grassing and the other is 900mm standard new Jersey barrier. This is proposed in consultation with Traffic police department. The first type is considered where there is already existing convention median but in poor condition and the second type is considered as per the police requirement in places where there is existing low height concrete median or at specified places by the police department. Similarly, Guard rail is also proposed in two design, one is to install over conventional median and the second type is proposed to install over new jersey barrier in such a way to maintain uniform height. Typical section of median with guard rail is represented below.

Old Airport Road: -

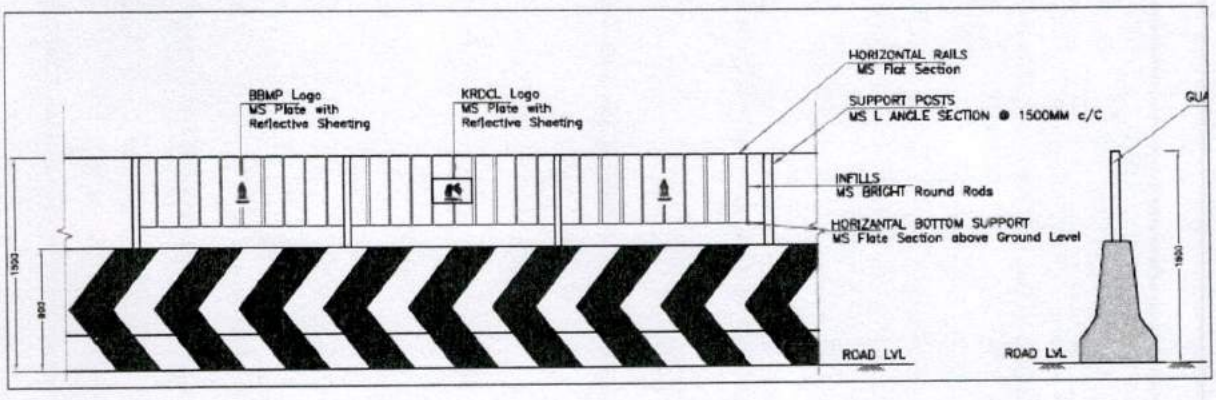
Sl No	From	To	Length in m
1	0+000	0+640	640
2	0+700	1+240	540
3	1+270	1+930	660
4	1+940	2+140	200
5	2+150	2+200	50
6	2+210	2+310	100
7	2+330	2+370	40
8	2+410	2+750	340
9	2+950	3+130	180
10	3+160	3+180	20
11	3+200	3+290	90
12	3+310	3+510	200
13	3+540	4+060	520
14	4+100	4+190	90
15	4+210	4+410	200
16	4+430	5+300	870
17	5+500	6+680	1180
18	6+720	6+950	230
19	6+990	7+220	230
20	7+230	7+840	610
21	7+860	8+000	140
22	8+030	8+250	220
23	8+260	8+480	220
24	8+510	9+960	1450
25	10+200	10+760	560
26	10+810	11+050	240
27	11+070	11+540	470
28	11+560	12+540	980
29	12+560	13+080	520
30	13+100	13+580	480
31	13+605	13+740	135
32	13+760	14+050	290
33	14+160	14+315	155
34	14+340	14+660	320
35	14+690	15+215	525
36	15+235	15+400	165
37	15+420	15+635	215
38	15+655	15+770	115
39	15+790	15+800	10
40	15+820	15+900	80
41	15+920	16+090	170
42	16+110	16+470	360
43	16+490	16+775	285
44	16+795	17+150	355

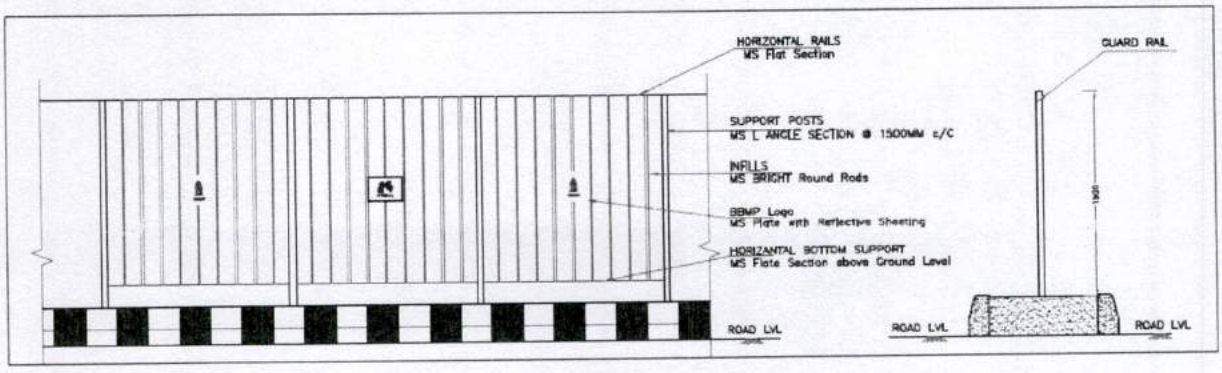
Sarjapur Road: -

Sl No	From	To	Length in m
1	0+100	0+600	500
2	1+650	4+000	2350
3	5+750	10+400	4650

Outer Ring Road KR Puram to Silk Board: -

SI No	From	To	Length, m
1	0+300	1+150	850
2	1+600	2+810	1210
3	3+100	3+700	600
4	3+900	5+500	1600
5	5+800	7+600	1800
6	7+950	9+200	1250
7	9+500	10+100	600
8	10+400	11+300	900
9	11+700	12+800	1100
10	13+460	14+550	1090
11	15+150	16+650	1500





3.3.7 Bus Bays: -

Improvement proposal of Existing bus bays includes pavement overlay in case of Flexible Pavement, Pavement Markings, and Sign Board installations. in Bellary road Existing bus bays are proposed for improvements as discussed. But, with respect to Old Madras road and Outer ring road project reaches new bus bays are proposed as required by traffic police department.

Old Airport Road: -

SI No	Bus bay Chainage	Location
2+700	Near Dommalur flyover	2+700
4+620	Rajeshwari Talkies	4+620
6+600	Near HAL Helicaptor Division	6+600
7+850	Borewell Busstop	7+850
10+550	Kundalahalli Gate	10+550

Sarjapur Road: -

SI No	Bus Bay Chainage	Location
1	3+800	Agara
2	6+220	Bellandur Gate
3	7+250	Kaikondanahalli Busstop
4	8+080	Junnasandra Gate
5	9+320	Doddakanahalli

Outer Ring Road KR Puram to Silk Board: -

SI No	Bus bay Chainage	Location
1	5+560	Near Marathahalli Underpass
2	7+650	Kadubeesanahalli

3.3.8 Drainage and Structural Improvements: -

Existing Drainage facility is studied along the project corridors, for availability and functioning, based on which it is proposed for construction of New Drain with cover slab and replacement of damaged cover slab. in addition, it is also provisioned for any emergency repairs of RE Wall portions of the Grade Separators.

Old Airport Road: -

Sl No	From	To	Length in m
1	0+900	1+400	500

Sarjapur Road: -

Sl No	From	To	Length in m
1	3+000	3+200	400
2	3+270	3+440	170 (LHS)
3	5+750	5+850	200

Outer Ring Road KR Puram to Silk Board: -

Provision has been made for 1.5Km length at damaged and discontinued section

3.3.9 Utility and Ducts

There are no proposals for shifting of utilities in these stretches, further the initial improvements are taken only for a part length of 191 kms, the provision of utility ducts is not considering as there will be no continuity of ducts if provided. Further it was decided in various meetings that the current project is of maintenance nature and utilities are in the scope of respective utility departments and KRDCL will focus on maintenance of road assets.

3.3.10 Road Markings, Traffic Signboards and other Appurtenances: -

Road Markings viz Edge lines, Centre lines, Pedestrian Crossings, Directional Arrows are proposed as per the standard requirements and as indicate in the drawings. Similarly raised pavement markers or Road studs are proposed along road markings, at Junctions, at HRPCs as per standards and as indicated in the Drawings. Different Type of Sign boards are provisioned for the project corridors and Appropriate Type & number of sign boards shall be Installed as per the Good for Construction Drawings. The provisions under this head also includes Road Delineators, Hazard markers, Bollards, Single arrow directional sign Boards, overhead gantry sign boards, Traffic Umbrella / KIOSK for Traffic Policemen, Traffic Signals, and Gratings at VUPs. Road Delineators are provided to demarcation of the Bus priority lane, turning demarcation and at edges of the islands. Hazard markers are provisioned for installation at approaches of all structures, at Median openings, etc. Single Arrow directional signboards are provisioned to aid in identification of cross roads, where the board is not available. Over Head Gantry Sign

Boards, Traffic KIOSKs and Traffic Signals are all included for costing as per the requirements of the traffic police department.

3.4 Annual Maintenance Proposals

As part of maintenance proposals, government has decided to go for a 5 years long term maintenance and during which the road has to be kept in the good condition for easy and safe movement of traffic and pedestrians at all time. **Road Maintenance** includes routine Maintenance, preventive Maintenance, periodic Maintenance, disaster Maintenance, exigencies and inspections.

- Periodic Maintenance: works such as re-surfacing of pavements may be required to restore the functional deficiencies that have developed over a time period. Which shall be decided based on functional and structural valuation studies.
- Routine Maintenance: Contractor shall carry out day-to-day site inspection of the designated road stretches and note done the damages that have occurred due to natural or artificial causes, they should take immediate steps to correct or rectify the damages. Routine Maintenance are undertaken by the maintenance staff almost round the year.
- Preventive Maintenance: The preventive maintenance is performed to improve or extend the functional life of pavement surface while in good condition. This may defer the need of periodic maintenance and rehabilitation
- Disaster Maintenance: Occasionally several damages are caused to roads cross drainage and other road assets. structures by floods or very heavy down pour or rains, though these may not occur every year. Under such circumstances works are to be completed as early as possible and the road infrastructure shall be restored so as to minimized the inconvenience to road users.
- Safety & Traffic Management – this includes enforcement of regulations together with the relevant authorities. Keep project roads safer, this also includes hazard response and Road patrols
- Asset management – this includes daily, routine and periodic inspections, Maintenance, repairs, housekeeping and emergency Maintenance

following are the maintenance activities suggested with Time limits for rectification.

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
A	Carriageway/Road surface, Hard shoulders, Drains and	

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
	Cross Drainage works, Bridges / Interchanges / Grade Separators (Fly Overs/ RUB/ ROB/ Under Pass / any other Road structure).	
1	Maintaining a public relations unit to interface with and attend to suggestions from the Users, government agencies, media and other agencies and deploying the required staff. Equipment Installation and Office setup (Large TV, Computers, Printers and other equipment), deploying Three non-technical and two technical staff	On or before 30 days from LOA
2	all surplus construction machinery and materials, waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project in a clean, tidy and orderly condition, and in conformity with Applicable Laws, Applicable Permits and Good Industry Practice.	Daily
3	Carriageway Sweeping using mechanical sweepers and footpath manual cleaning Minimum 4 vehicle mounted sweeping machines to be deployed all the debris/dust/litter shall be safely carried and disposed away at designated places.	Daily
4	Breach or blockade (the item of works shall be removal of fallen concrete wall, trees, electric pole etc.	Temporary restoration of traffic within 3 hours' permanent restoration within 7 days
5	Roughness not more than 2600mm/km for each lane in a km length (as measured by a standardized rough meter/bump integrator).	**As indicated in the Work order, for this work.**
6	Skid Resistance (Skid Number, SN; minimum Desirable shall be 55 SN	**As indicated in the Work order, for this work**
7	Potholes	24 hours
8	Cracking all types in less than 5% of road surface for each lane in a km length	3 (Three) days
9	Ravelling/Stripping of bitumen and all types in less than 5% of road surface for each lane in a km length	3 (Three) days
10	Settlement all types in less than 5% of road surface for each lane in a km length	3 (Three) days
11	Rutting exceeding 5 mm in more than 2% of road surface for each lane in a km length (measured ROMDAS or equivalent technology)	7 (Seven) days
12	Bleeding	3 (Three) days
13	Damage to pavement edges exceeding 100 mm	24 hours
14	Painting of Kerb, railing, parapets, crash barriers,	Twice every year

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
15	All types of Road Marking	Retro reflectivity mcd/m2/lux of 150 during the contract period / Twice every year
16	Joint Sealing in concrete pavement	7 (Seven) days
17	Replacement of Pavement Quality Concrete slabs	15 (fifteen) days
18	Rain cuts/gullies in slope	3 (Three) days
19	Damage to or silting of culverts and side drains during and immediately preceding the rainy season	3 (Three) days
20	Desilting of drains in Road side Drains	3 (Three) days
21	Cracks - Temporary measures	Within 48 hours
22	Spalling/scaling	3 (Three) days
23	Foundations-cavitation	3 (Three) days
24	Piers, abutments, return walls, RE-walls Cracks and damages including settlement and tilting Temporary measures	30 (Thirty) days
25	Bearings All type- Replacements	**As indicated in the Work order, for this work**
26	Joints in bridges: Loosening and malfunctioning of joints	**As indicated in the Work order, for this work**
27	Deforming of pads in elastomeric bearings	**As indicated in the Work order, for this work**
28	Gathering of dirt in bearings and joints or clogging of spouts, weep holes and vent-holes	3 (Three) days
29	Damage or deterioration in parapets and handrails	3 (Three) days
30	Rain-cuts or erosion of banks of the side slopes of approaches	3 (Three) days
31	Resurfacing of wearing coat	**As indicated in the Work order, for this work**
32	Damage or deterioration in approach slabs	3 (Three) days
33	Growth of vegetation affecting the structure or obstructing the waterway	3 (Three) days
B	**Foot Path/Medians/Drains**	
34	Manual cleaning of footpaths, all the debris/dust/litter shall be safely carried and disposed away at designated places	Daily
35	Damage to paver blocks or concrete surface or tiles of footpath	3 (Three) days
36	Damage to Kerbs, bollards, tree guards, pedestrian railings	3 (Three) days
37	Road side Drains and inlets	Should be Clean at all times
38	Damage to drain cover, walls	3 (Three) days
C	**Road safety and furniture including all road sign boards**	

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
	and pavement raised marking (road studs)	
39	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
40	Damaged/missing road signs requiring replacement	7 (seven) days
41	Painting of railing, parapets, crash barriers	Once every year
42	Reflective Pavement Markers (Road Studs) Numbers and Functionality as per specification in IRC :SP:84-2014 and IRC :35-2015, unless specified	At all times
43	Pedestrian Guard rail : Functionality: Functioning of guardrail as intended	At all times
44	Traffic Safety Barriers: Functionality: Functioning of Safety Barriers as intended	At all times
45	Overhead Sign Structures shall be structurally and functionally adequate	At all times
D	**Miscellaneous Works (Trees and Plantation, Road Patrol, Road Cutting Restoration, Road lighting**	
46	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
47	Deterioration in health of trees and bushes	Timely watering and treatment
48	Replacement/replanting of plants and bushes on medians, islands, footpaths and green edges	3 (Three) days
49	Removal of vegetation affecting sight line and road structures	3 (Three) days
50	Patrolling of roads by a vehicle of Bolero or equivalent with a driver, assistant and a supervisor at all times - 2 vehicles and two teams	All through the day
51	Restoration of road cutting as per IRC specifications Temporary Permanent	**As indicated in the Work order, for this work**
52	Road lighting	Not Included.
E	**Emergency Works**	
53	Removal of Fallen Trees	3 hours
54	Towing of Accident vehicle / Breakdown vehicle / Abandoned vehicle, mandatory deployment of: • LMV Towing vehicle –for towing of light commercial vehicles and below – 1 nos • HCV Towing vehicle –for towing of buses/ heavy commercial vehicles - 1 nos	1 hour
55	Water logging / Ponding on road surface / grade separators, mandatory deployment of Tippers, pumps, sucking machines, etc., as needed	1 hour

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
56	Fallen Street pole / Sign Boards / any other structure	1 hour

3.4.1 Traffic Incident Management

As a part of maintenance proposals, The Project corridors are required to Patrol continually through dedicated staff and Vehicle, to monitor any possible hindrance for the free flow of traffic and to ensure good condition of all Road Assets. Two patrol vehciles with staff are provided for each package of work

During the discussions with the police department, provision of cranes for toeing was asked to toe away the vehicles stranded, met in accident or illegally parked on HDC's. provision of two toeing vehicles one for heavy vehicles like buses and trucks and another for LMV's is proposed.

Water logging at selected locations is a perennial issue during rainy season, especially at underpasses. In the even of water logging, the provision of sucking machines, pumps and labour is also provisioned in the maintenance work.

CHAPTER 4: COST ESTIMATE

4.1 General

The Project cost is worked out based on estimated quantities from the detailed engineering design including road works, drainage works, pavement, culverts, road furniture, road safety appurtenances etc.

4.2 Construction Items

The following factors have been considered to arrive at the unit rates for various construction items.

The project cost estimates have been prepared separately for initial improvement works and Annual Maintenance works based on various items of works considered for the upgradation and annual maintenance of the project roads. The Major items rates are considered from **PWP IWTD SoR 2018-19, Bangalore Circle,** Govt. of Karnataka along with latest issue rates, and for few items derived rates are adopted.

Table 4.1 Adopted Unit Rates for Some of the Major Items (Excluding Area Weight Factor)

Sl. No.	Items	Unit	Rate
1	Milling of Existing Bituminous Layer	Sqm	70.00
2	Granular Sub base	Cum	1882.00
3	Wet Mix Macadam	Cum	1888.00
4	Dense Bituminous Macadam (DBM)	Cum	6045.00
5	Bituminous Concrete (BC)	Cum	6939.00
6	Interlocking Paver Blocks	Sqm	1110.00
7	M15 for Kerb Laying	Cum	5422.00
8	Kerb	Nos	450.00
9	Painting two Coats for Kerb	Sqm	82.00
10	Yard Manure	Cum	204.00
11	Planting permanent hedge	Mt	296.00
12	Tree Guard / Grating and Median guard Rail	Quintal	7187.00
13	Providing and Laying M20 for Drain	Cum	6670.00
14	Steel Reinforcement	Tonnes	61365.00
15	Road Marking- Thermoplastic	Sqm	429.00
16	Moulded Shank Raised Pavement Markers	Nos	337.00

4.3 Project Costing

Quantification

The quantification of various items of work is based upon the proposals recommended in the previous chapters. The quantities have been worked out separately for different items of work. The construction cost has been sub - divided into Preliminary Works, Carriageway improvement, Junction Improvement, Footpath and Kerbs, Medians and guard rails, Bus bays and Road Widening Works, Drainage Improvement and other structural Works, Traffic signs, Marking and other Appurtenances.

The following are the Bill wise of works, which have been estimated:

Preliminary Works including Dismantling, Clearance and Earthworks: The area considered for Site Clearance is the area within the proposed Right of Way width. and the damaged portions of Median Kerbs, and Footpath are proposed for dismantling.

Carriageway Improvements: Carriageway improvements costs includes Milling of existing bituminous surface, Strengthening and overlay as per the structural evaluation and Pavement design.

Junction Improvements: Junction improvement cost includes overlay for carriageway, Road markings, installation of sign Boards, High raised pedestrian crossings, construction of channelization islands as per the requirement.

Footpath and Kerbs: Footpath works cost includes removal of damaged paver blocks, kerb stones, etc and replacement with the new ones. In addition, the costing also includes the Green Hedging provision along the footpath

Median and Guardrail: The estimation of quantities for Median construction were based on site inventory, and Median Guard rails for pedestrian safety as per police department instruction is considered .

Bus Bays and Road Widening Works: The estimation of quantities for Bus bays and road widening works were based on the police department requirements , detailed design and drawings.

Drainage Improvement and Structural Works: Provision under this sub-head has been made for cost for construction of side drains, and repairs of RE wall.

Traffic Sign, Markings and Other Appurtenances: Proper traffic signs were selected at required locations along the project corridor. It is reviewed considering the traffic, pedestrian safety, and modified if required. Centre line and edge markings required

from safety point of view were considered in the quantity estimate.

4.4 Total Project Cost

The total project cost of **package 2** is **111.86 Crores**, which includes Initial Improvement cost of **64.50 Crores**, Annual maintenance cost of **21.75 Crores**, 12% for GST, 5% Administration Charges, 3% for DPR and PMC charges, 10% Contingencies. The summary of the project is given in **Table 4.2** below for Total Project Cost along with Road Wise Cost Summary.

The detailed rate analysis and quantity estimation is given in Volume-3: Cost Estimate.

Table 4.2: Summary of Cost for the Project

Sl. No	Description	HDC 03	HDC 04	HDC 12C	Package II
		Amount (Crores)	Amount (Crores)	Amount (Crores)	Amount (Crores)
1	Preliminary Works including Dismantling, Clearance and Earthworks	0.16	0.03	0.27	0.45
2	Carriagway Improvements	11.56	1.03	10.02	22.61
3	Junction Improvements	1.71	0.64	1.53	3.88
4	Footpath and Kerbs	6.56	3.41	6.28	16.26
5	Median and Guardrail	4.87	2.37	3.98	11.21
6	Bus Bays and Road Widening Works	0.28	0.21	0.19	0.68
7	Drainage Improvement and Structural Works	0.72	0.94	2.03	3.69
8	Traffic Sign, Markings and Other Appurtenances	2.32	0.70	2.69	5.72
A.	**Initial Improvement Cost**	28.17	9.33	26.99	**64.50**
B.	**Annual Maintenance Cost**	7.38	4.04	10.34	**21.75**
C.	**GST @ 12% of (A+B)**	4.27	1.60	4.48	**10.35**
D.	**Administrative Charges @ 5% on (A+B)**	1.78	0.67	1.87	**4.31**
E.	**DPR & PMC Charges @ 3% on (A+B)**	0.93	0.48	1.08	**2.49**
F.	**Contingencies @ 10%**	3.13	1.44	3.84	**8.42**
G.	**Miscellaneous and Rounding off**	0.01	0.02	0.01	**0.04**
H.	**Total Project Cost (A+B+C+D+E+F+G)**	45.67	17.58	48.61	**111.86**

4.5 Implementation Plan

An implementation plan refers to a detailed description of actions that demonstrate how to implement an activity within the project in the context of achieving the objectives,

addressing the requirements, and meeting the expectations. The above project is to be implemented in two forms.

1. Initial Improvement and
2. Maintenance

Initial Improvement: Initial improvement is to be done within first nine months of the project tenure year for carriage way, Junctions improvements, Footpath and Drain improvements, Traffic lane markings and sign boards, median island improvements and providing green edge in ongoing BBMP Tender works.

Maintenance: The proposed project roads are to be maintained periodically by clearing of pavement, Repair of traffic signs and road markings, Repair of damage caused by traffic accidents. The project corridors are to be maintained for 5 years.

4.6 Packaging

The Total Length of the all the high-density corridor is 191 Km which is spreader over the entire Bengaluru city. this will make the task of maintaining the road very cumbersome, as it will be very difficult to accesses, Monitor and control the activities over entire length. Hence the Total 15 roads of high-density corridors are grouped in to four packages, such that it will be convenient to Access, Monitor and control the different activities running along the corridor within each package.

4.7 Time Schedule.

The duration for the initial improvement works is 270 days covering various stages of work. The time schedule of the Project along with work programme of activities is given below.

Sl. No	Description	Duration	Start Date	End Date
A	**Initial Improvement Works**	**270 Days**	**01-04-2021**	**31-12-2021**
1	Strengthening/Resurfacing, Road Marking, Traffic Signs for Priority Stretches	90 Days	01-04-2021	30-06-2021
2	Drainage and Utility Works	90 Days	01-04-2021	30-06-2021
3	Footpath and Kerbs	90 Days	01-05-2021	31-07-2021
4	Median and Guardrails	60 Days	01-07-2021	31-08-2021

Sl. No	Description	Duration	Start Date	End Date
5	Junction Improvements	60 Days	01-09-2021	31-10-2021
6	Strengthening/Resurfacing, Road Marking, Traffic Signs Road Appurtenances for Other Stretches	90 Days	01-10-2021	31-12-2021

The Annual Maintenance works needs to be executed continually throughout the year for the project duration of 5 Years.

Design Traffic Calculation for overlay design - Old Airport Road

YEAR	LCV		BUS		TWO AXLE		THREE AXLE TRUCK		MULTI AXLE		Total Yearly Standard Axle	Design Cumulative Standard Axle
	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles		
2021	1656	0.453	1574	0.431	547	0.749	459	0.628	81	0.111	2	
2022	1739	0.476	1653	0.452	574	0.786	482	0.660	85	0.116	2	2
2023	1826	0.500	1735	0.475	603	0.825	506	0.693	89	0.122	3	5
2024	1917	0.525	1822	0.499	633	0.867	531	0.727	94	0.128	3	7
2025	2013	0.551	1913	0.524	665	0.910	558	0.764	98	0.135	3	10
2026	2114	0.579	2009	0.550	698	0.956	586	0.802	103	0.141	3	13

Design Traffic Calculation for overlay design - Sarjapura Road

YEAR	LCV		BUS		TWO AXLE		THREE AXLE TRUCK		MULTI AXLE		Total Yearly Standard Axle	Design Cumulative Standard Axle
	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles		
2021	1135	0.311	2200	0.602	299	0.409	286	0.391	6	0.008	2	
2022	1192	0.326	2310	0.632	314	0.430	300	0.411	6	0.009	2	2
2023	1251	0.343	2426	0.664	330	0.451	315	0.432	7	0.009	2	4
2024	1314	0.360	2547	0.697	346	0.474	331	0.453	7	0.010	2	5
2025	1380	0.378	2674	0.732	363	0.497	348	0.476	7	0.010	2	7
2026	1449	0.397	2808	0.769	382	0.522	365	0.500	8	0.010	2	10

Design Traffic Calculation for overlay design - ORR KR Puram to Silk Board

YEAR	LCV		BUS		TWO AXLE		THREE AXLE TRUCK		MULTI AXLE		Total Yearly Standard Axle	Design Cumulative Standard Axle
	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles		
2021	3614	0.791	3716	0.814	1455	1.593	746	0.817	207	0.227	4	
2022	3795	0.831	3902	0.854	1528	1.673	783	0.858	217	0.238	4	4
2023	3984	0.873	4097	0.897	1604	1.757	822	0.901	228	0.250	5	9
2024	4184	0.916	4302	0.942	1684	1.844	864	0.946	240	0.262	5	13
2025	4393	0.962	4517	0.989	1769	1.937	907	0.993	252	0.276	5	18
2026	4612	1.010	4743	1.039	1857	2.033	952	1.043	264	0.289	5	23

Design Traffic Calculation for overlay design - ORR KR Puram to Silk Board

YEAR	LCV		BUS		TWO AXLE		THREE AXLE TRUCK		MULTI AXLE		Total Yearly Standard Axle	Design Cumulative Standard Axle
	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles	AADT (Veh/day)	Yearly Standard Axles		
2021	3614	0.791	3716	0.814	1455	1.593	746	0.817	207	0.227	4	
2022	3795	0.831	3902	0.854	1528	1.673	783	0.858	217	0.238	4	4
2023	3984	0.873	4097	0.897	1604	1.757	822	0.901	228	0.250	5	9
2024	4184	0.916	4302	0.942	1684	1.844	864	0.946	240	0.262	5	13
2025	4393	0.962	4517	0.989	1769	1.937	907	0.993	252	0.276	5	18
2026	4612	1.010	4743	1.039	1857	2.033	952	1.043	264	0.289	5	23

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Annexures 3.1
Details from BBMP

MAINTENANCEOF HIGH DENSITY CORRIDORS IN BENGALURU CITY

HDC No -03 Old Airport Road Corridor

Sl No	Chainage to Km		Location		BBMP Department	Ongoing Works / Completed works implemented by	Works Considered by KRDCL for Initial Improvement	Maintainenace Proposal
	From	to	From	to				
Link 03- ASC Center to Hope farm Junction								
1	Ch 0.00	Ch 3.80	ASC Center	HP Petrol Bunk	RI - East	-	Proposed Improvement by KRDCL	1.. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
	Ch 3.80	Ch 4.10	HP Petrol Bunk	Coffe day		SFC in progress by Project Central BBMP	-	
	Ch 4.10	Ch 5.20	Coffe day	HAL Starting gate		-	Proposed Improvement by KRDCL	
	Ch 5.20	Ch 5.50	HAL Starting gate	Suranjandas road		SFC in progress by project central BBMP	-	
2	Ch 5.50	Ch 6.90	Suranjandas road	Yemalur Junction	RI-KR Puram	-	Proposed Improvement by KRDCL	
3	Ch 6.90	Ch 10.80	Yemalur Junction	ITPB	RI-Mahadevapura	-	Proposed Improvement by KRDCL	
	Ch 10.80	Ch 11.10	ITPB	Ganesh Juice Center		SFC in progress by project central BBMP	-	
	Ch 11.10	Ch 17.150	Varthur Kodi	Hope Farm Junction		-	Road Improvement taken up by KRDCL	
Length of Corridor			17.150 Km					

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I-EAST) EE (RI-KRPURAM) EE (RI-MAHADEVAPURA) EE (KRDCL-SOUTH)

MAINTENANCEOF HIGH DENSITY CORRIDORS IN BENGALURU CITY

HDC No -04 Sarjapura Road Corridor

No	Chainage to Km		Location		BBMP Department	Ongoing Works / Completed works implemented by	Works Considered by KRDCL for Initial Improvement	Maintainenace Proposal
	From	to	From	to				
Link 04 St Johns Hospital to Agara, Iblur Junction to Carmelram Bridge								
1	Ch 0.00	Ch 3.00	Hosur Road	Jakkasandra	RI - South	White topping work in progress by Project Central (BBMP)	-	1.. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries. roadside silt. C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch 3.00	Ch 4.10	Jakkasandra	Agara	RI-Bommanahalli	-	Proposed Improvement by KRDCL	
3	Ch 0.00	Ch 4.75	Iblur Junction	Carmelram Bridge	RI-Mahadevapura	Proposed Improvement by RI- ~~Mahadevapura~~ (BBMP) (Road Widening)		
	Length of Corridor		8.85 Km					

Executive Engineer
Infrastructure - South
ngalore Mahanagara Pa...

ಕಾರ್ಯಪಾಲಕ ಅಭಿಯಂತರರು
ಪಶ್ಚಿಮ ಮೂಲಭೂತ ಸೌಕರ್ಯ, ಬೊಮ್ಮನಹಳ್ಳಿ ವಿಭಾಗ
ಬೃಹತ್ ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪಾಲಿಕೆ

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MAINTENANCEOF HIGH DENSITY CORRIDORS IN BENGALURU CITY

Summary of Works Under HDC No -12 B KR Puram to Silk Board Road Corridor

Sl No	Chainage to Km		Location		BBMP Department	Ongoing Works / Completed works implemented by	Works Considered by KRDCL for Initial Improvement	Maintainenace Proposal
	From	to	From	to				
Silk Board to Lowry Junction								
1	Ch 0.00	Ch 3.20	Silk Board	Agara	RI · Bommanahalli	Proposed improvement under RI-TEC		1.. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch 3.20	Ch 5.10	Agara	Iblur junction	RI· Bommanahalli	Proposed improvement under RI·Bommanahalli		
3	Ch 5.10	Ch 16.50	Iblur	Lowry Junction	RI· Mahadevapura	This Road has already developed by R.I Mahadevapura and it is under DLP	Proposed Improvement by KRDCL	
	Length of Corridor		16.50 Km					

ಕಾರ್ಯಪಾಲಕ ಅಭಿಯಂತರರು
ಮೂಲಭೂತ ಸೌಕರ್ಯ, ಮಹದೇವಪುರ ವಿ
ಬೃಹತ್ ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪಾಲಿಕೆ

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CHAPTER 1: INTRODUCTION

1.1 Project Background

Bangalore is one of the fastest growing cities in Asia and also one of the most sought - after cities in India by people, companies and multinationals. The massive growth that the city has witnessed in the last decade is a clear indication of this city being developed to be at par with the most modern cities in the world. The population of Bangalore has grown enormously on account of migration of people from all corners of India, neighboring countries and from countries in the West. Bengaluru 's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets.

The main arterial roads of Bengaluru coming into the city include Bellary Road in the north, Tumkur Road and Mysore Road in the west, Kanakapura Road, Bannerghatta Road and Hosur Road in the south and Airport Road and Old Madras Road in the east, these high-volume traffic arterial roads are inter connected with Outer Ring Road. Bangalore Commissioner of Police notified these 12 Major Roads connecting inter-districts and inter-states as High Traffic Density Corridors vide Notification dated:03-09-2016, and are named as High-Density Corridors.

Roads, and means of transport, make a crucial contribution to economic development and growth and bring important social benefits. Poorly maintained roads constrain mobility, significantly raise vehicle operating costs, increase accident rates and their associated human and property costs. Deterioration of constructed pavement is natural. It's natural because over time the materials that make up Bitumen begin to break down and become affected by elements such as rain, sunlight and chemicals that come into contact with the pavement surface. The liquid Bitumen binder that is the "glue" of the pavement begins to lose its natural resistance to water, allowing it to penetrate into and underneath the pavement. Once this happens, the surface can quickly fall prey to a number of different types of deterioration.

The construction and maintenance of roads to address the growing traffic in the city has been a challenge to the BDA and the BBMP. To reduce the pressure of hectic maintenance activities for BBMP and to ensure the effective maintenance of high-volume traffic arterial roads it has been proposed to handover the maintenance of High-density corridors to KRDCL.

The decision has been taken in the meeting held on 06-11-2019 under the Chairmanship of Hon'ble Chief Minister, Govt. Of Karnataka for Upgradation and maintenance of 12 High Traffic Density Corridors as per IRC guidelines to be taken by Karnataka Road Development Corporation Ltd.

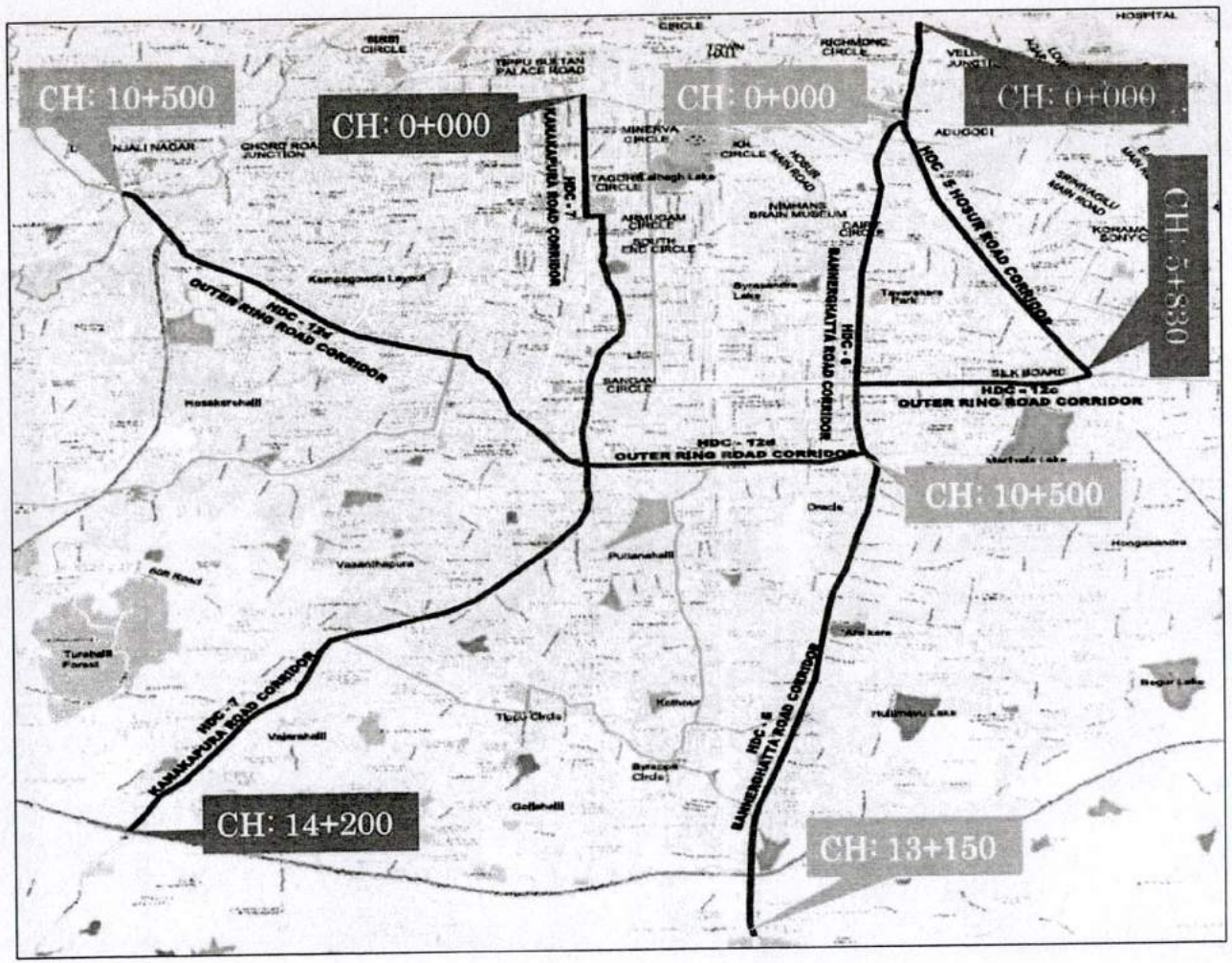
Karnataka Road Development Corporation Limited (KRDCL) was incorporated on 21st of July 1999 as a wholly owned Government of Karnataka Company as per the Provisions of the Company's Act, 1956. The company is managed by a Board of Directors chaired by Principal Secretary to Government, PWP and IWID with Members from other organizations.

KRDCL is a company under the Public Works, Ports & Inland Water Transport Department. This Company was established to promote surface infrastructure by taking up Road Works, Bridges etc., and to improve road network by taking up construction, widening and strengthening of roads, construction of bridges, maintenance of roads etc., and to take up projects on BOT, BOOT, BOLT. With the emerging industrial and economic development of the past few decades, there has been a tremendous growth in terms of the traffic on all the roads

Karnataka Road Development Corporation Limited (KRDCL) has appointed ***M/s Infra Support Engineering Consultants Pvt Ltd*** (ISECPL) as consultants for Preparation of DPR and Project Management Consultancy (Including Detailed Designs) for High Density Corridors (HDC) Package - 2 in Bengaluru, Karnataka comprising of the following roads: [HDC 5: Hosur Road, HDC 6: Bannerughatta Road, HDC 7: Kanakpura Road, HDC12d: Outer Ring Road. Total Length 91.85 Km (Approximate)".

Table 1.1: Length of Project Corridors in Package 3

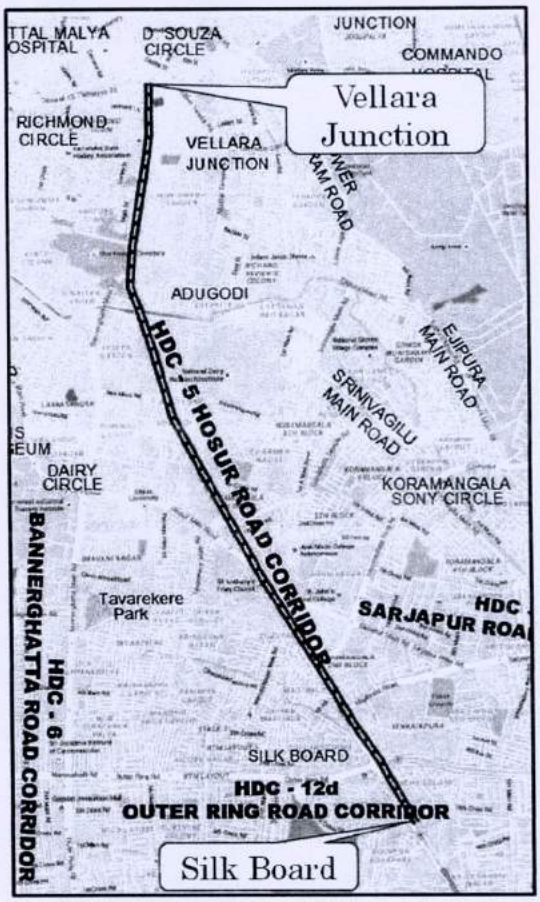
Sl. No	Name of the Road / Junction	Project length considered in km
	Package - 3	
1	HDC 5: Hosur Road - from Vellara Junction to Silk Board via Madiwala.	**6.45**
2	HDC 6: Bannerugatta Road - from Hosur Road to Bannerghatta via Jayadeva, Jedimara, Kolifarm.	**16.50**
3	HDC 7: Kanakpura Road – from KR Road to Nice Road via Banashankari, Konanakunte Cross	**14.50**
4	HDC 12d: Outer Ring Road – from Silk Board to Nayandanahalli via Jayadeva jn. Jedimara, Sarakki	**12.00**
	Total length in Km	**91.85**



Index Map of Project Road

HDC 5: Hosur Road - from Vellara Junction to Silk Board via Madiwala.

The scope of work for the stretch HDC No. 5 starts at Vellara Junction on Hosur Road and ends at Silk Board via Madiwala with a total length of 6.45 Km. This road has 4 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. This road experiences heavy commercial vehicles movement. A sketch indicating the alignment plan is shown below.,

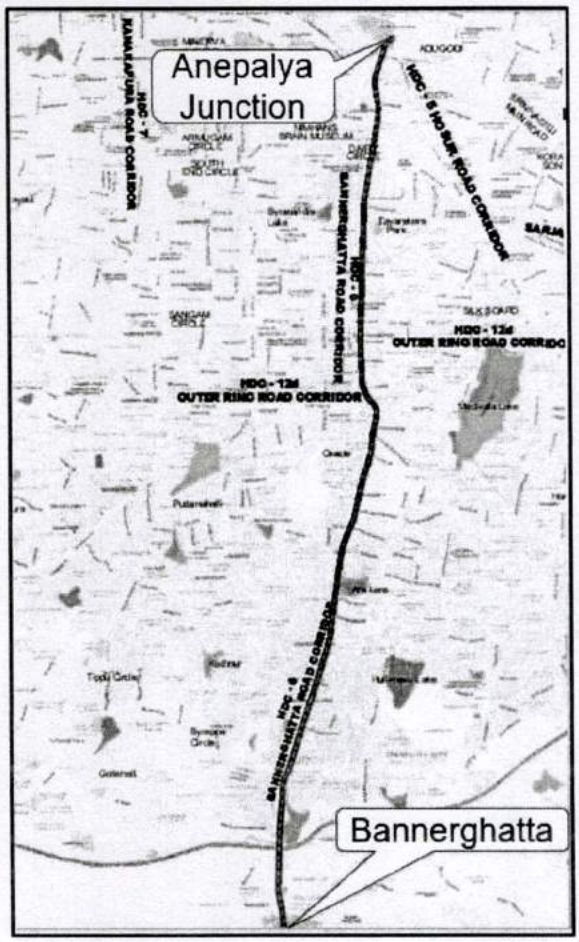


Index	
Work considered by KRDCL for Initial Improvements	0.00 Km
Ongoing / Tendered works under BBMP	6.45 Km
Total Length	**6.45 Km**

Figure 2.1 Key Plan of Alignment (Hosur Road)

HDC 6: Bannerugatta Road - from Hosur Road to Bannerghatta via Jayadeva, Jedimara, Kolifarm.

The scope of work for the stretch HDC No.6 Bannerugatta Road from Hosur Road to Bannerghatta starts at Hosur Road and ends at Bannerghatta via Jayadeva, Jedimara, Kolifarm with a total length of 16.50 Km. This road has 4/6 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below

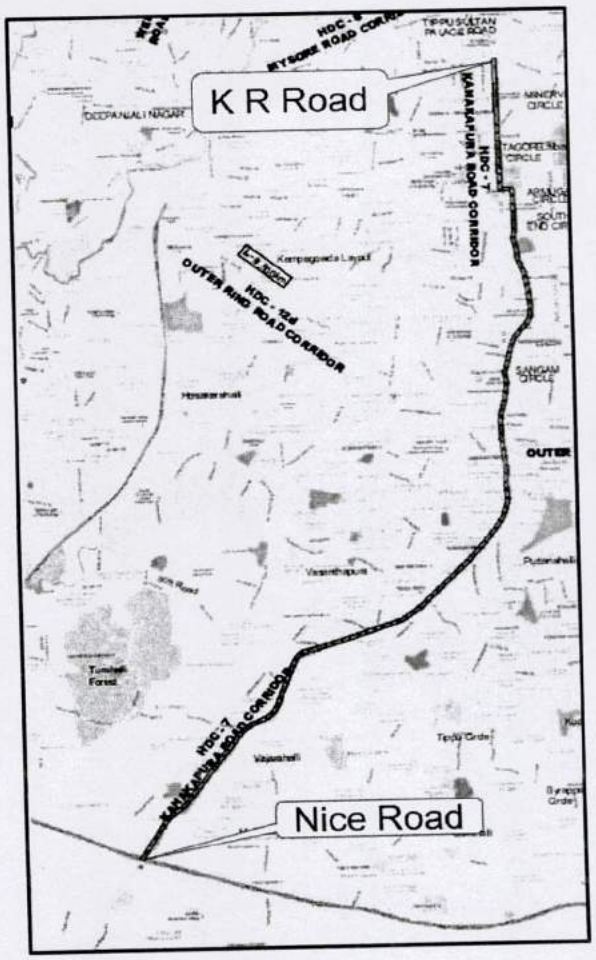


Index	
Work considered by KRDCL for Initial Improvements	0.00 Km
Ongoing / Tendered works under BBMP	6.90 Km
Ongoing / Tendered works under BMRCL	9.60 Km
Total Length	**16.5 Km**

Figure 2.2 Key Plan of Alignment (Bannerughatta Road)

HDC 7: Kanakpura Road - from KR Road to Nice Road via Banashankari, Konanakunte Cross

The scope of work for the stretch HDC No.7 Kanakpura Road from KR Road to Nice Road starts at KR Road and ends at Nice Road with a total length of 14.50 Km. This road has 4 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below.

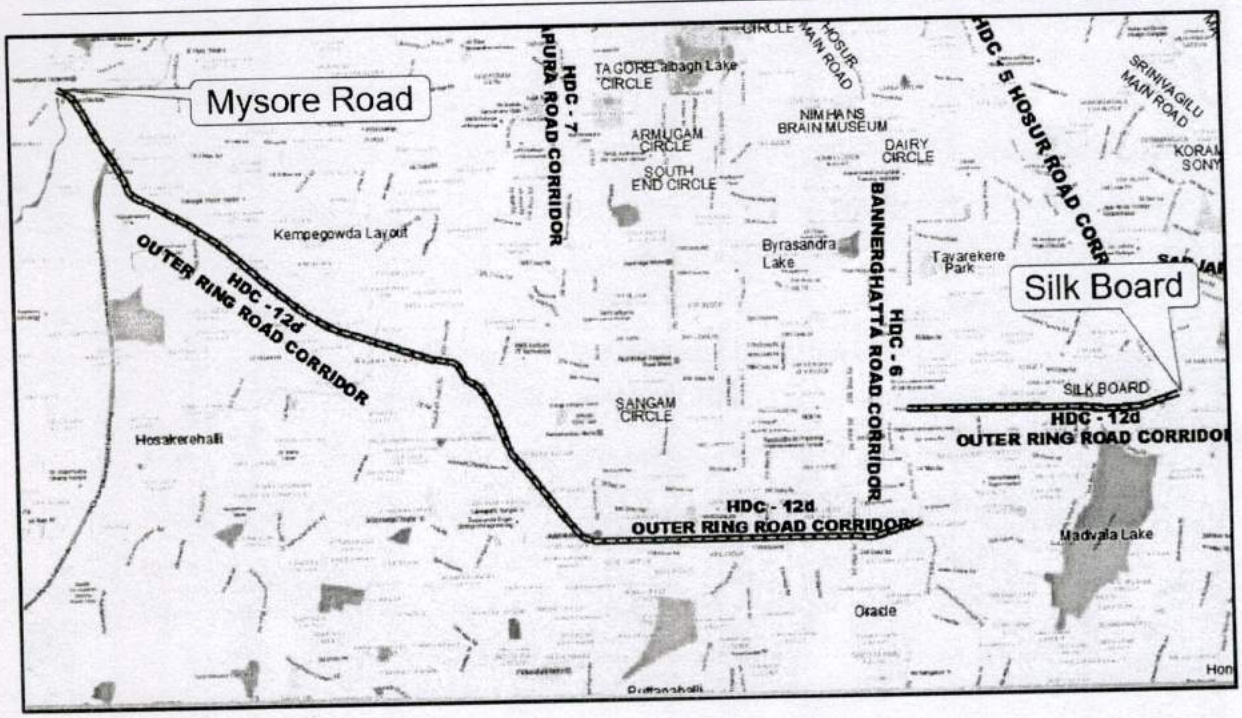


Index	
Work considered by KRDCL for Initial Improvements	0.50 Km
Ongoing / Tendered works under BBMP	8.30 Km
Ongoing / Tendered works under BMRCL	5.70 Km
Total Length	**14.5 Km**

Figure 2.3 Key Plan of Alignment (Kanakapura Road)

HDC 12d: Outer Ring Road – from Silk Board to Nayandanahalli

The scope of work for the stretch HDC No.12d Outer Ring Road starts at Silkboard and ends at Nayandanahalli with a total length of 12.00 Km. This road has 4/6 lane divided Carriageway. This stretch is the mix of commercial and residential layouts on both sides. A sketch indicating the alignment plan is shown below.



Index	
Work considered by KRDCL for Initial Improvements	0.00 Km
Ongoing / Tendered works under BBMP	9.80 Km
Ongoing / Tendered works under BMRCL	2.20 Km
Total Length	12.00 Km

Figure 2.4 Key Plan of Alignment (Outer Ring Road – Silk Board to Mysore Road)

1.2 Objective of the Project

The objective of the consultancy Services is to provide the required technical services to KRDCL in preparation of Detailed designs, Drawings, Estimations, Assisting in Tender Processes, and Project Management including construction supervision, maintenance supervision of the High-Density Corridors.

The following works are intended to be carried out on the Project Road:

1. Identification of possible improvements in the existing alignment.
2. Improvement of drainage at poor drainage locations and clear identification of the same on the drawings.
3. Rehabilitation /Reconstruction of bridges and culverts where necessary,

4. Improvement to junctions/intersections
5. Improvement of sidewalks with all required appurtenances like bollards, chamber covers, landscaping, access to properties, lighting etc.
6. Improvements to Signage, road markings
7. Street lighting of the corridor
8. Requirement for Provision of pedestrian facilities
9. Requirement for Improvement of junctions/intersections.
10. Assessing the Provision of road furniture and adequate road markings.
11. Assessing the Provision of traffic control devices where appropriate.
12. Preparation of roadway plans, sidewalk, median and all required drawings to be issued for good for construction.
13. Preparation of BOQ, specifications, estimates.
14. Preparation of routine maintenance intervals and specifications.
15. Presentations, meetings and discussions with various stakeholders in city.
16. Assisting in Preparation of bidding documents (schedules, specifications and drawings).
17. Bid processing assistance.

1.3 Scope of the Project

The broad scope of work encompasses

Stage 1: Carrying out surveys, investigations, detailed designs on the project roads, estimation, costing and submission of good for construction drawings

and

Stage 2: Project management including construction supervision, maintenance supervision, progress reports and PMS uploading.

Following is the brief scope of work as extracted from the RFP Document for Stage 1.

- Analysis of Available Reports and data's from KRDCL, BBMP and other departments.
- Survey and investigations of the Project Road
- Traffic Studies and Analysis
- Road safety assessment
- Pavement Structural Strength
- Topographic Survey

- Bridge / Structures Inventory and Condition Survey
- Hydrology and Drainage Investigations
- Pavement crust thickness
- Detailed Design
- Report and Drawings
- Bid process management

1.4 Meetings with Clients and Stakeholders

During the course of preparation of DPR meetings are held with client and Stakeholders for finalization of improvement proposals and other technical aspects. Following Meetings were held with various stakeholders for administration and Technical approval.

Sl No	Meeting held on	Meeting Chaired by	Meeting Location
1	30/11/2020	Additional Chief Secretary, PWD	Vikasa Soudha
2	1/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
3	2/12/2020	DULT Commissioner	DULT office
4	11/12/2020	Additional Commissioner, Bangalore Traffic Police	Bangalore Traffic Centre
5	11/12/2020	Additional Chief Secretary, PWD	Vikasa Soudha
6	16/12/2020	Managing Director, KRDCL	KRDCL Office
7	24/12/2020	Chief Secretary	Vidhana Soudha
8	29/12/2020	DULT Commissioner	Online
9	4/1/2021	Chairman, Technical committee	KRDCL Office
10	8/1/2021	ACS, UDD	Vikasa Soudha
11	12/1/2021	ACS, UDD	Vikasa Soudha
12	13/1/2021	ACS, UDD	Vikasa Soudha
13	30/11/2020	Additional Chief Secretary, PWD	Vikasa Soudha

1.5 Structure of the Report

The Draft Project Report has been structured as follows.

Volume – 1: Main report

Chapter 1 : Project back ground

Chapter 2 : Surveys and investigations carried out and Interpretation of data

Chapter 3 : Improvement Proposals

Chapter 4 : Cost Estimation

Annexures

Volume – II: Drawings

Strip Plan

Plan with Sections

Standard Drawings

Volume – III: Cost Estimation

Bill of Quantities - Package 1

Bill of Quantities – Individual Roads in Package 1

Cost Estimation - Individual Roads in Package 1

Rate Analysis

Volume – IV: Schedules

Schedule A: Existing Features

Schedule B: Initial Improvement Proposals.

Schedule C: Specifications and Standards

Schedule D: Interim Milestones for Initial Improvement Works

Schedule E: Applicable Permits

Schedule F: Maintenance Requirements

Schedule G: Control and Command Centre

Schedule H: Payments Schedule

Schedule I: Safety Requirements

Schedule J: Inter-Departmental Coordination Standard Operating Procedure (Sop) & Support Agreement

Schedule K: Format of Bank Guarantee for Performance Security.

Schedule L: Appointment of Project Management Consultant

Schedule M: Format of Bank Guarantee for Advance Payment

Schedule N: Change of Scope Formats

Schedule O: Work Order Format for Additional Works

CHAPTER 2: SURVEYS AND INVESTIGATIONS

2.1 Introduction

This chapter deals with various surveys and Investigations carried out as per the Terms of Reference and required for quality compliance of the Project design and report preparation.

Major surveys and Investigations carried out are as follows:

- Road Inventory
- Pavement condition survey
- Structural Inventory
- Traffic surveys
- Topographic surveys
- FWD Survey

2.2 Road Inventory and Condition Surveys

2.2.1 Road Inventory

Road Inventory surveys have been conducted. Surveys are carried out as per the standard methodology / IRC guidelines. However brief methodology is given below:

As per the ToR consultants have to propose improvement proposals for the existing roads along the project corridors. Hence, the road and bridge inventory and condition surveys were conducted accordingly.

The road inventory survey involves making visual estimates and actual measurements of geometric and cross-sectional elements of the road and its deficiencies. This survey involves the collection of the data pertaining to the existing road such as the pavement type, width of the carriageway, type of the shoulder and its width, condition of road, type and condition of drain, footpath, median islands, number of CD structures, available land widths etc. Road inventory has been recorded in a standard format.

The team has travelled and walked along the alignments and adjacent roads collected first-hand information on the width and type of carriage way, type and condition of road, junctions, traffic intensity, width of footpath cum drains, Median islands, cross drainage structures, Bus stops/Bus bays/Bus shelters and relevant details of Grade separators, Metro Rail crossings and skywalks comprising in the proposed High-Density corridor are noted.

2.2.2 Right of Way

The Right of way details for the project road is taken by measuring drain to drain or footpath outer edge at regular intervals, RoW vary from 12m to 60 m. Details of RoW is shown in below table

Table 2.1: Table showing details of RoW along for HDC-05 Hosur Road

From in Kms	To in Kms	Length in m	ROW in m
0+000	000+230	230.00	18.3
0+230	000+330	100.00	18.4
0+330	000+450	120.00	16.4
0+450	000+520	70.00	18.3
0+520	000+780	260.00	23.0
0+780	000+830	50.00	22.2
0+830	000+960	130.00	14.7
0+960	001+090	130.00	14.7
1+090	001+150	60.00	16.9
1+150	001+280	130.00	16.9
1+280	001+440	160.00	22.8
1+440	001+490	50.00	31.1
1+490	001+600	110.00	26.9
1+600	001+620	20.00	25.0
1+620	001+780	160.00	16.5
1+780	001+910	130.00	32.5
1+910	002+270	360.00	29.2
2+270	002+330	60.00	31.0
2+330	002+500	170.00	27.6
2+500	002+530	30.00	18.8
2+530	002+670	140.00	31.5
2+670	002+700	30.00	28.6
2+700	002+800	100.00	29.0
2+800	003+230	430.00	29.5
3+230	003+690	460.00	31.3
3+690	003+940	250.00	25.8
3+940	004+020	80.00	29.3
4+020	004+070	50.00	33.1
4+070	004+130	60.00	32.00
4+130	004+280	150.00	29.2
4+280	004+300	20.00	29.4
4+300	004+410	110.00	33.1
4+410	004+540	130.00	29.6
4+540	004+770	230.00	29.5
4+770	005+020	250.00	19.25
5+020	005+390	370.00	34.9

2.2.6 Footpath

At some locations drain cum footpath is provided where land availability is limited where sufficient land is available footpaths are provided separately. Details are shown in below table.

Table 2.17: Table showing details of footpath for HDC-05 Hosur Road

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
0+000	0+230	230.00	Paved	2.20		
0+230	0+330	100.00	Paved	0.80	Paved	1.5
0+330	0+450	120.00	Paved	0.60	Paved	1.5
0+450	0+520	70.00	Paved	1.00	Paved	1.0
0+520	0+780	260.00	Paved	0.80	Paved	1.0
0+780	0+830	50.00			Paved	1.3
0+830	0+960	130.00			Paved	1.3
0+960	1+090	130.00			Paved	1.8
1+090	1+150	60.00			Paved	0.6
1+150	1+280	130.00			Paved	1.6
1+280	1+440	160.00			Paved	1.6
1+440	1+490	50.00	Paved	3.30	Paved	1.6
1+490	1+600	110.00	Paved	1.00	Paved	0.9
1+600	1+620	20.00			Paved	0.9
1+620	1+780	160.00			Paved	0.0
1+780	1+910	130.00	Paved	2.00	Paved	3.3
1+910	2+270	360.00	Paved	2.00	Paved	1.3

From in Kms	To in Kms	Length in m	Footpath			
			LHS		RHS	
			Type (Paved/Unpaved)	Width	Type (Paved/Unpaved)	Width
2+270	2+330	60.00	Paved	2.00	Paved	1.3
2+330	2+500	170.00				
2+500	2+530	30.00				
2+530	2+670	140.00				
2+670	2+700	30.00	Paved	1.30		
2+700	2+800	100.00	Paved	1.30	Paved	1.3
2+800	3+230	430.00	Paved	1.30	Paved	1.8
3+230	3+690	460.00	Paved	1.50	Paved	1.8
3+690	3+940	250.00	Paved	1.30	Paved	1.3
3+940	4+020	80	Paved	3.30	Paved	2.5
4+020	4+070	50	Paved	1.80	Paved	2.5
4+070	4+130	60	Paved	1.60	Paved	2.5
4+130	4+280	150	Paved	1.80	Paved	1.0
4+280	4+300	20	Paved	2.80	Paved	1.3
4+300	4+410	110	Paved	2.80	Paved	1.3
4+410	4+540	130	Paved	2.80	Paved	1.3
4+540	4+770	230	Paved	2.80	Paved	1.3
4+770	5+020	250				
5+020	5+390	370	Paved	3.60	Paved	0.9
5+390	5+580	190	Paved	0.90		
5+580	5+830	250				

Table 2.18: Table showing details of footpath for HDC-06 Bannerghatta Road

From, Kms	To, Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
0+000	0+100	100.00	Paved	1.7	Paved	1.7
0+100	0+200	100.00	Paved	1.7	Paved	1.7
0+200	0+300	100.00	Paved	1.7	Paved	1.7
0+300	0+400	100.00	Paved	1.7	Paved	1.7
0+400	0+500	100.00	Paved	1.7	Paved	1.7
0+500	0+600	100.00	Paved	1.5	Paved	3.0
0+600	0+700	100.00	Paved	1.5	Paved	2.0
0+700	0+800	100.00	Paved	1.5	Paved	1.5

From, Kms	To, Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
0+800	0+900	100.00	Paved	1.5	Paved	0.0
0+900	1+000	100.00	Paved	1.5	Paved	1.5
1+000	1+100	100.00	Paved	1.5	Paved	3.0
1+100	1+200	100.00	Paved	1.5	Paved	1.7
1+200	1+300	100.00	Paved	1.7	Paved	1.7
1+300	1+400	100.00	Paved	1.5	Paved	1.5
1+400	1+500	100.00	Paved	1.7	Paved	1.7
1+500	1+600	100.00	Paved	1.2	Paved	1.2
1+600	1+700	100.00	Paved	2.0	Paved	2.0
1+700	1+800	100.00	Paved	2.0	Paved	2.0
1+800	1+900	100.00	Paved	2.0	Paved	2.0
1+900	2+000	100.00	Paved	2.0	Paved	2.0
2+000	2+100	100.00	Paved	2.0	Paved	2.0
2+100	2+200	100.00	Paved	5.0	Paved	3.0
2+200	2+300	100.00	Paved	6.0	Paved	3.0
2+300	2+400	100.00	Paved	4.5	Paved	3.0
2+400	2+500	100.00	Paved	1.7	Paved	1.7
2+500	2+600	100.00	Paved	1.7	Paved	1.7
2+600	2+700	100.00	Paved	1.0	Paved	1.0
2+700	2+800	100.00	Paved	1.0	Paved	1.0
2+800	2+900	100.00	Paved	1.5	Paved	
2+900	3+000	100.00	Paved	1.5	Paved	
3+000	3+100	100.00	Paved	1.5	Paved	
3+100	3+200	100.00	Paved	1.5	Paved	
3+200	3+300	100.00	Paved	1.5	Paved	
3+300	3+400	100.00	Paved	1.2	Paved	
3+400	3+500	100.00	Paved	1.2	Paved	
3+500	3+600	100.00	Paved	3.0	Paved	
3+600	3+700	100.00	Paved		Paved	
3+700	3+800	100.00	Paved	1.2	Paved	3.5
3+800	3+900	100.00	Paved	1.2	Paved	2.0
3+900	4+000	100.00	Paved	2.5	Paved	6.5
4+000	4+100	100.00	Paved	2.5	Paved	1.5
4+100	4+200	100.00	Paved	2.5	Paved	1.0
4+200	4+300	100.00	Paved	2.5	Paved	1.0
4+300	4+400	100.00	Paved	2.5	Paved	1.0
4+400	4+500	100.00	Paved	2.5	Paved	1.0
4+500	4+600	100.00	Paved	4.0	Paved	2.5
4+600	4+700	100.00	Paved	1.5	Paved	1.5
4+700	4+800	100.00	Paved	7.0	Paved	1.0
4+800	4+900	100.00	Paved	1.5	Paved	1.0

From, Kms	To, Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
4+900	5+000	100.00	Paved	1.5	Paved	1.0
5+000	5+100	100.00	Paved	1.5	Paved	2.0
5+100	5+200	100.00	Paved	1.5	Paved	1.5
5+200	5+300	100.00	Paved	4.5	Paved	1.0
5+300	5+400	100.00	Paved	4.5	Paved	2.0
5+400	5+500	100.00	Paved	4.5	Paved	2.0
5+500	5+600	100.00	Paved	3.0	Paved	2.0
5+600	5+700	100.00	Paved	1.7	Paved	2.0
5+700	5+800	100.00	Paved	1.7	Paved	2.0
5+800	5+900	100.00	Paved	1.5	Paved	2.0
5+900	6+000	100.00	Paved	1.5	Paved	2.0
6+000	6+100	100.00	Paved	1.5	Paved	2.0
6+100	6+200	100.00	Paved	2.5	Paved	1.5
6+200	6+300	100.00	Paved	2.5	Paved	2.0
6+300	6+400	100.00	Paved	3.0	Paved	0.0
6+400	6+500	100.00	Paved	6.5	Paved	2.0
6+500	6+600	100.00	Paved	6.5	Paved	2.0
6+600	6+700	100.00	Paved	5.0	Paved	2.0
6+700	6+800	100.00	Paved	0.0	Paved	2.0
6+800	6+900	100.00	Paved	0.0	Paved	2.5
6+900	7+000	100.00	Paved	6.8	Paved	3.5
7+000	7+100	100.00	Paved	6.8	Paved	2.0
7+100	7+200	100.00	Paved	6.8	Paved	2.0
7+200	7+300	100.00	Paved	1.2	Paved	1.5
7+300	7+400	100.00	Paved	1.2	Paved	1.5
7+400	7+500	100.00	Paved	1.5	Paved	1.5
7+500	7+600	100.00	Paved	1.5	Paved	2.0
7+600	7+700	100.00	Paved	1.5	Paved	2.0
7+700	7+800	100.00	Paved	0.0	Paved	2.0
7+800	7+900	100.00	Paved	1.5	Paved	2.0
7+900	8+000	100.00	Paved	1.5	Paved	2.0
8+000	8+100	100.00	Paved	1.5	Paved	2.0
8+100	8+200	100.00	Paved	2.0	Paved	2.0
8+200	8+300	100.00	Paved	2.0	Paved	2.0
8+300	8+400	100.00	Paved	2.0	Paved	2.0
8+400	8+500	100.00	Paved	1.0	Paved	0.0
8+900	9+000	100.00	Paved	1.5	Paved	1.5
9+000	9+100	100.00	Paved	1.5	Paved	1.5
9+100	9+200	100.00	Paved	1.8	Paved	0.0
9+200	9+300	100.00	Paved	1.8	Paved	0.0
9+300	9+400	100.00	Paved	1.8	Paved	0.0

From, Kms	To, Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
9+400	9+500	100.00	Paved	1.8	Paved	1.5
9+500	9+600	100.00	Paved	1.5	Paved	0.0
9+600	9+700	100.00	Paved	1.5	Paved	0.0
9+700	9+800	100.00	Paved	1.7	Paved	0.0
9+800	9+900	100.00	Paved	1.5	Paved	0.0
9+900	10+000	100.00	Paved	1.5	Paved	0.0
10+000	10+100	100.00	Paved	1.5	Paved	0.0
10+100	10+200	100.00	Paved	1.5	Paved	0.0
10+200	10+300	100.00	Paved	1.5	Paved	1.5
10+300	10+400	100.00	Paved	1.5	Paved	1.5
10+400	10+500	100.00			Paved	1.5
10+500	10+600	100.00			Paved	2.0
10+600	10+700	100.00				0.0
10+700	10+800	100.00	Closed	1.5		0.0
10+800	10+900	100.00	Closed	1.5	Closed	1.5
10+900	11+000	100.00	Closed	1.5		0.0
11+000	11+100	100.00	Closed	1.5		0.0
11+100	11+200	100.00	Closed	1.5	Closed	1.5
11+200	11+300	100.00	Closed	1.5	Closed	1.0
11+300	11+400	100.00				0.0
11+400	11+500	100.00			Closed	1.5
11+600	11+700	100.00			Closed	2.5
11+700	11+800	100.00			Closed	1.5
11+800	11+900	100.00	Closed	1.7	Closed	1.8
11+900	12+000	100.00	Closed	1.7	Closed	1.5
12+000	12+100	100.00	Closed	1.7	Closed	1.5
12+300	12+400	100.00			Closed	1.8
12+400	12+500	100.00				
12+500	12+600	100.00	Closed	1.4	Closed	1.4
12+600	12+700	100.00	Closed	1.4		
12+700	12+800	100.00	Closed	1.4		
12+800	12+900	100.00	Closed	1.5		
12+900	13+000	100.00	Closed	1.5		
14+900	15+000	100.00	Closed	1.5		
15+300	15+400	100.00			Closed	1.0
15+400	15+500	100.00	Closed	1.0		
15+500	15+600	100.00	Closed	1.0		
15+800	15+900	100.00			Closed	1.0
16+000	16+100	100.00			Closed	1.0
16+100	16+200	100.00			Closed	1.0
16+200	16+300	100.00			Closed	1.2

From, Kms	To, Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
16+300	16+400	100.00			Closed	1.2

Table 2.19: Table showing details of footpath for HDC-7 Kanakpura Road

From, Kms	To,Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
0+000	0+100	100	Paved	3	Paved	2
0+100	0+200	100	Paved	3	Paved	2
0+200	0+300	100	Paved	3	Paved	3
0+300	0+400	100	Paved	3	Paved	3
0+400	0+500	100	Paved	3	Paved	4
0+500	0+600	100	Paved	5	Paved	3
0+600	0+700	100	Paved	2	Paved	3
0+700	0+800	100	Paved	3	Paved	0
0+800	0+900	100	Paved	3	Paved	3
0+900	1+000	100	Paved	3	Paved	3
1+000	1+100	100	Paved	4	Paved	5
1+100	1+200	100	Paved	4	Paved	5
1+200	1+300	100	Paved	1	Paved	3
1+300	1+400	100	Paved	3	Paved	2
1+400	1+500	100	Paved	3	Paved	2
1+500	1+600	100	Paved	3	Paved	2
1+600	1+700	100	Paved	2	Paved	3
1+700	1+800	100	Paved	2	Paved	4
1+800	1+900	100	Paved	3	Paved	4
1+900	2+000	100	Paved	3	Paved	4
2+000	2+100	100	Paved	3	Paved	4
2+100	2+200	100	Paved	3	Paved	4
2+200	2+300	100	Paved	3	Paved	3
2+300	2+400	100	Paved	3	Paved	3
2+400	2+500	100	Paved	2	Paved	2
2+500	2+600	100	Paved	2	Paved	2
2+600	2+700	100	Paved	2	Paved	2
2+700	2+800	100	Paved	3	Paved	2
2+800	2+900	100	Paved	3	Paved	3
2+900	3+000	100	Paved	3	Paved	3
3+000	3+100	100	Paved	2	Paved	2
3+100	3+200	100	Paved	3	Paved	2
3+200	3+300	100	Paved	3	Paved	2
3+300	3+400	100	Paved	3	Paved	2

From, Kms	To,Kms	Length in m	Footpath			
			LHS		RHS	
			Type (P/UP)	Width	Type (P/UP)	Width
3+400	3+500	100	Paved	3	Paved	2
3+500	3+600	100	Paved	3	Paved	2
3+600	3+700	100	Paved	3	Paved	3
3+700	3+800	100	Paved	3	Paved	3
3+800	3+900	100	Paved	3	Paved	2
3+900	4+000	100	Paved	3	Paved	2
4+000	4+100	100	Paved	3	Paved	2
4+100	4+200	100	Paved	3	Paved	3
4+200	4+300	100	Paved	3	Paved	3
4+300	4+400	100	Paved	2	Paved	2
4+400	4+500	100	Paved	2	Paved	2
4+500	4+600	100	Paved	1	Paved	1
4+600	4+650	50	Paved	1	Paved	1
4+650	4+700	50	Paved	0	Paved	0
4+700	4+800	100	Paved	0	Paved	0
4+800	4+900	100	Paved	4	Paved	6
4+900	5+000	100	Paved	4	Paved	2
5+000	5+100	100	Paved	4	Paved	2
5+100	5+200	100	Paved	2	Paved	2
5+200	5+300	100	Paved	2	Paved	3
5+300	5+400	100	Paved	2	Paved	2
5+400	5+500	100	Paved	2	Paved	2
5+500	5+600	100	Paved	2	Paved	2
5+600	5+700	100	Paved	2	Paved	3
5+700	5+800	100	Paved	2	Paved	2
5+800	5+900	100	Paved	3	Paved	3
5+900	6+000	100	Paved	3	Paved	3
6+000	6+100	100	Paved	2	Paved	3
6+100	6+200	100	Paved	2	Paved	2
6+200	6+300	100	Paved	2	Paved	2
6+300	6+400	100	Paved	2	Paved	2
6+400	6+500	100	Paved	2	Paved	3
6+500	6+600	100	Paved	2	Paved	3
6+600	6+700	100	Paved	3	Paved	3
6+700	6+800	100	Paved	2	Paved	2
6+800	6+900	100	Paved	2	Paved	2
6+900	7+000	100	Paved	2	Paved	2
7+000	7+100	100	Paved	2	Paved	2
7+100	7+200	100	Paved	2	Paved	2
7+200	7+300	100	Paved	3	Paved	4
7+300	7+400	100	Paved	1	Paved	0

Sl No	Chainage	Side		Remarks
		LHS	RHS	
71	12+680	Yes	-	Koli Farm Gate
72	12+690	-	Yes	Viewers colony
HDC 07 - Kanakapura Road				
73	0+050	Yes	-	Makkalakota Busstop
74	0+390	Yes	-	Mahila Seva Samaja Busstop
75	0+450	-	Yes	Mahila Seva Samaja Busstop
76	0+860	Yes	-	National college Busstop
77	0+880	-	Yes	National college Busstop
78	0+960	-	Yes	National college Busstop
79	1+720	Yes	-	Basavanagudi Police Station Busstop
80	1+750	-	Yes	Basavanagudi Police Station Busstop
81	3+090	Yes	-	Yediyur busstop
82	3+150	-	Yes	Yediyur busstop
83	3+730	-	Yes	Deepak Nursing Home Busstop
84	3+750	Yes	-	Deepak Nursing Home Busstop
85	4+410	-	Yes	Hunasemara Busstop
86	4+420	Yes	-	Hunasemara Busstop
87	4+740	Yes	-	Banashankari Busstation
88	5+570	Yes	-	Sarakki Busstop
89	5+580	-	Yes	Sarakki Busstop
90	5+840	Yes	-	Jaya Prakash Nagar Busstop
91	5+890	-	Yes	Sarakki Signal Busstop
92	6+470	Yes	-	Jaraganahalli Cross Busstop
93	6+590	-	Yes	Jaraganahalli Busstop
94	6+940	-	Yes	Yelachenahalli Busstop
95	6+950	Yes	-	Yelachenahalli Busstop
96	7+200	Yes	Yes	Yelachenahalli Metro Busstop
97	7+360	Yes	-	Yelachenahalli Metro Busstop
98	7+600	Yes	-	Metro Busstop
99	7+620	-	Yes	Metro Busstop
100	8+000	Yes	-	Konanakunte Cross Busstop
101	8+060	-	Yes	Konanakunte Cross Busstop
102	8+180	Yes	-	Konanakunte Cross Busstop
103	8+200	-	Yes	Konanakunte Cross Busstop
104	9+090	-	Yes	Doddakallasandra Busstop
105	9+630	-	Yes	Gubbalala Bustop
106	9+680	Yes	-	Gubbalala Bustop
107	10+390	Yes	-	Raguvanahalli Cross Busstop

Sl No	Chainage	Side		Remarks
		LHS	RHS	
108	10+430	-	Yes	Raguvanahalli Cross Busstop
109	11+040	Yes	Yes	Bayyanapalya Busstop
110	11+650	Yes	Yes	Jyotipuram Busstop
111	12+040	Yes	-	Thalagattapura Busstop
112	12+070	-	Yes	Thalagattapura Busstop
113	12+470	Yes	-	CS- Towardssinkler School Thalagattapura Busstop
114	12+730	Yes	Yes	Vajramuneshwara gate Busstop
115	13+430	Yes	-	Jyothi Farm Busstop
116	13+450	-	Yes	Jyothi Farm Busstop
117	13+750	-	Yes	Nice Road Kanakapura Road Junction
HDC 12d - Mysore road to Silk Board				
118	0+030	-	Yes	BMTC Bus Stop
119	0+930	-	Yes	Veerabhadra Nagara Bus Stop
120	1+000	Yes	-	Veerabhadra Nagara Bus Stop
121	1+480	Yes	-	PES Institute of Technology Bus Stop
122	1+550	-	Yes	PES Institute of Technology Bus Stop
123	2+410	-	Yes	Hosakerehalli Cross Bus Stand
124	2+730	Yes	Yes	Janatha Bazar Bus Stop
125	3+220	-	Yes	Kathriguppe Bus Stop
126	3+660	-	Yes	Kamakya Bus Stand
127	4+360	-	Yes	Deve Gowda Petrol Bunk Stop
128	5+150	-	Yes	Kadirenahalli Park Bus Stop
129	6+780	-	Yes	Ilas Nagar Bus Stop
130	8+350	Yes	-	J P Nagar 15th Cross Bus Stop
131	8+800	Yes	-	J P Nagar Bus Stop
132	9+730	Yes	-	J P Nagar 3rd Phase Bus Stop
133	9+810	Yes	-	J P Nagar Bus Stop
134	9+880	-	Yes	Jeedimara Bus Stop
135	10+480	Yes	-	Gopalan Innovation Mall Bus Stop
136	10+520	-	Yes	Mico Layout Bus Stop
137	11+160	Yes	-	Mico Layout Bus Stop
138	11+570	Yes	-	BTM Water Tank Bus Stop
139	11+780	-	Yes	Udupi Garden Bus Stop
140	11+800	Yes	-	Udupi Garden Bus Stop
141	12+515	Yes	-	BTM Bus Stop
142	13+200	-	Yes	Silk Board Bus Stop

Sl No	Chainage	Side		Remarks
		LHS	RHS	
143	13+470	-	Yes	Silk Board Bus Stop
144	14+050	Yes	-	HSR Apartment Bus Stop
145	14+970	Yes	-	HSR 14th Main Bus Stop
146	14+990	-	Yes	HSR 14th Main Bus Stop
147	15+700	-	Yes	HSR Mantri Bus Stop

2.5 Pavement Condition Survey

The survey regarding road inventory and pavement condition was carried out along the project corridor. The width of the carriageway along the project road varies from 4 lane divided carriage way to six lane divided carriageway. Visual inspection is conducted at improvement length of the project road, the study showed a Fair surface condition.

The condition of the pavement has been evaluated based on the field measurements of primary pavement surface distress of cracking (narrow and wide), patching, raveling and potholes, noted for each kilometer length. The extent of each distress has been visually estimated for every kilometer length of the road in terms of percentage area affected and then averaged for one-kilometer road length.

The distress conditions are measured under the following sub-heads:

- Cracking (%)
- Potholes (%)
- Raveling (%)
- Patching (%)
- Settlement & Upheaval (%)

2.4.1 Cracks

Pavement cracking is a typical failure commonly observed in flexible / bituminous pavements occurring predominantly due to the higher number of repetitions of heavier axle loads. Pavement Cracks (%) details along the existing project corridor are in **Annexure 2.2.** The average values of minimum, maximum and average percentage of cracks in the project roads are 3.5%, 3.95%, 3.73% respectively for Kanakpura road.

2.4.2 Patching

The variation of Pavement Patching (%) with length is shown in Figure 2.2. Pavement patching (%) details along project corridor is in **Annexure 2.1**. No significant patching is noticed except at few localized spots. The average values of minimum, maximum and

average percentage of patching area in the project roads are 3.25%, 4.20%, 3.73% respectively for Kanakpura road.

2.4.3 Raveling

Disintegration of the pavement surface caused due to failure of binder to hold the material together causing blowing off of fine aggregates leaving behind pock marks and when larger particles are broken free with stripping of aggregates is termed as Raveling. Pavement raveling (%) details along the project corridor is in **Annexure2.1**. The average values of minimum, maximum and average percentage of raveling in the project roads are 3.3%, 4.0%, 3.65% respectively for Kanakpura road.

2.4.4 Potholes

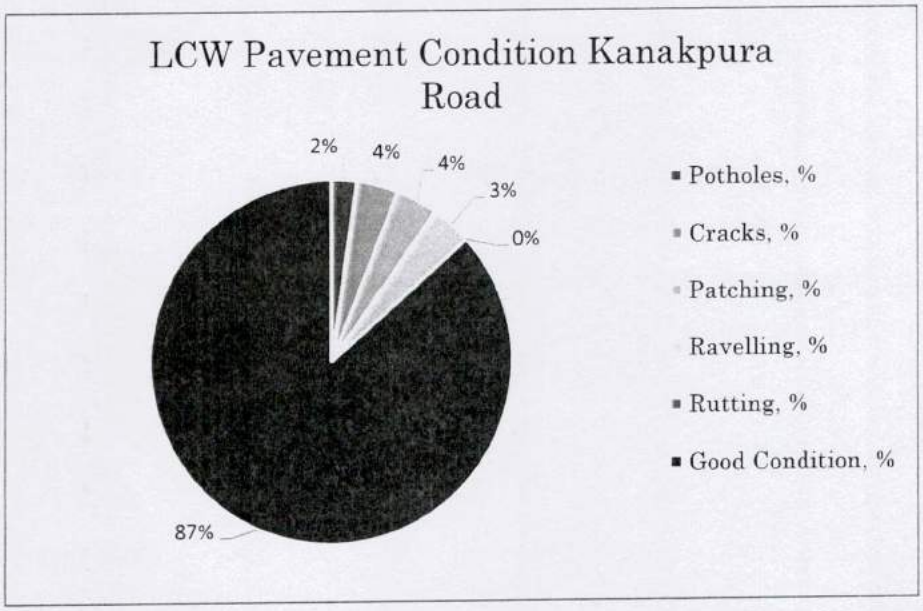
Potholes are bowl-shaped holes of varying sizes in the surface layer extending into the base course. Potholes are mainly formed due of loose base course or base course not covered properly with wearing course or due to inadequate bonding between base course and subsequent top layers. Pavement Potholes (%) details along the project corridor are in **Annexure2.1**. The average values of minimum, maximum and average percentage of potholes in the project roads are 2.5%, 2.0%, 2.25% respectively for Kanakpura road.

2.4.5 Rutting

Rutting is a surface depression in the wheel path. Pavement uplift (shearing) may occur along the sides of the rut. Ruts are particularly evident after a rain when they are filled with water. There are two basic types of rutting: mix rutting and subgrade rutting. Mix rutting occurs when the subgrade does not rut yet the pavement surface exhibits wheel path depressions as a result of compaction/mix design problems. Subgrade rutting occurs when the subgrade exhibits wheel path depressions due to loading. In this case, the pavement settles into the subgrade ruts causing surface depressions in the wheel path. Pavement Rutting (%) details along the project corridor are in Annexure2. 1. The average values of minimum, maximum and average percentage of potholes in the project roads 0.0%, 0.0%, 0.0% respectively for Kanakpura road.

2.4.6 Summary of Observations on Pavement Condition

The overall condition of the pavement is in fair to Good condition with around 87.0 % of the pavement area in fair condition for Kanakpura Road. Since there is no improvement length in Hosur Road, Bannerughatta Road and Outer Ring Road (Silk Board to Nayandahalli) this data is not reported.



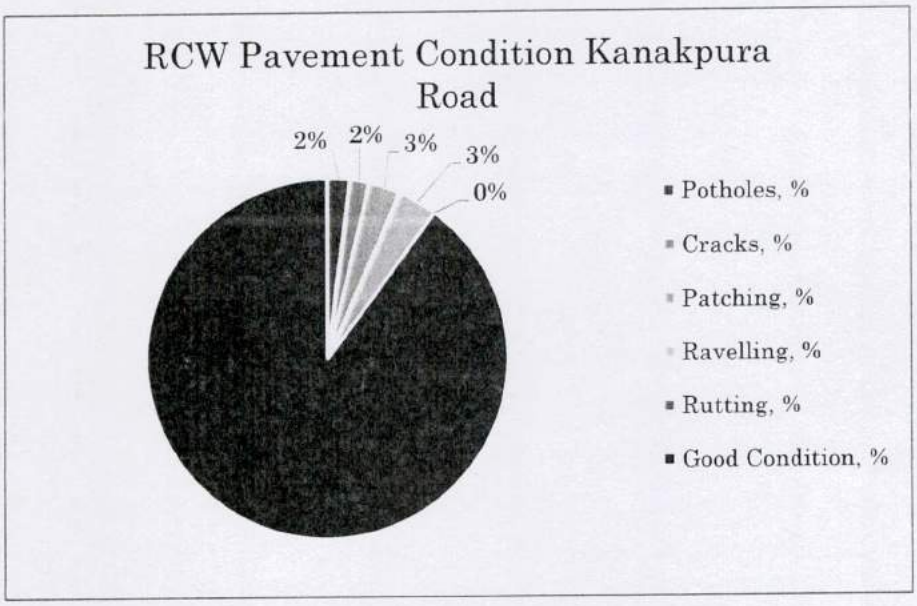


Figure 2.1:- Summary of existing Pavement condition of HDC 03 Kanakapura Road

2.6 Camber

Carriageway camber is checked at intervals to assess the camber at site, the camber is very important for effective drainage of rain water. The standard camber is 2.5% on our roads, but quite often the camber reduces or becomes non uniform during the course of life of road in urban roads due to distress, frequent overlays. Following table represents the camber on the existing roads. Since this package contains negligible improvement length the data is not reported.

2.7 Traffic Survey

Traffic surveys are an integral component of any transport study where appreciation of existing traffic and travel characteristics of the study area are extremely important. However, Traffic surveys are not required in this assignment as no additional widening is proposed beyond available ROW. However, the traffic survey details available with KRDCL are collected for Analysis of pavement Evaluation and overlay design.

At the outset, ISECPL has collated available traffic survey details to establish the base line data for the study.

The classified traffic volume count data available was processed and compiled using Spread Sheet software packages to get Commercial Vehicles per day, which is further utilized to compute the design traffic. Since this package contains negligible improvement length the data is not reported.

2.8 Existing Pavement Structure

The bituminous layers contribute the major part of the strength of the flexible pavement structure. Hence pavement investigation is carried out to know the Existing Bituminous Thickness without disturbing the surrounding area of test pit, the existing bituminous layer thickness is measured by cutting a bituminous core cutting equipment. The core samples are taken on all the project roads at an effective interval of 2 Km. The photographs taken during core cutting in project stretch are given in following paragraphs. Since the package contains negligible improvement length the data is not reported.

2.9 Pavement structural Evaluation using Falling Weight Deflectometer Studies

Falling Weight Deflectometer (FWD) applies dynamic load on the pavement, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads. The FWD test was carried out in accordance with IRC: 115-2014 "Guidelines for structural evaluation and strengthening of flexible road pavements using Falling Weight Deflectometer (FWD) Technique. FWD readings were taken along the wheel path. Readings were taken at 250m interval, with test points staggered on both sides. Adjustments to reading locations were made to avoid culverts, bridge decks and locally damaged areas. Pavement and air temperatures were recorded for the purpose of temperature correction. Subgrade moisture data was also obtained from field moisture

measurements for applying seasonal corrections to deflection measurements.

Principle of Pavement evaluation using FWD

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as subgrade strength, pavement thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Among the equipment available for structural evaluation of pavements, the Falling Weight Deflectometer (FWD) is extensively used world-wide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. The resulting load-deflection data can be interpreted through appropriate analytical `techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are, in turn, used for (i) the strength evaluation of different layers of in-service pavements (ii) the estimation of the remaining life of in-service pavement (iii) determination of strengthening requirement, if any and (iv) evaluation of different rehabilitation alternatives (overlay, recycling, partial reconstruction, etc.

Falling Weight Deflectometer (FWD) is an impulse-loading device in which a transient load is applied to the pavement and the deflected shape of the pavement surface is measured. Impulse load is applied by means of a falling mass, which is allowed to drop vertically on a system of springs placed over a circular loading plate. The deflected shape of the pavement surface is measured using displacement sensors which are placed at different radial distances starting with the center of the load plate. Trailer mounted as well as vehicle mounted FWD models are available commercially. The working principle of all these FWD models is essentially the same. A mass of weights is dropped from a pre-determined height onto a series of springs/ buffers placed on top of a loading plate. The corresponding peak load and peak vertical surface deflections at different radial locations are measured and recorded.

FWD is non-destructive test equipment for pavements. It applies a dynamic load to a pavement structure which simulates a moving load, unlike in case of BBD where static load is applied, which does not simulate moving load. FWD provides fast, non-destructive evaluation of pavements and is safe in operating with traffic. It evaluates the condition of

underlying pavement layers and can trace the complete shape of bowl formed under dynamic loading.

The survey has been carried out by conducting deflection studies over the existing carriageway along the wheel paths at an effective interval of 250 m alternatively on both lanes of carriageway on each side. The deflections are measured by lowering the loading plate in proper contact with the pavement surface along with the required number of geophones placed at known distance from the loading plate. A target load of 40KN is achieved by dropping the mass from predetermined height. At each study point the load is applied once as seating load and the corresponding deflection is need not be recorded. After seating load, Raise the mass and drop minimum 3 times and record load and deflection data into the computer through data acquisition system on all 3 drops. While peak load and peak deflections at different selected radial positions must be recorded. After that the loading plate and Geophone frames are raised to original position and vehicle is moved to next test point. Temperatures are recorded at an interval of half hour and it has ensured FWD studies are not carried with pavement temperature greater than 45°C.

Temperature Correction

Back calculated moduli values of the bituminous layers evaluated by FWD survey are influenced by the pavement temperature. Hence the back calculated moduli obtained at temperatures other than the identified standard temperature will have to be corrected. For areas in India having a tropical climate, the standard pavement temperature is recommended as 35°C.

Correction for Seasonal Variation

Moisture content affects the strength of subgrade and granular subbase/base layers. The extent to which the strength is affected will depend on the nature of subgrade soil, gradation and nature of fines in the granular layers, etc. For applying these guidelines, it is intended that the pavement layer moduli values should pertain to the period when the subgrade is at its weakest condition. In India, this period occurs during the recession of monsoon. It is, therefore, desirable to conduct deflection measurements during this period. Where the same is not feasible, a correction procedure should be adopted.

The deflection measurement results with due temperature, seasonal corrections and characteristic deflections are presented in **Annexure 2.2**.

The Summar of Normalized deflection are presented in Table 2.17 to Table 2.20 and the summary for FWD analysis and pavement overlay design is presented in Table 2.21 to the completed details of FWD analysis and overlay design is Annexed with this report. Since the package contains negligible improvement length the data is not reported.

2.10 Inventory and Condition Survey of Culverts, Bridges, Grade Separators / VUPs / PUPs

A detailed reconnaissance and inventory of Bridges / Grade Separators / CD structures / VUPs / PUPs inventory were carried out along the project road corridor, in order to collect the relevant information w.r.to the following parameters to assess the condition of existing structures.

- Structure location in km
- Type of Structures (Culverts, Bridges, Grade Separators / VUPs / PUPs)
- Carriageway Width (m) and other general arrangements of footpath, handrails, etc.

Table 2.22: Showing Summary of Structures along the Corridor

Sl. No	Type of Structure	No of Structures				Total
		HDC 05	HDC 06	HDC 07	HDC 12d	
1	Bridges	1	1	-	-	2
2	Culverts	-	-	13	-	13
3	Flyover	1	-	-	3	4
4	ROB/RUB	-	-	-	-	-
5	VUP/PUP/CUP/VOP	1	3	2	4	10
6	Subways	-	-	-	-	-
7	Skywalks	4	-	-	-	4

2.11 Topographic Survey

As per ToR, topographic survey has to be conducted along the project stretches. The main purpose of the topographical survey was to produce digital 3d base maps showing the existing terrain including all existing road features including houses, telephone line, OFC, electric line, monuments, place of worship, cremation ground, utility line, trees, hand pumps and other features covering the entire right of way of the road. The digital 3d base maps are the basis for preparation of the digital terrain models (dtm) required for the road design.

The methodology as per terms of reference (ToR) was adopted for topographical survey by the consultants for capturing all the physical features along the project corridor for facilitating proposals for the final center line of the proposed 2/4-lane road, keeping in view the possible local realignments. The corridor for survey is at least 30 m beyond either side of the center line of the proposed divided carriageway or land boundary and additional width for interchanges and intersections, toll plazas, wayside amenities and at high embankment locations such as approaches to bridges / Rob's. This survey includes reading spot levels along L-section at every 25m interval, cross sections at every 50m interval, fixing GPS/ Benchmarks at every 5 Km interval and the Reference Benchmark Pillars at every 250m interval connected to GTS Benchmarks as specified in TOR.

The project road alignment was surveyed and Reference / Bench Mark pillars for horizontal and vertical control were fixed on the ground along the project road as per TOR. The scope of Consultancy was to carry out the topographic survey to cover following aspects:

- Control Surveys
- GPS Control
- Total Station Traverse
- Height Control

CHAPTER 3: IMPROVEMENT PROPOSALS

3.1 General

The project corridors are studied thoroughly with respect to the existing features on the project roads viz No of lanes, carriageway details, Drains and CDs, Footpaths, Medians, Junctions, Bus bays, sign Boards and other traffic Appurtenances as discussed in Chapter 2. the project corridors under package 3 i.e., **HDC 05: Hosur Road**, **HDC 06: Bannerghatta Road**, **HDC 07: Kanakapura Road**, and **HDC 12d: Outer Ring Road from Mysore Road to Silk Board** comprise carriageway varying from 4 lane to 6 lanes.

Table 3.1 Lane Configuration

SI No	Road Name	Lane Km			
		4 Lane	6 Lane	For SR Lane	Total Lane Km
1	Hosur Road	12.24 Km	20.34 Km	0	**33 Km**
2	Bannerghatta Road	66 Km	0	0	**66 Km**
3	Kanakapura Road	58 Km	0	0	**58 Km**
4	Outer Ring Road (Mysore road to Silk Board)	40 Km	12 Km	6.4 Km	**59 Km**
	Total	**176.24 Km**	**32.34 Km**	**6.4 Km**	**216 Km**

Since the project corridors are under control of BBMP, there are already various improvement works have been carrying out or already tendered by BBMP and BMRCL in the project corridors. Improvement proposals are made for the remaining length which has not been considered for improvement works under BBMP / BMRCL. In Package 3, about 99% length of the project corridor is being under construction / tendered by BBMP or BMRCL, except for a very minimal length of 0.5 Km in Kanakapura road, and ORR where provisions made for emergency pavement treatment, the initial improvement works in the package is very minimum.

The Project Proposals are Prepared in 2 Parts

1. **Initial Improvement Proposals**
2. **Annual maintenance Proposal**

3.2 Discussions made with various Stake Holders

3.2.1 Assets to be included as part of the maintenance project

KRDCL has informed that several meetings were held on this project at various levels of

ACS, CS and it was concluded to include and exclude the following assets as part of maintenance by KRDCL

Table 3.2 Below showing Table of Assets

SL No	Assets Proposed for Maintenance
	Assets Included for Maintenance by KRDCL
1	Carriageway
2	Median
3	Junctions
4	Grade Separators (Flyovers/Underpasses/RoB/RUB)
5	Bus Bays
6	Service Roads / Slip Roads / Parking Lanes
7	Road Markings
8	Sign Boards
9	Footpath
10	Pedestrian Guard Rails
11	Bollards
12	High Raised Pedestrian Crossings
13	Traffic Signals at Junctions
14	Installation of Traffic KIOSK / Umbrella for Policemen
15	Side Drains
16	Cross Drainage Structures
17	Road Sweeping
18	Manhole chamber Improvements
19	Tree Guards
20	Tree pruning
21	Road Cutting and Restoration
23	Removal of Construction and Demolition Debris
	Assets Excluded for Maintenance by KRDCL
1	Bus Shelters
2	Sky Walks
3	Solid Waste Management
4	Encroachment Clearance
5	Street Lighting
6	Land Acquisition for improvements
7	Water Supply and Sanitary lines leakages by BWSSB
8	Faulty Power Lines by BESCOM/KPTCL
9	Gas Leakages in Gas Lines by GAIL

3.2.2 Bruhat Bengaluru Mahanagara Palike (BBMP)

Meetings and Discussions are held with BBMP officials regarding the ongoing improvement works or tendered works along the project length of the High-Density corridors. The details of the works which are already considered by BBMP and BMRCL are collected and summary of the same is tabulated below. The stretch wise details of the

works considered by BBMP / BMRCL are annexed with the report.

Table 3.3 Tendered length of BBMP and BMRCL

HDC No	Corridor Name	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
5	Hosur Road	6.45	6.45	0
6	Bannerughatta Road	16.5	6.9	9.6
7	Kanakapura Road	14.5	8.3	5.7
12 d	Outer Ring Road (Mysore road to Silk Board)	12	9.8	2.2
Package III Length, Km		**49.45**	**31.45**	**17.5**

3.2.3 Traffic Police Department

Police department has prepared a corridor wise proposal for the works to be considered in Short Term, Mid Term and Long-Term measures to improve the Traffic discipline, reduce the congestion, and minimize the accidents and fatalities. the detailed report submitted by the department is annexed with this report and the prominent, short term measures, Midterm Measures, and long-Term measures, which are included in the project proposal are Summarized in the table below.

Table 3.4 Proposals considered as per Traffic Police Department

SI No	Items Considered in Estimate as per Traffic Police Requirement	Quantity			
		HDC 05	HDC 06	HDC 07	HDC 12d
1	Junction Improvement	2 Nos	Nil	3 Nos	6 Nos
2	High Raised Pedestrian Crossing	9 Nos	20 Nos	11 Nos	16 Nos
3	Median Guard Railing	5.8 Km	14.85 Km	13.05 Km	10.8 Km
4	Bus Bay	1 No	Nil	2 Nos	6 Nos
5	Widening of road	Nil	Nil	60 m	Nil
6	Traffic Sign Boards	112 Nos	77 Nos	113 Nos	86 Nos
7	Traffic Umbrella/Kiosk	4 Nos	5 Nos	8 Nos	5 Nos
8	Traffic Signals	1 Nos	2 Nos	2 Nos	2 Nos
9	Skywalks	02 Nos	03 Nos	04 Nos	05 Nos

SI No	Items Considered in Estimate as per Traffic Police Requirement	Quantity			
		HDC 05	HDC 06	HDC 07	HDC 12d
10	Surveillance and Enforcement Cameras installation	12 Nos	24 Nos	22 Nos	24 Nos

Various discussion held with ACS, CS on these issues concluded that the skywalks shall be taken up on PPP basis separately and cameras will be taken up under separate head, hence these two items are excluded from the current scope of project.

3.2.4 Proposals from DULT

DULT suggested to provide bus lanes and cycle lanes in all roads as per the budgetary announcement made by Hon'ble CM. various discussions held on this at ACS, CS level and following suggested to include bus lanes at roads (preferable Outer Ring Road) where 6 lanes are more exists at present and any other stretches needed will be added alter with proper permission/approval from Govt.

Table 3.5 Proposals of DULT

SI No	High Density Corridor	Length of Bus Priority Lane Considered, Km
1	HDC 05 – Hosur Road	Nil
2	HDC 06 –Bannerghatta Road	Nil
3	HDC 07 –Kanakpura Road	Nil
4	HDC 12 D Silk Board to Mysore Road	2.0 Km
	Total Length of Bus Lane in Package 3	**2.0 Km**

3.3 Initial Improvement Works

Initial improvement works are proposed in the Balance length of the corridors which are not considered for improvement by BBMP / BMRCL. The summary of the initial improvement lengths of the 4 corridors under Package 3 is represented below.

Table 3.6 Table below shows the Length of Initial Improvement Works

HDC No	Corridor Name	Length Considered for Initial Improvement, Km	Total Length of the corridor, Km	BBMP ongoing work length, Km	BMRCL ongoing work length, Km
5	Hosur Road	0.00	6.45	6.45	0.00
6	Bannerghatta Road	0.00	16.5	6.9	9.6
7	Kanakpura Road	0.5	14.5	8.3	5.7
12d	Outer Ring Road (Mysore road to Silk Board)	0.0	12.0	9.8	2.2
Package I Length, Km		0.5	49.45	31.45	17.5

The Proposals have been split into following Major Heads.

(i) Where No works are taken up by BBMP or BMRCL, these stretches the project improvement proposals includes

- Carriageway Improvements
- Junction Improvements
- Footpath Improvement and Construction of Green Hedging
- Median Improvements and Guardrail
- Construction of Bus Bays & Road Widening
- Drain Improvements
- Traffic Signs, Road Markings and Other Appurtenances

(ii) Whereas for the section where, works taken by BBMP / are under progress or already tendered, only the following works are provisioned.

- Service road improvement as per police requirement.
- Median Guardrail Provisioned
- Construction of Green Hedging
- Missing Sign Boards installation
- Selected Junction Improvements.

3.3.1 Preliminary Works:

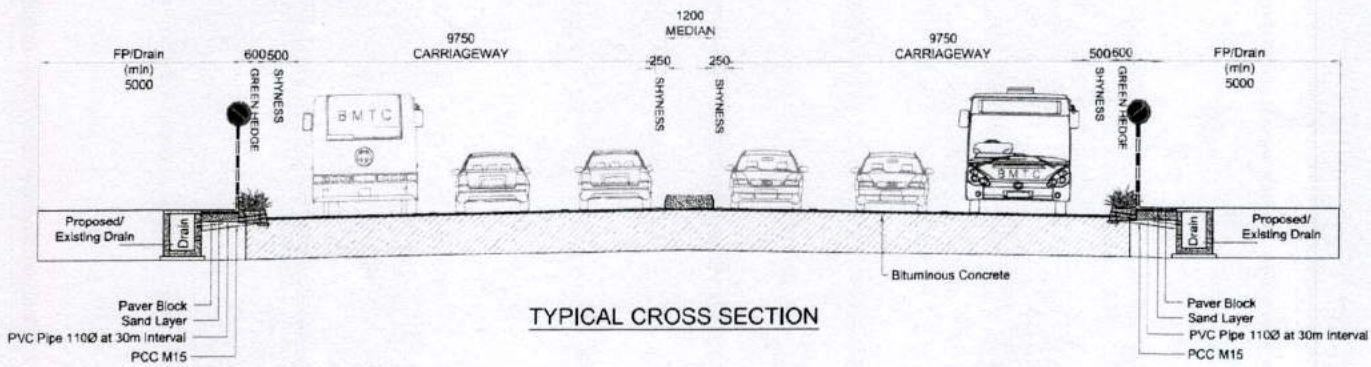
Following works are considered under preliminary works along the project roads under Package 03, viz Hosur Road, Bannerghatta Road, Kanakpura Road and Silk Board to Mysore Road. Clearing and grubbing is considered for removal and disposal of unwanted plants and waste materials from the project site. The damaged portion of Medians, Kerbs

and Footpaths in the improvement lengths are proposed for Dismantling and refixing.

3.3.2 Carriageway Improvements: -

Uniform lanes: the carriageways are widened over a period of time and there's no standard lane widths at present, the outer lane widths varies and at few places, its less than the standard lane width. Based on tender sure experience the lane widths are standardized as below, the outer lane shall be of 3.5 m as buses move on this lane, center lane shall be 3.0 m as this is predominately LMV's for and inner lane shall be 3.25 m giving a shyness of 0.25 m for median. This is been done in discussion with DULT and BBMP as per the tender sure experience.

Resurfacing: Carriageway in the initial improvement length is proposed with functional overlay as per the pavement evaluation and overlay design. Prior to laying overlay, **milling of existing bituminous surface is considered in order to achieve required camber and to reduce profile correction course**. The carriage way is proposed with uniform lane markings, and installation of raised pavement markers. Carriageway improvements are represented in Volume 3 – Drawings. Since the package contains negligible improvement length the data is not reported.



TYPICAL CROSS SECTION

3.3.3 Junction Improvements:

The selected junctions along the corridor are proposed with carriageway improvements, road markings, sign board installations, construction or modification of traffic channelizing islands. provision for precast new jersey barrier to guide the traffic. the junctions are redesigned in order to ensure safe maneuvering of vehicles and pedestrians. In coordination with police department few selected junctions which are not in initial improvement section are also considered for improvement. Junctions considered for improvement are tabulated below.

Hosur Road: -

SI No	Junction Chainage	Junction Name
1	2+500	Adugodi junction

Bannerghatta Road: -

SI No	Junction Chainage	Junction Name
Nil		

Kanakpura Road: -

SI No	Junction Chainage	Junction Name
1	4+750	Banashankari Junction
2	5+680	Sarakki Junction

Silk Board to Mysore Road: -

SI No	Junction Chainage	Junction Name
1	1+500	Devegowda circle
2	3+500	Kamakya junction
3	5+650	K S layout junction

3.3.4 Footpath and Kerb

Footpath proposal includes construction of new walkways with interlocking paver blocks, where space is available or where existing footpath is in poor condition. In addition, replacement of damaged Kerbs and paver blocks are also considered.

Hosur Road: -

Provision of 200 m is kept in the entire length for damaged or discontinued section as per police requirement.

Bannerghatta Road: - Nil

Kanakpura Road: -

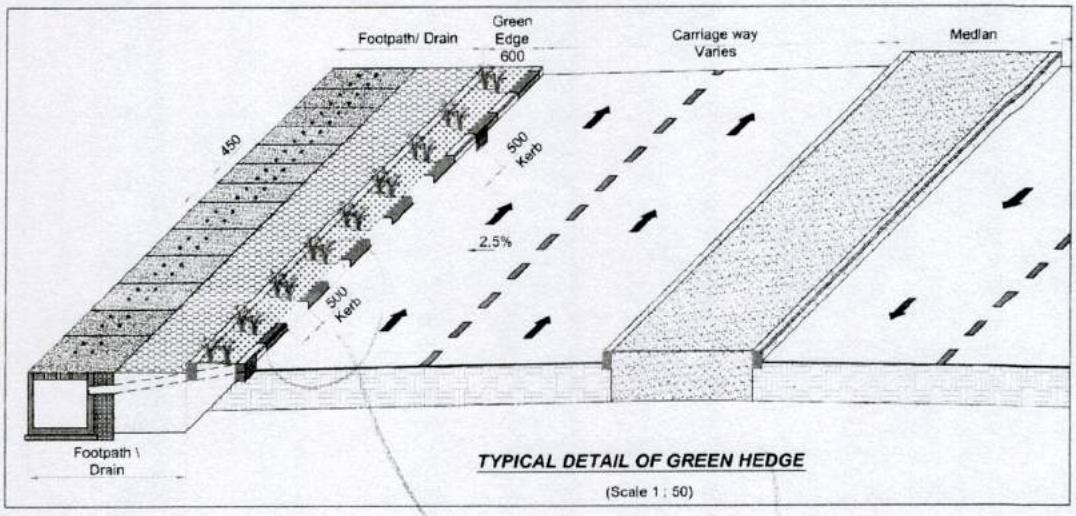
Provision of 1.0 km is considered in the for damaged or unattended section between saarakki junction and Nice Road Junction.

Silk Board to Mysore Road: -

Provision of 1.3 km is kept in the entire length for damaged or unattended section.

3.3.5 Green Hedging: -

With the intention to improve the aesthetics of the high-density corridors, Green Hedging is proposed on the footpath sides of the carriageway. the proposal includes installation of additional kerb line and supplying and spreading of farm yard Manure to support planting of permanent hedges. Green hedging is proposed at all feasible locations which are being improved by both BBMP or KRDCL. in addition, provision for chute drains is made along the Kerb line to guide the carriageway runoff to the drain. Cross sections indicating green hedging is represented below.



3.3.6 Median and Guard rail: -

Two types of median are considered for improvement one is the conventional median with both side Kerb with grassing and the other is 900mm standard new Jersey barrier. This is proposed in consultation with Traffic police department. The first type is considered where there is already existing convention median but in poor condition and the second type is considered as per the police requirement in places where there is existing low height concrete median or at specified places by the police department. Similarly, Guard rail is also proposed in two design, one is to install over conventional median and the second type is proposed to install over new jersey barrier in such a way to maintain uniform height. Typical section of median with guard rail is represented below.

Hosur Road: -

Sl. No	From	To	Length of Guard rail, in m
1	0+000	0+625	625
2	0+960	3+590	2630
3	3+720	5+420	1700
4	5+600	6+450	850

Bannerghatta Road: -

Sl No	From	To	Length in m
1	0+000	0+550	550
2	0+600	0+800	200
3	0+850	1+000	150
4	1+030	1+800	770
5	1+870	2+780	910
6	2+820	3+280	460
7	3+300	3+650	350
8	3+700	5+120	1420
9	5+180	5+600	420
10	5+670	5+770	100
11	5+800	6+900	1100
12	6+960	7+800	840
13	7+870	8+680	810
14	8+720	9+070	350
15	9+120	9+310	190
16	9+380	9+800	420
17	9+900	11+600	1700
18	11+900	16+000	4100

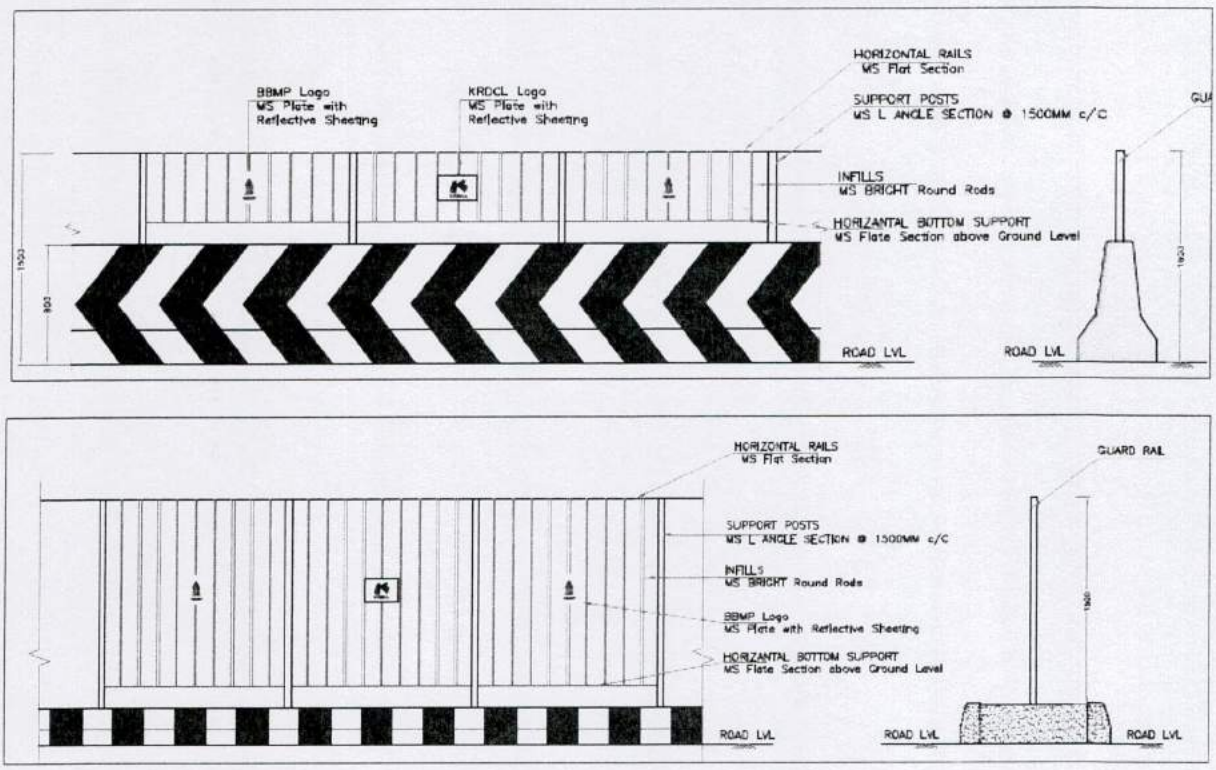
Kanakapura Road : -

Sl No	From	To	Length of Guard rail, in m
1	0+400	0+880	480
2	0+900	0+950	50

Sl No	From	To	Length of Guard rail, in m
3	1+000	1+800	800
4	1+840	1+870	30
5	2+010	2+080	70
6	2+100	2+380	280
7	3+100	3+470	370
8	3+500	3+900	400
9	4+000	4+280	280
10	4+320	4+640	320
11	4+800	5+900	1100
12	5+950	8+150	2200
13	8+500	9+400	900
14	9+800	9+950	150
15	10+050	10+120	70

Silk Board to Mysore Road: -

SI No	From	To	Length, m
1	0+000	0+700	700
2	0+780	3+060	2280
3	3+110	4+150	1040
4	4+500	6+250	1750
5	6+300	6+540	240
6	6+600	6+850	250
7	6+900	8+750	1850
8	9+100	9+520	420
9	10+650	11+650	1000
10	11+750	12+240	490
11	12+320	13+090	770
12	0+000	0+700	700



Hosur Road: -

SI No	Bus bay Chainage	Location
1	2+700	Adugodi

Bannerghatta Road: - NiL

Kanakpura Road: -

SI No	Bus bay Chainage	Location
1	2+900	Yadiyur lake
2	6+600	Jaraganahalli
3	8+150	Konankunte Cross
4	11+600	Jothipuram
5	12+530	CS-Towardsinkler School Thalagattapura

Silk Board to Mysore Road: -

SI No	Bus bay Chainage	Location
1	0+950	Veerabhadranagar
2	3+150	Katriguppe Bus stop

SI No	Bus bay Chainage	Location
3	7+000	J P Nagar 6th Phase
4	8+550	J P Nagar 5th Phase
5	11+800	BTM Layout 16th Main
6	12+900	Slik Board

3.3.8 Drainage and Structural Improvements: -

Existing Drainage facility is studied along the project corridors, for availability and functioning, based on which it is proposed for construction of New Drain with cover slab and replacement of damaged cover slab. in addition, it is also provisioned for any emergency repairs of RE Wall portions of the Grade Separators.

Hosur Road: -

Sl No	From	To	Length in m
1	1+620	1+750	260

Bannerghatta Road: - Nil

Kanakapura Road: -

Provision has been made for damaged and discontinued sections

Outer Ring Road KR Puram to Silk Board: -

Provision has been made for 200m length at damaged and discontinued section.

3.3.9 Utility and Ducts

There are no proposals for shifting of utilities in these stretches, further the initial improvements are taken only for a part length of 191 kms, the provision of utility ducts is not considering as there will be no continuity of ducts if provided. Further it was decided in various meetings that the current project is of maintenance nature and utilities are in the scope of respective utility departments and KRDCL will focus on maintenance of road assets.

3.3.10 Road Markings, Traffic Signboards and other Appurtenances: -

Road Markings viz Edge lines, Centre lines, Pedestrian Crossings, Directional Arrows are proposed as per the standard requirements and as indicate in the drawings. Similarly raised pavement markers or Road studs are proposed along road markings, at Junctions, at HRPCs as per standards and as indicated in the Drawings. Different Type of Sign

boards are provisioned for the project corridors and Appropriate Type & number of sign boards shall be Installed as per the Good for Construction Drawings. The provisions under this head also includes Road Delineators, Hazard markers, Bollards, Single arrow directional sign Boards, overhead gantry sign boards, Traffic Umbrella / KIOSK for Traffic Policemen, Traffic Signals, and Gratings at VUPs. Road Delineators are provided to demarcation of the Bus priority lane, turning demarcation and at edges of the islands. Hazard markers are provisioned for installation at approaches of all structures, at Median openings, etc. Single Arrow directional signboards are provisioned to aid in identification of cross roads, where the board is not available. Over Head Gantry Sign Boards, Traffic KIOSKs and Traffic Signals are all included for costing as per the requirements of the traffic police department.

3.4 Annual Maintenance Proposals

As part of maintenance proposals, government has decided to go for a 5 years long term maintenance and during which the road has to be kept in the good condition for easy and safe movement of traffic and pedestrians at all time. **Road Maintenance** includes routine Maintenance, preventive Maintenance, periodic Maintenance, disaster Maintenance, exigencies and inspections.

- Periodic Maintenance: works such as re-surfacing of pavements may be required to restore the functional deficiencies that have developed over a time period. Which shall be decided based on functional and structural valuation studies.
- Routine Maintenance: Contractor shall carry out day-to-day site inspection of the designated road stretches and note done the damages that have occurred due to natural or artificial causes, they should take immediate steps to correct or rectify the damages. Routine Maintenance are undertaken by the maintenance staff almost round the year.
- Preventive Maintenance: The preventive maintenance is performed to improve or extend the functional life of pavement surface while in good condition. This may defer the need of periodic maintenance and rehabilitation
- Disaster Maintenance: Occasionally several damages are caused to roads cross drainage and other road assets. structures by floods or very heavy down pour or rains, though these may not occur every year. Under such circumstances works are to be completed as early as possible and the road infrastructure shall be restored so as to minimised the inconvenience to road users.

- Safety & Traffic Management – this includes enforcement of regulations together with the relevant authorities. Keep project roads safer, this also includes hazard response and Road patrols
- Asset management – this includes daily, routine and periodic inspections, Maintenance, repairs, housekeeping and emergency Maintenance

following are the maintenance activities suggested with Time limits for rectification.

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
A	**Carriageway/Road surface, Hard shoulders, Drains and Cross Drainage works, Bridges / Interchanges / Grade Separators (Fly Overs/ RUB/ ROB/ Under Pass / any other Road structure).**	
1	Maintaining a public relations unit to interface with and attend to suggestions from the Users, government agencies, media and other agencies and deploying the required staff. Equipment Installation and Office setup (Large TV, Computers, Printers and other equipment), deploying Three non-technical and two technical staff	On or before 30 days from LOA
2	all surplus construction machinery and materials, waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project in a clean, tidy and orderly condition, and in conformity with Applicable Laws, Applicable Permits and Good Industry Practice.	Daily
3	Carriageway Sweeping using mechanical sweepers and footpath manual cleaning Minimum 4 vehicle mounted sweeping machines to be deployed all the debris/dust/litter shall be safely carried and disposed away at designated places.	Daily
4	Breach or blockade (the item of works shall be removal of fallen concrete wall, trees, electric pole etc.	Temporary restoration of traffic within 3 hours' permanent restoration within 7 days
5	Roughness not more than 2600mm/km for each lane in a km length (as measured by a standardized rough meter/bump integrator).	**As indicated in the Work order, for this work.**
6	Skid Resistance (Skid Number, SN, minimum Desirable shall be 55 SN	**As indicated in the Work order, for this work**
7	Potholes	24 hours
8	Cracking all types in less than 5% of road surface for each lane in a km length	3 (Three) days

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
9	Ravelling/Stripping of bitumen and all types in less than 5% of road surface for each lane in a km length	3 (Three) days
10	Settlement all types in less than 5% of road surface for each lane in a km length	3 (Three) days
11	Rutting exceeding 5 mm in more than 2% of road surface for each lane in a km length (measured ROMDAS or equivalent technology)	7 (Seven) days
12	Bleeding	3 (Three) days
13	Damage to pavement edges exceeding 100 mm	24 hours
14	Painting of Kerb, railing, parapets, crash barriers,	Twice every year
15	All types of Road Marking	Retro reflectivity mcd/m2/lux of 150 during the contract period / Twice every year
16	Joint Sealing in concrete pavement	7 (Seven) days
17	Replacement of Pavement Quality Concrete slabs	15 (fifteen) days
18	Rain cuts/gullies in slope	3 (Three) days
19	Damage to or silting of culverts and side drains during and immediately preceding the rainy season	3 (Three) days
20	Desilting of drains in Road side Drains	3 (Three) days
21	Cracks - Temporary measures	Within 48 hours
22	Spalling/scaling	3 (Three) days
23	Foundations-cavitation	3 (Three) days
24	Piers, abutments, return walls, RE-walls Cracks and damages including settlement and tilting Temporary measures	30 (Thirty) days
25	Bearings All type- Replacements	As indicated in the Work order, for this work
26	Joints in bridges: Loosening and malfunctioning of joints	As indicated in the Work order, for this work
27	Deforming of pads in elastomeric bearings	As indicated in the Work order, for this work
28	Gathering of dirt in bearings and joints or clogging of spouts, weep holes and vent-holes	3 (Three) days
29	Damage or deterioration in parapets and handrails	3 (Three) days
30	Rain-cuts or erosion of banks of the side slopes of approaches	3 (Three) days
31	Resurfacing of wearing coat	As indicated in the Work order, for this work
32	Damage or deterioration in approach slabs	3 (Three) days
33	Growth of vegetation affecting the structure or obstructing	3 (Three) days

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
	the waterway	
B	**Foot Path/Medians/Drains**	
34	Manual cleaning of footpaths, all the debris/dust/litter shall be safely carried and disposed away at designated places	Daily
35	Damage to paver blocks or concrete surface or tiles of footpath	3 (Three) days
36	Damage to Kerbs, bollards, tree guards, pedestrian railings	3 (Three) days
37	Road side Drains and inlets	Should be Clean at all times
38	Damage to drain cover, walls	3 (Three) days
C	**Road safety and furniture including all road sign boards and pavement raised marking (road studs)**	
39	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
40	Damaged/missing road signs requiring replacement	7 (seven) days
41	Painting of railing, parapets, crash barriers	Once every year
42	Reflective Pavement Markers (Road Studs) Numbers and Functionality as per specification in IRC :SP:84-2014 and IRC :35-2015, unless specified	At all times
43	Pedestrian Guard rail : Functionality: Functioning of guardrail as intended	At all times
44	Traffic Safety Barriers: Functionality: Functioning of Safety Barriers as intended	At all times
45	Overhead Sign Structures shall be structurally and functionally adequate	At all times
D	**Miscellaneous Works (Trees and Plantation, Road Patrol, Road Cutting Restoration, Road lighting**	
46	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
47	Deterioration in health of trees and bushes	Timely watering and treatment
48	Replacement/replanting of plants and bushes on medians, islands, footpaths and green edges	3 (Three) days
49	Removal of vegetation affecting sight line and road structures	3 (Three) days
50	Patrolling of roads by a vehicle of Bolero or equivalent with a driver, assistant and a supervisor at all times - 2 vehicles and two teams	All through the day
51	Restoration of road cutting as per IRC specifications Temporary Permanent	**As indicated in the Work order, for this work**
52	Road lighting	Not Included.

Sl. No.	Nature of Defect or Deficiency	Time limit for Repair/Rectification
E	Emergency Works	
53	Removal of Fallen Trees	3 hours
54	Towing of Accident vehicle / Breakdown vehicle / Abandoned vehicle, mandatory deployment of: • LMV Towing vehicle –for towing of light commercial vehicles and below – 1 nos • HCV Towing vehicle –for towing of buses/ heavy commercial vehicles - 1 nos	1 hour
55	Water logging / Ponding on road surface / grade separators, mandatory deployment of Tippers, pumps, sucking machines, etc., as needed	1 hour
56	Fallen Street pole / Sign Boards / any other structure	1 hour

3.4.1 Traffic Incident Management

As a part of maintenance proposals, The Project corridors are required to Patrol continually through dedicated staff and Vehicle, to monitor any possible hindrance for the free flow of traffic and to ensure good condition of all Road Assets. Two patrol vehciles with staff are provided for each package of work

During the discussions with the police department, provision of cranes for toeing was asked to toe away the vehicles stranded, met in accident or illegally parked on HDC's. provision of two toeing vehicles one for heavy vehicles like buses and trucks and another for LMV's is proposed.

Water logging at selected locations is a perennial issue during rainy season, especially at underpasses. In the even of water logging, the provision of sucking machines, pumps and Labour is also provisioned in the maintenance work.

CHAPTER 4: COST ESTIMATE

4.1 General

The Project cost is worked out based on estimated quantities from the detailed engineering design including road works, drainage works, pavement, culverts, road furniture, road safety appurtenances etc.

4.2 Construction Items

The following factors have been considered to arrive at the unit rates for various construction items.

The project cost estimates have been prepared separately for initial improvement works and Annual Maintenance works based on various items of works considered for the upgradation and annual maintenance of the project roads. The Major items rates are considered from **PWP IWTD SoR 2018-19, Bangalore Circle,** Govt. of Karnataka along with latest issue rates, and for few items derived rates are adopted.

Table 4.1: Adopted Unit Rates for Some of the Major Items (Excluding Area Weight Factor)

Sl. No.	Items	Unit	Rate
1	Milling of Existing Bituminous Layer	Sqm	70.00
2	Granular Sub base	Cum	1882.00
3	Wet Mix Macadam	Cum	1888.00
4	Dense Bituminous Macadam (DBM)	Cum	6045.00
5	Bituminous Concrete (BC)	Cum	6939.00
6	Interlocking Paver Blocks	Sqm	1110.00
7	M15 for Kerb Laying	Cum	5422.00
8	Kerb	Nos	450.00
9	Painting two Coats for Kerb	Sqm	82.00
10	Yard Manure	Cum	204.00
11	Planting permanent hedge	Mt	296.00
12	Tree Guard / Grating and Median guard Rail	Quintal	7187.00
13	Providing and Laying M20 for Drain	Cum	6670.00
14	Steel Reinforcement	Tonnes	61365.00
15	Road Marking- Thermoplastic	Sqm	429.00
16	Moulded Shank Raised Pavement Markers	Nos	337.00

4.3 Project Costing

Quantification

The quantification of various items of work is based upon the proposals recommended in the previous chapters. The quantities have been worked out separately for different items of work. The construction cost has been sub - divided into Preliminary Works, Carriageway improvement, Junction Improvement, Footpath and Kerbs, Medians and guard rails, Bus bays and Road Widening Works, Drainage Improvement and other structural Works, Traffic signs, Marking and other Appurtenances.

The following are the Bill wise of works, which have been estimated:

Preliminary Works including Dismantling, Clearance and Earthworks: The area considered for Site Clearance is the area within the proposed Right of Way width. and the damaged portions of Median Kerbs, and Footpath are proposed for dismantling.

Carriageway Improvements: Carriageway improvements costs includes Milling of existing bituminous surface, Strengthening and overlay as per the structural evaluation and Pavement design.

Junction Improvements: Junction improvement cost includes overlay for carriageway, Road markings, installation of sign Boards, High raised pedestrian crossings, construction of channelization islands as per the requirement.

Footpath and Kerbs: Footpath works cost includes removal of damaged paver blocks, kerb stones, etc and replacement with the new ones. In addition, the costing also includes the Green Hedging provision along the footpath

Median and Guardrail: The estimation of quantities for Median construction were based on site inventory, and Median Guard rails for pedestrian safety as per police department instruction is considered .

Bus Bays and Road Widening Works: The estimation of quantities for Bus bays and road widening works were based on the police department requirements , detailed design and drawings.

Drainage Improvement and Structural Works: Provision under this sub-head has been made for cost for construction of side drains, and repairs of RE wall.

Traffic Sign, Markings and Other Appurtenances: Proper traffic signs were selected at required locations along the project corridor. It is reviewed considering the traffic, pedestrian safety, and modified if required. Centre line and edge markings required from safety point of view were considered in the quantity estimate.

4.4 Total Project Cost

The total project cost of **package 3** is **81.66 Crores**, which includes Initial Improvement cost of **39.35 Crores**, Annual maintenance cost of **21.88 Crores**, 12% for GST, 5% Administration Charges, 3% for DPR and PMC charges, 10% Contingencies. The summary of the project is given in **Table 4.2** below for Total Project Cost along with Road Wise Cost Summary.

The detailed rate analysis and quantity estimation is given in Volume-3: Cost Estimate.

Table 4.2: : Summary of Cost for the Project

Sl. No	Description	HDC 05	HDC 06	HDC 07	HDC 12D	Package III
		Amount (Crores)	Amount (Crores)	Amount (Crores)	Amount (Crores)	Amount (Crores)
1	Preliminary Works including Dismantling, Clearance and Earthworks	0.00	0.00	0.02	0.19	0.20
2	Carriageway Improvements	0.10	0.26	0.58	4.37	5.31
3	Junction Improvements	0.10	0.03	0.23	0.34	0.71
4	Footpath and Kerbs	2.42	0.00	4.74	5.11	12.27
5	Median and Guardrail	1.83	4.67	4.11	3.41	14.03
6	Bus Bays and Road Widening Works	0.05	0.00	0.15	0.27	0.48
7	Drainage Improvement and Structural Works	0.55	0.25	0.72	0.45	1.96
8	Traffic Sign, Markings and Other Appurtenances	0.51	0.95	1.03	1.89	4.38
A.	**Initial Improvement Cost**	**5.57**	**6.17**	**11.58**	**16.03**	**39.35**
B.	**Annual Maintenance Cost**	3.12	6.94	6.16	5.67	21.88
C.	**GST @ 12% of (A+B)**	1.04	1.57	2.13	2.60	**7.35**
D.	**Administrative Charges @ 5% on (A+B)**	0.43	0.66	0.89	1.08	**3.06**
E.	**DPR & PMC Charges @ 3% on (A+B)**	0.35	0.90	0.79	0.65	**2.69**
F.	**Contingencies @ 10%**	1.04	2.04	2.08	2.14	**7.31**
G.	**Miscellaneous and Rounding off**	0.00	0.01	0.01	0.01	**0.03**
H.	**Total Project Cost (A+B+C+D+E+F+G)**	**11.56**	**18.28**	**23.63**	**28.19**	**81.66**

4.5 Implementation Plan

An implementation plan refers to a detailed description of actions that demonstrate how to implement an activity within the project in the context of achieving the objectives, addressing the requirements, and meeting the expectations. The above project is to be implemented in two forms.

1. Initial Improvement and
2. Maintenance

Initial Improvement: Initial improvement is to be done within first nine months of the project tenure year for carriage way, Junctions improvements, Footpath and Drain improvements, Traffic lane markings and sign boards, median island improvements and providing green edge in ongoing BBMP Tender works.

Maintenance: The proposed project roads are to be maintained periodically by clearing of pavement, Repair of traffic signs and road markings, Repair of damage caused by traffic accidents. The project corridors are to be maintained for 5 years.

4.6 Packaging

The Total Length of the all the high-density corridor is 191 Km which is spreader over the entire Bengaluru city. this will make the task of maintaining the road very cumbersome, as it will be very difficult to accesses, Monitor and control the activities over entire length. Hence the Total 15 roads of high-density corridors are grouped in to four packages, such that it will be convenient to Access, Monitor and control the different activities running along the corridor within each package.

4.7 Time Schedule.

The duration for the initial improvement works is 270 days covering various stages of work. The time schedule of the Project along with work Programme of activities is given below.

Sl. No	Description	Duration	Start Date	End Date
A	**Initial Improvement Works**	270 Days	01-04-2021	31-12-2021
1	Strengthening/Resurfacing, Road Marking, Traffic Signs for Priority Stretches	90 Days	01-04-2021	30-06-2021

Sl. No	Description	Duration	Start Date	End Date
2	Drainage and Utility Works	90 Days	01-04-2021	30-06-2021
3	Footpath and Kerbs	90 Days	01-05-2021	31-07-2021
4	Median and Guardrails	60 Days	01-07-2021	31-08-2021
5	Junction Improvements	60 Days	01-09-2021	31-10-2021
6	Strengthening/Resurfacing, Road Marking, Traffic Signs Road Appurtenances for Other Stretches	90 Days	01-10-2021	31-12-2021

The Annual Maintenance works needs to be executed continually throughout the year for the project duration of 5 Years.

MAINTENANCE OF HIGH DENSITY CORRIDORS IN BENGALURU CITY.

Summary of Works Under HDC No. 5 - Hosur Road Corridor

Sl. No.	Chainage in km		Location		BBMP Department	Ongoing Works / Completed Works Implemented By	Works Considered by KRDCL for Initial Improvement	Maintenance Proposal
	From	To	From	To				
1	Ch.0.000	Ch.1.950	Vellara Junction	Church Near Storm Water Drain crossing	RI-East	Proposed Widening and White Topping Work by Central Project (BBMP)	-	1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
2	Ch.1.950	Ch.5.050	Church Near Storm Water Drain crossing	Madivala Underpass	RI-South	Proposed White Topping Work by Central Project (BBMP)	-	
3	Ch.5.050	Ch.5.600	Madivala Underpass ← Flyover	Silk Board Fly Over ~~Start~~ →	RI-South Rd. Bommana halli.	Proposed Improvement by RI South	-	
4	Ch.5.600	Ch.6.450	Silk Board Fly Over Start	Start of NH Limit	RI-Bommanahalli	Work under progress ~~by RI- TEC~~ not considered.	-	

EE (RI-East)

EE (RI-South)

EE (RI-TEC)

EE (Project-Central) G

EE (KRDCL-SOUTH)

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4	Ch.13.000	Ch.16.500	Koliform Gate	Bannerghatta National Park	PWD	Overlay work in progress by PWD	-	
	Length of Corridor: 16.50 Km				**Total Cost:**		-	**Rs.9.56 Crores / year**

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Executive Engineer
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EE (RI-Road Widening)

MAINTENANCEOF HIGH DENSITY CORRIDORS IN BENGALURU CITY

Summary of Works Under HDC No -12 C Silk Board to Mysore Road Corridor

SL No	Chainage to Km		Location		BBMP Department	Ongoing Works / Completed works implemented by	Works Considered by KRDCL for Initial Improvement	Maintainenace Proposal
	From	to	From	to				
Link 1- Mysore road to Jedi Mara								1. Routine Maintenance incl. Mechanical Sweeping of carriageways and Manual Cleaning of Footpath. 2. Removal debries, roadside silt, C&D Wastes & allied works using Tractor Labours. 3. Patrolling. 4. Maintenance of Carriageway. 5. Maintenance of Drain & Footpath. 6. Street Light Maintenance. 7. Other Allied Works on emergent days
1	Ch 0.00	Ch 1.40	Mysore Road (Nayandahalli Junction)	PES college	RI - South	Proposed improvement under RI-TEC ✓		
2	Ch 1.40	Ch 9.50	PES college	Jedi Mara	RI - South	SFC work under progress by Project Central (BBMP)		
Link 2- Jayadeva to Silk Board								
3	Ch 0.00	Ch 2.50	Jayadeva	Silk Board	RI - South	Proposed improvement under RI ~~South~~ Extn. & Metro Corridor.		
	Length of Corridor		12.00 Km					

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EE (KRDCL-SOUTH)

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INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 General

India has a road network of over 4,689,842 kilometres (2,914,133 mi) in 2013, the second largest road network in the world. At 0.66 km of roads per square kilometre of land, the quantitative density of India's road network is like that of the United States (0.65) and far higher than that of China (0.16) or Brazil (0.20). However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are being improved. As of 2011, 54 percent – about 2.53 million kilometres – of Indian roads were paved.

Adjusted for its large population, India has less than 3.8 kilometres of roads per 1000 people, including all its paved and unpaved roads. In terms of quality, all season, 4 or more lane highways, India has less than 0.07 kilometres of highways per 1000 people, as of 2010. These are some of the lowest road and highway densities in the world. For context, United States has 21 kilometres of roads per 1000 people, while France about 15 kilometres per 1000 people – predominantly paved and high quality in both cases. In terms of all season, 4 or more lane highways, developed countries such as United States and France have a highway density per 1000 people that is over 15 times as India.

1.2 Classification of Roads in India

As per Indian Road Congress (IRC) and Ministry of Road Transport & Highways, Indian Roads are classified into three classes i.e. Primary, Secondary and Tertiary Systems, for the purposed of transport planning, functional identification, earmarking administrative jurisdictions and assigning priorities on a road network.

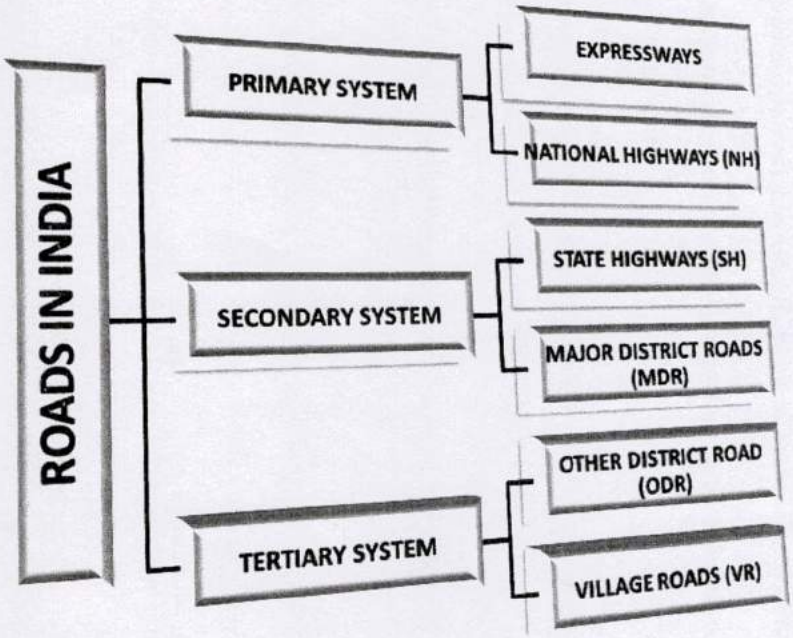


Figure 1.1 Classification of Roads in India

1.3 Classification of Urban Roads in India

The road systems within urban areas are classified as Urban Roads and will form a separate category of roads to be taken care by the representative urban authorities. Further urban roads are classified as

Figure 1.2 Classification of Urban Roads in India

1.4 Project Background

Bengaluru's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads and residential streets.

The main arterial roads of Bengaluru coming into the city include Bellary Road in the north, Tumkur Road and Mysore Road in the west, Kanakpura Road, Bannerghatta Road and Hosur Road in the south and Airport Road and Old Madras Road in the east, and all these roads are inter connected with Outer Ring road.

Bangalore Commissioner of Police notified 12 Major Roads connecting inter-districts and inter-states as High Traffic Density Corridors vide Notification dated:03-09-2019

Bengaluru 's vehicular traffic has increased manifold, with 1.6 million registered vehicles in the city – the second highest for an Indian city, after New Delhi.

The construction and maintenance of roads to address the growing traffic in the city has been a challenge to the BDA and the BBMP. To reduce the pressure of hectic maintenance activities for BBMP and to ensure the effective maintenance of high-volume traffic arterial roads it has been proposed to handover the maintenance of High-density corridors to Karnataka Road Development Corporation Limited (KRDCL).

A decision has been taken in the meeting held on 06/11/2019 under the Chairmanship of Hon'ble Chief Minister, Govt. Of Karnataka for Upgradation and maintenance of 12 High Traffic Density Corridors as per IRC guidelines to be taken by Karnataka Road Development Corporation Ltd.side drains, Construction of Pedestrian footpaths.

1.4.1 Location and Terrain condition

Table 1.1 Details of Road

Sl. No	Name of the Road	Length in Km
1	HDC 8: Mysore Road	15.40
2	HDC 9: Magadi Road	12.00
3	HDC 10: Tumkur Road	7.90
4	HDC 11: West of Chord Road	8.40
5	HDC 12a: ORR (From Mysore Road to Gorguntepalya)	10.90
	Total	**54.60**

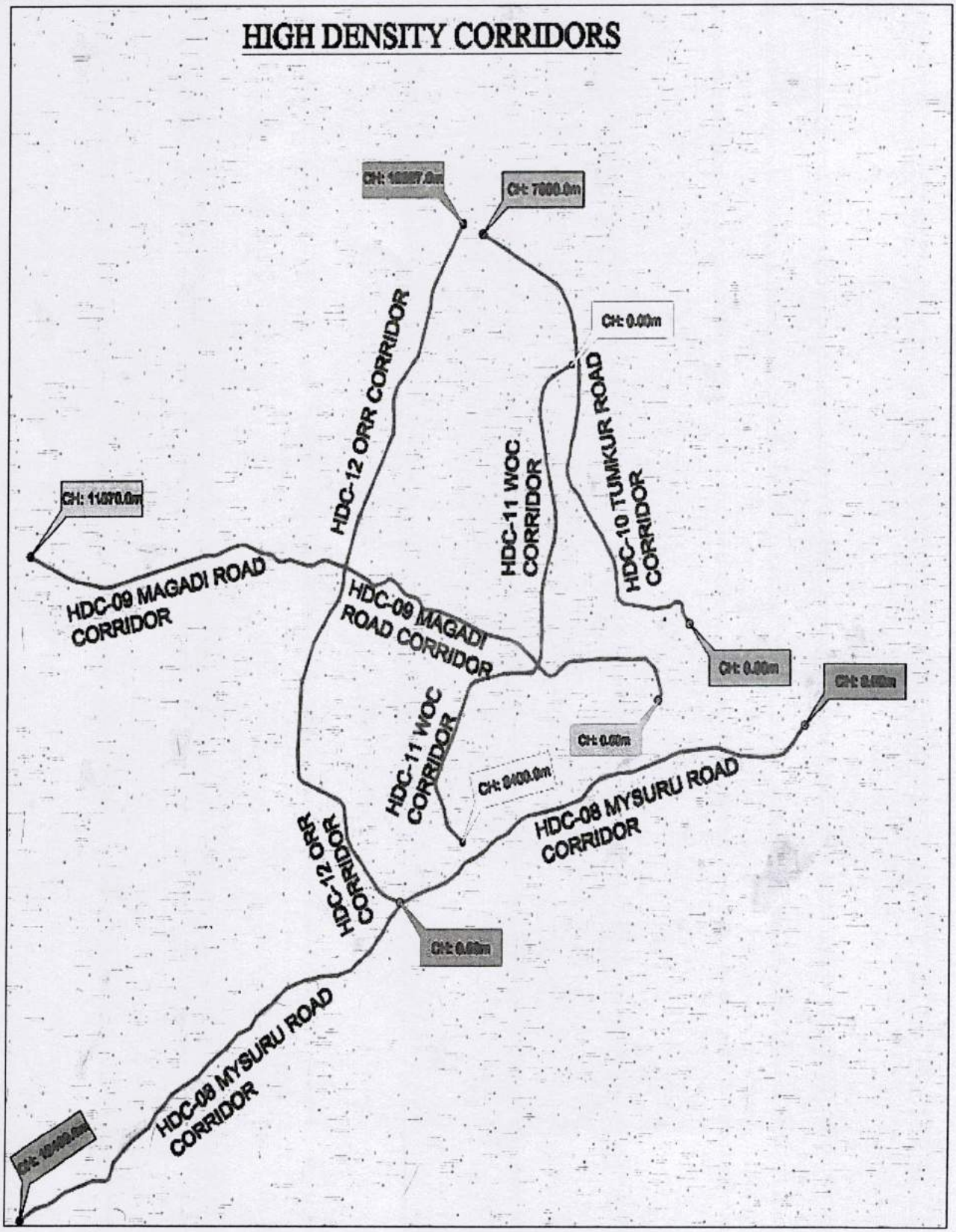


Figure 1.3 Map Showing Road Network

1.5 Objective

The objective of the consultancy services is to recommend an optimal proposal for implementation, which comprises of:

- *Reconnaissance Survey.*
- *Inventory and Pavement Condition Survey.*
- *Pavement Structural Evaluation*
- *Topographical Surveys.*
- *Hydrological and Drainage Investigation.*
- *Provision of road and CD Works to meet functional and structural requirements;*
- *Adequate road side drainage to preserve the road assets; and*
- *Highest safety of road users achieved through improvement to road & junction geometrics, appropriate street furniture, road signs and illumination.*
- *Preparation of cost estimate.*

1.4 Structure of the Report

This report includes following:

- *Chapter 1 : Introduction*
- *Chapter 2 : Methodology Adopted for Study*
- *Chapter 3 : Engineering Surveys and Investigations*
- *Chapter 4 : Preliminary Alignment Study*
- *Chapter 5 : Pavement Design*
- *Chapter 6 : Conclusions*

CHAPTER 2

METHODOLOGY ADOPTED FOR STUDY

2.1 General

Various engineering surveys and investigations that are essential inputs for the preparation of detailed project report have been carried out along the Project Road section conforming to IRC Specifications/Codes to generate adequate database for preparing the most appropriate and optimal improvement proposal for rehabilitation, widening/strengthening and upgrading the existing road section. All the relevant maps/data/details available with the concerned departments have been collected, compiled and reviewed. Particular attention has been given to past/historical data. A review of the past data available in the various studies has been made use of, after updating/augmenting the data wherever necessary. The activities were performed on several fronts fully complying with the requirements. The activities carried out with specific reference to the present project are succinctly brought out hereunder. All the investigation/surveys have been carried out on a priority basis. The various engineering surveys/investigations, which have been carried out include:

- *Reconnaissance Survey*
- *Pavement Condition Survey*
- *Material Survey*
- *Pavement Structural Evaluation*
- *Topographic/Levelling Survey*
- *Traffic Surveys*
- *Inventory and Condition Survey of Bridges and CD Structures*
- *Engineering Design*
- *Cost Estimates*

The basic data collected from different engineering surveys along with the results of the survey / investigations, data analyses are compiled.

2.2 Engineering Surveys and Investigations

2.2.1 Reconnaissance Survey

The consultants made an in-depth study of the available land width (ROW), topographic survey maps of the project area and other relevant information were collected.

BANGALORE

A detailed reconnaissance survey was conducted on the total project area and an assessment of possible alignment change at places, if required, was also made. Detailed features such as land-use, habitation, water routes, utilities such as electrical lines (HT / LT), etc. were also noted down. This enabled the Consultants to visualize the possible problems likely to be encountered with in the execution of the project. The detailed ground reconnaissance of project influence area was utilized for planning and programming the detailed surveys and investigations.

2.2.2 Road Inventory and Road Condition

An inventory of the project road has been carried out by visual observations supplemented with sample measurements using tape etc. Kilometre wise features like terrain, land-use, pavement surfacing type and width, shoulder surfacing type & width, Subgrade, local soil type, curve details, retaining structures details, location of water bodies, height of embankment or depth of cut, ROW, CD structures, road side arboriculture, existing utility services and general drainage conditions etc., were recorded. Also Crust Thickness of the existing pavement were recorded by core cutting. The road inventory has been referenced to the existing km posts established along the roadside. A detailed road inventory, Crust Thickness and condition survey are presented in the **Appendix**

2.2.3 Pavement Structural Evaluation

Principle of Pavement Evaluation using FWD

The structural strength evaluation of the existing pavements was carried out as per IRC 115: 2014. Performance of Flexible Pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads and analyzing these data duly considering the factors influencing the performance such as subgrade strength, thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Falling weight Deflectometer (FWD) is extensively used worldwide because it simulates, to a large extent, the actual loading conditions of the pavement. When a moving wheel load passes over the pavement it produces load pulses. Normal stresses at a location in the pavement will increase in magnitude from zero to a peak value as the moving load approaches the location. The time taken for the stress pulses to vary from zero to peak value is termed as 'rise time of pulse'. As the wheel moves away from the location, magnitude of stress reduces from peak value to zero. The time period during which the magnitude of stress

pulse varies from 'zero-to-peak-to-zero 'is the pulse duration. Peak load and the corresponding pavement responses are of interest for pavement evaluation.

The resulting load deflection data can be interpreted through appropriate analytical techniques, such as back calculation technique, to estimate the elastic moduli of the pavement layers. The computed moduli are in turn used for

- The strength evaluation of different layers of in-service pavements
- The estimation of the remaining life of in-service pavement
- Determination of strengthening requirement, if any
- Evaluation of different rehabilitation alternatives (Overlay, recycling, partial reconstruction, etc)

2.2.4 Topographical Survey

Topographic survey using total station equipment was conducted and a contour map shall be prepared showing contour line drawn at an interval of 0.5m, it also indicates all the prominent existing features such as roads, railway tracks, colonies, (independent houses also), power lines, water bodies, farms, gardens, fields etc. Few reference stones were marked on the survey map and their levels were enlisted (smaller to larger scales). Providing and fixing of boundary stones at an interval of 50m and additionally wherever bends occurs was done as per the directions of Engineer In charge.

2.2.4.1 Block Level Survey

Block level survey was taken up and a contour map was prepared showing contours at intervals of 0.5m. It also indicates land use and all the prominent existing features such as roads, railway tracks, colonies, independent houses, water bodies, farms, gardens, fields, fences etc., cardinal points was marked with reference stones on the ground and marked on the survey map. The RL was indicated based on either an established PBM, if available, or with reference to a TBM established.

2.2.4.2 Office Processing

The field survey will be processed in the office to provide a digital output file for the design engineers. The Surveyor will arrange for a proof survey for a statistical sample to check the digital maps in the field.

The data will be structured so that the vertical profile of the proposed alignment can be produced automatically. The format of the resulting data will be such as will readily promote the calculations of earthworks (if any) and other quantities required for the evaluation of

detailed cost estimates.

2.2.5 Hydrology and Drainage Investigations

A detailed inventory and condition survey carried out to determine the High flood levels (HFL's) in the project area.

Some of the major features collected were:

- Information was collected about the soils vegetation and drainage pattern along the project area.
- All necessary hydrological and other data for storm water and sub-surface drainage systems were collected.
- Characteristics of water crossings and hydrological structures were collected.

2.2.6 Engineering Design

Based on the existing road conditions, present Right-of-way (ROW) and traffic movement, we have developed designs and roadway plans necessary for the project. The improved HDC's will look aesthetically pleasing, efficient in traffic movement, uniform lanes, pedestrian friendly sidewalks, pleasing medians, adequate lighting and landscaping where possible.

We have considered all the current improvements undertaken by BBMP, BDA and designed further needed improvements.

2.2.6.1 Pavement Design

The pavement design includes Overlay design of the existing pavement

Falling weight Deflectometer Test Results and Pavement Condition Survey data as well as close reconnaissance by experts were used to determine the strengthening requirement of existing pavement. The thickness of overlay was proposed judiciously considering the provisions of IRC: 115-2014.

New pavement design is in accordance with IRC:37-2018.

2.2.7 Preliminary Cost Estimates

The rate of materials adopted in the preliminary cost estimate is based on the basic rates of PW, P & IWTD S.O.R. (Bengaluru Circle). For items where these rates are not available, the rates were adopted as per Market rates. For the working out of preliminary cost estimate, work items are split into the following sub-heads:

- Site Clearance and earthworks
- Granular Pavement Courses

- Flexible Pavement Overlays
- Culverts, Retaining Walls and other structures
- Drainage and other Protective works
- Road Furniture and Road Safety Works
- Traffic Management and maintenance during construction

CHAPTER 3

SCHEDULES

3.1 The Site

Site of the Project Road shall include the Road works, Parking lots, Bus bays, land, Drains and structures as described in table 3.1.

An inventory of the Site including the road works, land, buildings, structures, trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority Representative and the Contractor, and such inventory shall form part of the memorandum referred to in the Agreement.

The Master plan of the project road is specified in Map attached below (Fig 3.1). The proposed improvement of the project Roads shall be followed by the contractor with not less than the minimum proposal as per the Schedule. The contractor, however, may improve/upgrade the proposal as indicated in Annexure-II based on site/design requirement.

Table 3.1 Details of Road

Sl. No	Name of the Road	Length in Km
1	HDC 8: Mysore Road	15.40
2	HDC 9: Magadi Road	12.00
3	HDC 10: Tumkur Road	7.90
4	HDC 11: West of Chord Road	8.40
5	HDC 12a: ORR (From Mysore Road to Gorguntepalya)	10.90
	Total	**54.60**

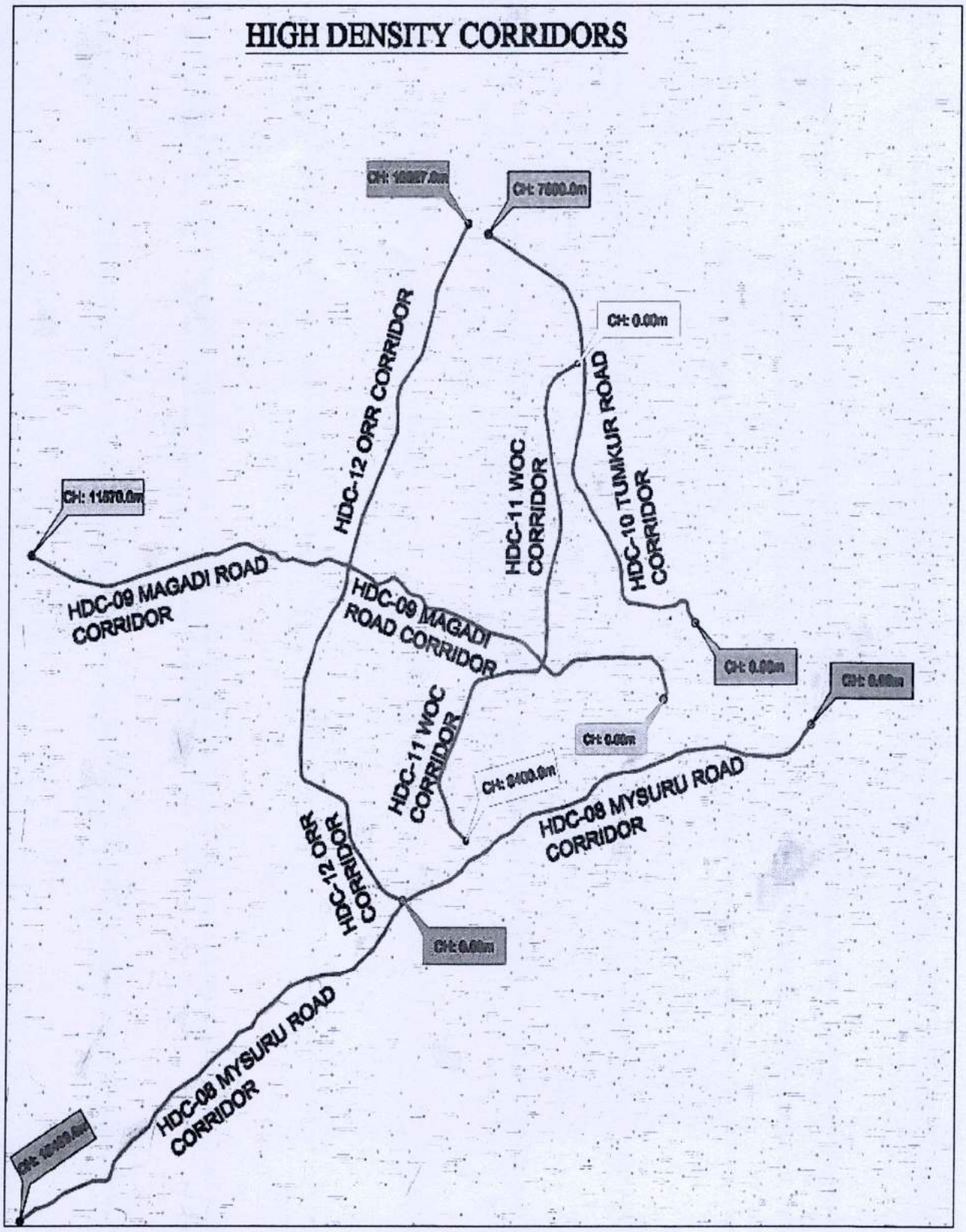


Figure 3.1 Map Showing Road Network

3.2 Land

The Site of the Project Road comprises the land, existing right of way as described below:

Sl. no	Name of Place		Existing Chainage in Km		Length in (Km)	Existing ROW(m)
	From	To	From	To		
HDC 08– Mysore Road						
1	Hudson Circle	Nice Road	0.00	15.40	15.40	13.50 m to 59.05 m
HDC 09 – Magadi Road						
2	Leprosy Hospital	Nice Road	0.00	12.00	12.00	15.00 m to 45.00 m
HDC 10 – Tumkur Road						
3	Sangolli Rayanna Circle	Gorguntepalya junction	0.00	7.90	7.90	16.30 m to 81.93 m
HDC 11– West Of Chord Road						
4	Sandal Soap Factory	Deepanjalinagar	0.00	8.40	8.40	22.30 m to 67.47m
HDC 12a – Outer Ring Road						
5	Nayadanahalli Junction	Gorguntepalya Junction	0.00	10.90	10.90	24.47 m to 62.30m
Total Length in Km					**54.60**	

3.3 Carriageway

The present carriageway of the Project Road varies from Two lane Single carriageway to Six lane divided carriageway. The type of the existing pavement is both Flexible and Rigid pavement. Details of the existing carriageway is given in the following table.

Existing Chainage in Km		Length in (Km)	One Way / Two Way Traffic Movement	Divided/ Undivided Carriageway	Carriageway Width			Pavement type
From	To				LHS	Median	RHS	
HDC 08– Mysore Road								
0.00	15.40	15.40	One Way and Two Way	Divided and Undivided	5.48m to 21.15m	0.45 m to 3.0 m	5.15 m to 7.62 m	CC and BC
HDC 09 – Magadi Road								
0.00	12.00	12.00	Two Way	Divided	6.00 m to 16.50 m	0.60 m to 2.50m	5.30 m to 23.60 m	BC

Existing Chainage in Km		Length in (Km)	One Way / Two Way	Divided/ Undivided Carriageway	Carriageway Width			Pavemen
HDC 10 – Tumkur Road								
0.00	7.90	7.90	Two Way	Divided	6.50 m to 25.50 m	0.35 m to 3.00m	5.50 m to 42.85 m	BC and White Topping
HDC 11– West Of Chord Road								
0.00	8.40	8.40	Two Way	Divided	6.30 m to 13.00 m	0.50 m to 3.00m	2.30 m to 14.00 m	CC and BC
HDC 12a – Outer Ring Road								
0.00	10.90	10.90	Two way	Divided	7.25m to 11.0m	0.60 m to 2.50 m	7.25m to 11.0m	CC and BC

3.4 Road Side Drain

The details of the side drain along the Project Corridors are as follows

Sl. No	Existing chainage in km		Length in km	Side	Total Length
	From	To			
HDC 08– Mysore Road					
1	0.00	15400	15.40	Both	18.70
HDC 09 – Magadi Road					
2	0.00	11000	11.00	Both	22.00
HDC 10 – Tumkur Road					
3	0.00	7700	7.70	Both	15.40
HDC 11– West of Chord Road					
4	0.00	8300	8.30	Both	16.60
HDC 12a – Outer Ring Road					
5	0.00	10827	10.827	Both	21.654
Total Length of Drain					**94.354**

3.5 Footpath

The details of the Existing Footpath along the Project Road are as follows.

Existing Chainage in Km		Length in (Km)	Paved / Unpaved	Footpath			
				LHS		RHS	
From	To			Length km	Width in m	Length km	Width in m
HDC 08– Mysore Road							
0.00	15400	15.40	Paved	15.40	0.3 m to 8.62 m	9.40	0.26 m to 6.0 m
HDC 09 – Magadi Road							
0.00	11000	11.00	Paved	11.00	0.0 m to 5.10 m	11.00	0.9 m to 5.0 m

HDC 10 – Tumkur Road							
0.00	7700	7.70	Paved	7.70	0.36 m to 5.30m	7.70	0.93 m to 5.68 m
HDC 11– West of Chord Road							
0.00	8300	8.30	Paved	8.30	0.79 m to 6.10 m	8.30	0.9 m to 3.5 m
HDC 12a – Outer Ring Road							
0.00	10827	10.827	Paved	10.827	1.0 m to 4.8 m	10.827	1.0 m to 9.5 m
Total Length of Footpath in Km						**58.98**	

3.6 Service Roads

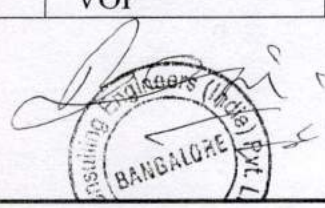
The Existing Service Road Detail is in the following table.

Sl. No	Existing chainage in Km		LHS			RHS		
	From	To	Length, Km	Width, m	Type of Pavement	Length, Km	Width, m	Type of Pavement
HDC 09– Magadi Road								
1	3.199	3.532	0.333	7.4m	Flexible	0.333	7.65 m	Flexible
HDC 10 – Tumkur Road								
2	5.100	7.600	2.50	7.5m	Flexible	0.1	2.9m	Flexible
HDC 11– West of Chord Road								
3	0.900	8.25	7.15	4.5 m to 15.0m	Flexible	7.35	4.5 m to 9.0m	Flexible
HDC 12a – Outer Ring Road								
4	0.650	10.827	10.027	3.8 m to 14.10m	Flexible	10.127	4.4 m to 14.30m	Flexible
Total Length of Service Road in Km						**37.920**		

3.7 Structures

The Existing Structure Detail is in the following table.

Sl No	Type of Structure	No of Structures					Total
		HDC 08	HDC 09	HDC 10	HDC 11	HDC 12a	
1	Bridges	2	1	2	1	3	9
2	Culverts	6	4	-	-	-	10
3	Flyover	2	-	1	3	7	13
4	ROB/RUB	-	-	2	1	-	3
5	VUP/PUP/CUP/ VOP	-	1	3	2	9	15



3.8 Bus Shelters / Bus Bays / BusStop

In this project road there are 115 No. of bus stops the details are shown below:

Sl No	Chainage	Side		Remarks
		LHS	RHS	
HDC 08– Mysore Road				
1	0.00	Yes	-	Hudson circle
2	690.0	Yes	-	State Gun House
3	1200	-	Yes	BMTC bus stop
4	2380	Yes	-	Murthi Cycle Shop
5	2430	-	Yes	Vetarinary Hospital
6	3200	-	Yes	RK Bar &Restaure
7	3620	-	Yes	Bharath Petroleum
8	3980	-	Yes	1st Main Cross Road
9	4030	-	Yes	Bus Stop
10	4050	Yes	-	GSPH (Lift)
11	4750	-	Yes	VPL Pvt.Ltd
12	4950	-	Yes	New Master Piece
13	5250	Yes	-	Satallite Bus Stand
14	6120	-	Yes	Deepanjali Nagar Junction
15	7000	Yes	-	Rajalakshmi weigh bridge
16	7500	-	Yes	2nd cross
17	8010	-	Yes	B.P Petrol bunk
18	11150	-	Yes	RV College Bus Stop
19	11200	Yes	-	RV College Bus Stop
20	13000	-	Yes	Kengeri Main Bus Station
21	13650	-	Yes	Kengeri police station
22	13700	Yes	-	KSRTC Ticket booking centre
HDC 09– Magadi Road				
23	200.00	-	Yes	Gopalapura 1st cross
24	800.00	-	Yes	Jana Jyothi Building
25	830.00	Yes	-	Jyoti motors
26	1330.00	-	Yes	Saptagiri complex
27	1450.00	Yes	-	M.S Complex
28	1630.00	Yes	-	Cholurpalya Cross
29	1800.00	Yes	-	Ganapati temple
30	1830.00	-	Yes	Indian oil Petrol Bunk
31	2563.00	-	Yes	Sri Shiradisai fashions
32	2860.00	Yes	-	DasarahalliBusstop
33	2997.00	-	Yes	whirpool service centre
34	3233.00	Yes	-	Indian oil Petrol Bunk
35	3423.00	-	Yes	UCO Bank
36	3530.00	Yes	-	Leonardo Automation

Sl No	Chainage	Side		Remarks
		LHS	RHS	
37	3600.00	-	Yes	Sri revannasiddeshvara mess
38	4195.00	-	Yes	Dananjaya palace
39	4211.00	-	Yes	AthreyaAyurvedha pharm
40	4941.00	Yes	-	Sri manjunatha creations
41	5290.00	-	Yes	Gajananan Xerox centre
42	5950.00	Yes	-	UdupiUpahaar
43	6200.00	-	Yes	Bank Of Baroda
44	7130.00	-	Yes	Sangeetha Mobiles
45	7200.00	Yes	-	Sri Murthy Comlex
46	7400.00	-	Yes	Star Furnitures
47	7850.00	Yes	-	Sri VinayakaTilor
48	7900.00	-	Yes	Adishwara
49	8450.00	Yes	-	Govt. School
50	8550.00	-	Yes	Shankar Nag Auto stand
51	9050.00	Yes	-	AnjanaNagara Junction
52	9100.00	-	Yes	Mamata Bangles
53	9750.00	Yes	-	KPTCL
54	9850.00	-	Yes	Kiran Wines
55	10150.00	Yes	-	Indian oil Petrol Bunk
56	10250.00	Yes	-	ManjunathCandimantes
57	10350.00	-	Yes	Home Style Furniture
58	10850.00	-	Yes	Sri Ranganatha Auto Mobiles
59	10900.00	Yes	-	Junction
HDC 10 – Tumkur Road				
60	468.00	-	Yes	RRR Kalyanamantapa
61	560.00	Yes	-	Jain heights palace
62	1120.00	Yes	-	Big tree
63	1150.00	-	Yes	Sujatha talkies
64	1156.00	-	Yes	SKT tyres
65	1165.00	Yes	-	Planet Honda service station
66	3010.00	-	Yes	Sagarsima 1960
67	4110.00	Yes	-	Karmikarajyavimanigama
68	4140.00	Yes	-	Indian oil Petrol bunk
69	4800.000	-	Yes	Sandal Soap metro station
70	4900.00	-	Yes	Statue
71	5500.00	Yes	-	Yeshwanthpura
72	6300.00	-	Yes	APMC Yard
73	6400.00	-	Yes	Vaishnavi sapphaire center
74	6600.00	Yes	-	ICICI Bank
75	6900.00		Yes	IOC Namratha Agency

Sl No	Chainage	Side		Remarks
		LHS	RHS	
76	7100.00	Yes	-	Sparsh Hospitals
77	7500.00	-	Yes	People tree Hospital
HDC 11– West Of Chord Road				
78	170.00	Yes	-	Mysore Sandal soap factory
79	180.00	-	Yes	Ravindu Toyota Show Room
80	192.00	-	Yes	Ravindu Toyota Show Room
81	830.00	Yes	-	Iskcon Temple
82	1200.00	Yes	-	Aram Hotel
83	1750.00	-	Yes	Metro Building
84	1760.00	Yes	-	Metro Building
85	2170.00	Yes	-	Sindhu Hotel
86	2580.00	-	Yes	Ananya Hospital
87	2870.00	Yes	-	Nandana Palace
88	3273.00	Yes	-	J.P lights
89	3280.00	-	Yes	Car decorators
90	3330.00	-	Yes	G.D cars
91	3330.00	Yes	-	G.D cars
92	5600.00	Yes	-	KSRTC Dispensary
93	5700.00	Yes	-	Falcon Foot Wear
94	5700.00	-	Yes	Falcon Foot Wear
95	6000.00	Yes	-	Mini Corner Stores
96	6200.00	-	Yes	Maruthi Complex
97	6200.00	-	Yes	Maruthi Complex
98	6450.00	-	Yes	Vacant Land
99	6650.00	Yes	-	Prasad Enterprises
HDC 12a – Outer Ring Road				
100	120	Yes	-	Mandovi Motors
101	620	-	Yes	Modern Bakery
102	700	Yes	-	Disha Designs
103	1450	Yes	-	Manish Food
104	1450	-	Yes	Manish Food
105	2230	-	Yes	Sai Ganesh Hotel
106	2300	Yes	-	Nandini Layout Bus stop
107	2700	-	Yes	To Nandini layout
108	2700	Yes	-	To Nandini layout
109	3300	Yes	-	GM Tours Travels
110	3500	-	Yes	Popular Finance
111	3950	-	Yes	CMH Bar
112	3950	Yes	-	CMH Bar
113	6400	Yes	-	Sri Plaza
114	7600	Yes	-	Open land

Sl No	Chainage	Side		Remarks
		LHS	RHS	
115	9950	Yes	-	Sri Maruthi Modular Kitchen

3.9 Junctions

In the project road, there are 94 major junctions and 09 minor junctions. Details of all the junctions are given below:

Major Junction

Sl. No	Existing chainage	Type of Junction	Road Type	Side
HDC 08– Mysore Road				
1	30.00	+	BT	Both
2	200.0	+	BT	Both
3	500.0	Y	BT	Both
4	575.0	Y	BT	Both
5	810.0	T	BT	Both
6	1150.0	+	BT	Both
7	1350.0	+	BT	Both
8	1740.0	T	BT	Both
9	1910.0	T	BT	Both
10	2170.0	+	BT	Both
11	2330.0	+	BT	Both
12	2440.0	+	BT	Both
13	2610.0	T	BT	Both
14	2790.0	T	BT	Both
15	3060.0	T	BT	Both
16	3350.0	+	BT	Both
17	3770.0	+	BT	Both
18	4270.0	T	BT	Both
19	4930.0	T	BT	Both
20	5230.0	T	BT	Both
21	5520.0	Circle	BT	Both
22	5760.0	T	BT	Both
23	6050.0	Circle	BT	Both
24	7260.0	+	BT	Both
25	7350.0	+	BT	Both
26	7500.0	+	BT	Both
27	7840.0	+	BT	Both
28	8300.0	+	BT	Both
29	8750.0	T	BT	Both
30	9350.0	T	BT	Both
31	10150.0	T	BT	Both

Sl. No	Existing chainage	Type of Junction	Road Type	Side
32	12500.0	T	BT	Both
33	13200.0	+	BT	Both
34	13600.0	+	BT	Both
35	15000.0	Y	BT	Both
HDC 09 – Magadi Road				
36	0.00	T	BT	RHS
37	1350.0	Y	BT	RHS
38	1850.0	+	BT	BOTH
39	2280.0	T	BT	LHS
40	2635.0	+	BT	BOTH
41	3020.0	T	BT	LHS
42	3300.0	+	BT	BOTH
43	3760.0	+	BT	BOTH
44	4036.0	Y	BT	RHS
45	4620.0	+	BT	BOTH
46	4690.0	Y	BT	RHS
47	4940.0	Y	BT	LHS
48	5430.0	+	BT	-
49	6261.0	T	BT	LHS
50	8400.0	T	BT	RHS
51	8600.0	T	BT	RHS
52	9080.0	+	BT	BOTH
53	9300.0	T	BT	LHS
54	9450.0	T	BT	RHS
55	10080.0	T	BT	LHS
56	10090.0	+	BT	BOTH
HDC 10 – Tumkur Road				
57	0.00	Skewed Y	BT	LHS
58	610.0	Skewed Y	BT	LHS
59	1250.0	+	BT	Both
60	1850.0	T	BT	RHS
61	2030.0	+	BT	Both
62	2200.0	+	BT	Both
63	2350.0	T	BT	Both
64	2750.0	+	BT	Both
65	3100.0	+	BT	Both
66	3400.0	+	BT	Both
67	3550.0	Multiple Intersection	BT	Both
68	3810.0	+	BT	Both
69	4050.0	T	BT	Both
70	5050.0	Y	BT	Both
71	6750.0	+	BT	Both
72	7300.0	+	cc	Both
HDC 11 – West Of Chord Road				

Sl. No	Existing chainage	Type of Junction	Road Type	Side
	815.00	T	BT	RHS
74	1200.0	+	BT	Both
75	1950.0	+	BT	Both
76	2450.0	+	BT	Both
77	3136.0	+	BT	Both
78	3435.0	+	BT	Both
79	4490.0	+	BT	Both
80	4900.0	+	BT	Both
81	5200.0	T	BT	RHS
82	5600.0	+	BT	Both
83	6100.0	T	BT	RHS
84	6250.0	+	BT	Both
85	6450.0	+	BT	Both
86	7150.0	T	BT	RHS
87	7450.0	+	BT	Both
HDC 12a – Outer Ring Road				
88	1030.0	+	BT	Both
89	1890.0	+	BT	Both
90	5180.0	+	BT	Both
91	6760.0	+	BT	Both
92	8300.0	T	BT	RHS
93	9020.0	+	BT	Both
94	10580.0	+	BT	Both

Minor Junction

From the inventory,it is found that there are 02 minor junctions in Mysore Road,01minor junction in Magadi Road , 02 minor junctions in Tumkur road, 01minor junction in West Of Chord Road and 03 minor junctions in Outer Ring Road.

3.10 Road Furnitures

Sl No	Description	Unit	Quantity					Total
			HDC 08	HDC 09	HDC 10	HDC 11	HDC 12a	
1	Street lights	No	514	322	144	559	558	2097
2	Highmast	No	-	3.00	-	-	-	3.00
3	Pedestrian guard rails	km	1.55	0.45	0.60	0.48	-	3.08
4	Kerb	km	7.75	5.90	5.40	7.30	9.60	35.95
5	Pavement marking							
5.1	Edge Lane Marking	km	2.70	7.10	3.20	6.20	4.70	23.90
5.2	Centre Lane	km	2.70	7.10	2.35	4.20	4.70	21.05

Sl No	Description	Unit	Quantity					Total
			HDC 08	HDC 09	HDC 10	HDC 11	HDC 12a	
	Marking							
6	New jersy barrier	km	2.45	0.60	2.40	2.30	0.60	8.35
7	Road studs	km	2.70	3.50	1.50	1.00	-	8.70
8	Sign boards	No	151	260	275	245	288	1219
9	Land scaping	km	2.15	3.20	2.40	5.54	9.90	23.19
10	Bollards	No	-	-	65.00	51.00	-	116.00

3.11 Pavement Type

Sl No	Chainage		Length	Pavement type	
	From	To		LHS	RHS
HDC 08– Mysore Road					
1	0.00	600	0.60	BT	BT
2	600	1150	0.55	BT	CC+BT
3	1150	1350	0.20	BT	CC
4	1350	2100	0.75	BT	BT
5	2100	2200	0.10	CC	BT
6	2200	2350	0.15	BT	CC+Paver
7	2350	2450	0.10	BT	CC
8	2450	3300	0.85	BT	CC+Paver
9	3300	3600	0.30	BT	BT
10	3600	3650	0.05	BT	CC+Paver
11	3650	3800	0.15	BT	CC+BT
12	3800	3850	0.05	CC+BT	CC+BT
13	3850	3950	0.10	CC+BT	CC
14	3950	4100	0.15	CC+BT	CC+Paver
15	4100	4150	0.05	CC+BT	CC
16	4150	4250	0.10	CC+BT	CC+Paver
17	4250	4300	0.05	CC+BT	CC+BT
18	4300	4400	0.10	CC+BT	CC+Paver
19	4400	4450	0.05	CC+BT	CC+BT
20	4450	4500	0.05	CC	CC+Paver
21	4500	4650	0.15	CC+BT	CC+Paver
22	4650	4850	0.20	CC+BT	CC+BT
23	4850	4950	0.10	CC	CC
24	4950	5600	0.65	CC+BT	CC+BT
25	5600	5700	0.10	BT	BT
26	5700	5900	0.20	CC+BT	CC+BT
27	5900	15400	9.50	BT	BT

Sl No	Chainage		Length	Pavement type	
	From	To		LHS	RHS
HDC 09 – Magadi Road					
1	0.00	11000	11.00	BT	BT
HDC 10 – Tumkur Road					
1	0	7000	7.00	BT	BT
2	7000	7700	0.70	White Topping	White Topping
HDC 11 – West of Chord Road					
1	0.00	200	0.20	CC	CC
2	200	300	0.10	BT	BT
3	300	500	0.20	CC	CC
4	500	600	0.10	BT	BT
5	600	1300	0.70	CC	CC
6	1300	1400	0.10	BT	BT
7	1400	1800	0.40	CC	CC
8	1800	6600	4.80	BT	BT
9	6600	8250	1.65	CC	CC
HDC 12a – Outer Ring Road					
1	0.00	1600	1.60	BT	BT
2	1600	2250	0.65	CC	BT
3	2250	2600	0.35	BT	BT
4	2600	2750	0.15	BT	CC
5	2750	3700	0.95	CC	CC
6	3700	3900	0.20	BT	CC
7	3900	4000	0.10	BT	BT
8	4000	4050	0.05	BT	CC
9	4050	4900	0.85	CC	CC
10	4900	4950	0.05	CC	BT
11	4950	5350	0.40	BT	BT
12	5350	5800	0.45	BT	CC
13	5800	5850	0.05	BT	BT
14	5850	7200	1.35	BT	CC
15	7200	7600	0.40	CC	CC
16	7600	8050	0.45	BT	CC
17	8050	8550	0.50	CC	CC
18	8550	8600	0.05	CC	BT
19	8600	10800	2.20	BT	BT
Total Length of Flexible Road:- 44.55 Km					
Total Length of Concrete Road:- 11.50 Km					
Total Length of Concrete and Flexible Road:- 3.50 Km					

Engineers (India) Pvt. BANGALORE

CHAPTER 4

DESIGN STANDARDS, METHODOLOGIES AND SPECIFICATIONS

4.1 Project Corridors

The proposed improvement is to be carried out to make it a good infrastructure for improvement of residential and commercial configuration in all respects. The terrain on this stretch is plain.

This section describes the standards and principles based on which various designs will be carried out. These proposed standards are consistent with the parameters recommended in the relevant standards of the Indian Roads Congress (IRC). The aim of this chapter is to evolve design standards and material specifications for the study, which is primarily based on IRC publications and MoRTH circulars and relevant standards.

4.2 Classification of Urban Roads

The following classification of urban roads has been recommended in IRC-86:1983

- Arterial Roads
- Sub-arterial roads
- Collector Streets
- Local streets

4.3 Guiding Principles

While carrying out the geometric design, the following points will be taken into consideration:

The designed facility shall not become obsolescent before the design year.

Design shall be consistent and the standards followed for different elements shall be compatible with one another.

The design shall cover all geometric aspects of the road including signage.

The design will be worked out, aiming at minimizing the vehicle operating cost, including initial cost and cost of maintenance etc.

The design will take into consideration the environmental and landscaping aspects of the project road

4.4 Traffic Design

4.4.1 General

IRC has, however, published highway capacity standards for rural / urban highways.

Capacity analysis is fundamental to the planning, design and operation of roads, and provides, among other things, the basis for determining the carriageway width to be provided at any point in a road network with respect to the volume and composition of traffic. Moreover it is a valuable tool for evaluation of the investments needed for future road constructions and improvements.

4.4.2 Definition and Concepts

Volume (or Flow) is the number of vehicles that pass through a given point on the road during a designated time interval. Since roads have a certain width and numbers of lanes are accommodated in that width. Flow is always expressed in relation to the given width (i.e., per lane or per two lane etc.). The time unit selected is an hour or a day. ADT is the volume of average Daily Traffic when the measurements are taken for a few days. AADT is the volume of the Annual Average Daily Traffic when measurements are taken for 365 days of the year and averaged out. (Clause 4.5 of IRC 106 of 1990)

Density (or Concentration) is the number of vehicles occupying a unit length of road at an instant of time. The unit length is generally one Kilometre. Density is expressed in relation to the width of the road (i.e. per lane or per two lanes etc.).

When vehicles are in jammed condition, the density is the maximum. It is then termed as the jamming density. (Clause 4.6 of IRC 106 of 1990)

Capacity is defined as the maximum hourly volume (vehicles per hour) at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing road way, traffic and control conditions. (Clause 4.7 of IRC 106 of 1990)

Design Service Volume is defined as the maximum hourly volume at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or road way during the given time period under the prevailing roadway, traffic and control conditions while maintaining a designated level of service. (Clause 3.5 of IRC 64 of 1990)

Peak Hours Factor is defined as the traffic volume during peak hour expressed as percentage of the AADT. The peak hour volume in this case is taken as the thirtieth hourly Volume (i.e., volume of traffic which is expected only during 30 hours in a year).

4.4.3 Level of Service (Clause 5.1 of IRC 106 of 1990)

Capacity standards are fixed normally in relation to the Level of Service (LOS) adopted for

the design. Level of Service is defined as a qualitative measure describing operational conditions

Level of Service definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. Six levels of service are recognised commonly, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow and Level of Service F the worst (i.e. forced or break-down flow). On urban roads, the Level of Service is affected strongly by factors like the heterogeneity of traffic, speed regulations, strongly by factors like the heterogeneity of traffic, speed regulations strongly by factors like the heterogeneity of traffic, speed regulations, frequency of intersections, presence of bus stops, on-street parking, roadside commercial activities, pedestrian volumes etc. This renders the Level of Service concept

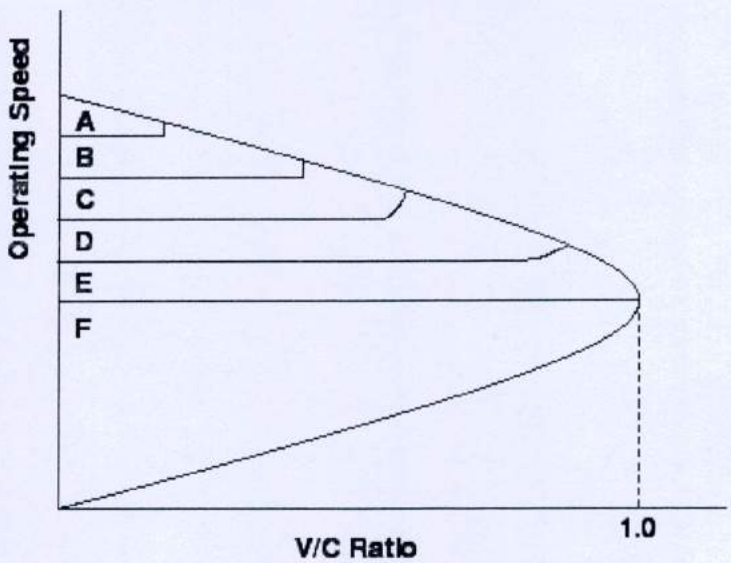


Figure 3.1 Map Showing Various Levels of Service in the form of indicative Volume-Flow Relationship

4.4.3.1 Equivalency Factors

The need of expressing capacity in passenger car units has triggered off many studies for establishing appropriate Passenger Car Equivalency (PCE) values for different types of vehicles. Notable among the studies carried out in India are the Road User Cost Studies (RUCS) by the CRRI and the MoRT&H. It has been recognised that the PCE values vary under different traffic and roadway conditions for any given type of vehicle.

Equivalency Factor is a factor to convert the mixed flow of traffic in to single unit to express the capacity of road. The unit generally employed is the Passenger Car Unit (PCU).

The maximum service flow in terms of PCUs per day in rolling and hilly terrain will depend upon the extent of trucks and buses present in the traffic stream, their PCU equivalent and the grades of the alignment, PCU for commercial vehicles vary with the magnitude of grade. Further, the passenger car equivalent factor decreases for the same grade with the increase in the percentage of commercial vehicles.

Tentative equivalency factor for conversion of different types of vehicles in to equivalent passenger car units based on their relative interference value are considered.

4.4.4 Recommended Design Service Volumes for Two Lane Roads

Design service volumes as given in Table 3.1 assume, that the functional classification of roads into arterial, sub-arterial and collector categories.

Table 4.1 Design service volumes for Two lane roads

Sl. No.	Type of Carriageway	Total Design Service Volumes for Different Categories of Urban Reacts		
		Arterial	Sub-Arterial	Collector
1	2-Lane (One Way)	2400	1900	1400
2	2-Lane (Two Way)	1500	1200	900
3	3-Lane (One Way)	3600	`2900	2200
4	4-Lane Undivided (Two Way)	3000	2400	1800
5	4-Lane Divided (Two Way)	3600	2900	-
6	6- Lane Undivided (Two Way)	4800	3800	-
7	6- Lane Divided (Two Way)	5400	4300	-
8	8- Lane Divided (Two Way)	7200	-	-

4.4.5 Traffic Signs and Road Markings

The design of traffic signs and road marking shall be done according to the IRC standards. Where necessary, AASHTO standards will be used to augment the IRC standards.

Following is the list of IRC standards, which are being followed:

- IRC: 35-2015 - Code of practice for Road markings
- IRC: 67-2012 - Code of practice for Road Signs
- IRC: SP: 55-2014 - Guidelines for Safety in Construction Zones

Adequate safety measures have been considered for the design of the project road.

These are indicated as below:

Crash barriers

Reflectors

Proper super elevation and radii of curvature

Traffic signage

Drainage

The safety during construction shall be achieved by providing;

Signs (regulatory, warning and direction)

Delineators

Traffic cones and cylinders

Drums

Barricades

Flagmen

4.5 Indicative Design Standards for Road

The indicative design standards for geometric design of road are illustrated in the **Tables 3.2** as Indicative Design Standards for main Carriageway and geometric standards

Table 4.2 Indicative Design Standards for Main Carriageway

Sl. No.	Parameter	Value	Standard / Code Reference
1	**Design Speed**		IRC: 86-2018
	Arterial	60 kmph	
	Sub-arterial	60 kmph	
	Collector Street	40 kmph	
	Local Street	30 kmph	
2	**Cross Section**		IRC: 86-2018
	(i) Carriageway	3.50m with Kerbs	
	(ii) Footpath	Minimum 1.8m	
	(iii) Cross slope:		

Sl. No.	Parameter	Value	Standard / Code Reference
	- Main carriageway and Paved shoulder	2.0 to 2.5%	
	- Footpath	2.5 to 3.0%	

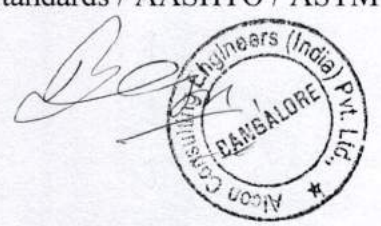
4.6 Road Markings

Road markings shall be as per IRC: 35-2015. These markings shall be applied to road center lines, edge lines, continuity line, stop lines, give-way lines, diagonal/chevron markings, zebra crossing and at parking areas by means of an approved self-propelled machine which has a satisfactory cut-off value capable of applying broken lines automatically.

Road markings shall be of hot applied thermoplastic paints with glass reflectorizing beads conforming to MoRTH Specifications for Road and Bridge works (5th Revision).

4.7 Specifications

The materials to be used in the Project work and the specifications for execution of work shall conform to "MORTH Specifications for Road and Bridge Works 5th Rev. 2013". However special Technical Specifications shall be framed wherever MORTH specifications need change / amendments. Where these specifications are silent with regard to certain specifications for the material in question, in that case, specifications under Bureau of Indian Standards / AASHTO / ASTM / BS or any other international standard shall apply.



CHAPTER - 5

CONCLUSIONS

5.1 Roads

A total length of km of existing road is been designed to be overlayed using thin white topping and is been detailed in Table No. 5.1.

Table 5.1 Details of Road

Sl. No	Name of the Road	Length in Km
1	HDC 8: Mysore Road	15.40
2	HDC 9: Magadi Road	12.00
3	HDC 10: Tumkur Road	7.90
4	HDC 11: West of Chord Road	8.40
5	HDC 12a: ORR (From Mysore Road to Gorguntepalya)	10.90
	Total	**54.60**

5.1.1 Milling

The milling of the existing asphalt pavement provides removal of rutting, a roughened surface to enhance the bonding between the new concrete overlay and the existing asphalt pavement. The depth of milling (25-50 mm) depends upon the types and severity of distress especially the depth of rutting or other surface distortions and the available thickness of asphalt pavement. Hand grinding/Light Chiselling may also be used gently for making the roughness in top surface of asphalt pavement at difficult locations.

5.1.2 Cleaning

After milling or providing the profile correction course, atop the existing asphalt pavement, the top surface is cleaned to ensure bonding between the existing asphalt pavement and the new concrete overlay. Different methods of cleaning to remove foreign particles are given as:

- Air blasting/vacuum cleaner
- Power brooming
- Water blasting
- Sand blasting
- Chiseling

5.1.4 Overlay

The carriageway is proposed with overlay (wearing course-Bituminous Concrete) or strengthening with overlay (Binder + wearing course – Dense Bituminous Macadam + Bituminous Concrete) as per IRC:115-2014. For rigid pavements joint maintenance is

considered, and since, white Topping roads are under DLP / maintenance hence not considered for Initial Improvements. Service road carriageways shall be improved similar to main carriageway. The improvement of carriageway is valued with proper Road Markings, Road Studs, Speed Calming Measures and adequate sign Board installations. Following are chainages where overlay or strengthening is proposed

Table 5.2 Details of Stretches where Overlay or Strengthening Layer is Proposed

Sl No	Road name	Stretch/Chainage (m)	No of Lanes	Lane width (m)	Length (m)	Overlay Thickness in mm	
						DBM	BC
1	Mysore Road	7700-8200	4 Lane Divided Carriageway	7.5	500	50	40
2		13250-13750	4 Lane Divided Carriageway	7.5	500	50	40
3		6650-7750	4 Lane Divided Carriageway	7.5	1100	-	40
4		8700-9500	4 Lane Divided Carriageway	7.5	800	-	40
5		9500-11500	4 Lane Divided Carriageway and 6 Lane Divided Carriageway	9500-9600 (10.5m), 9600-10100 (7.5m), 10100-10300 (10.5m), 10300-11500 (7.5m)	2000	-	40
6		11600-12550	4 Lane Divided Carriageway	7.5	950	-	40
7		12600-14250	4 Lane Divided Carriageway and 6 Lane Divided Carriageway	12600-13400 (7.5m), 13400-14300 (10.5m)	1650	-	40
8		14300-15300	4 Lane Divided Carriageway	7.5	1000	-	40
9	Magadi Road	670-2500	4 Lane Divided Carriageway and 6 Lane Divided Carriageway	670-1300 (7m), 1300-2000 (10.5m), 2000-2500 (7m)	1830	50	40
10		7100-11570	6 Lane Divided Carriageway	10.5	4470	50	40

Sl No	Road name	Stretch/Chainage (m)	No of Lanes	Lane width (m)	Length (m)	Overlay Thickness in mm	
						DBM	BC
11	Tumkur Road	5500-6800	6 Lane Divided Carriageway	10.5	1300	50	40
12		3300-3900	4 Lane Divided Carriageway	7.5	600	50	40
13		4200-5000	4 Lane Divided Carriageway	7.5	800	50	40
14	WOC Road	7000-7500	4 Lane Divided Carriageway	7.5	500	50	40
15		7550-8400	4 Lane Divided Carriageway	7.5	850	-	40

5.2 Roadside Drainage

Where, the existing condition of drain is found not functioning and structurally inadequate, maintenance is proposed by clearing of clogged drain and reconstruction is proposed to replace the damaged portion. Wherever, construction of new drain or upgradation of existing masonry / BS slab drain to RCC is envisaged, design of drain should be done as per applicable standards and approval should be taken from the relevant authority. De silting is considered for entire length and reconstruction of damaged portion is proposed

5.3 Median Improvement and Guard Rail

The improvement proposal includes replacing of broken new jersey barrier, pedestrian guard rails and kerb stones with the new ones and painting of the kerb for the entire stretch of the corridors.

To avoid the random road crossing of Pedestrians and to enhance the Pedestrian safety Median Guard rails are installed for entire length of the corridor

5.4 Footpath Improvement

Damaged and missing Portion is proposed with reconstruction of footpath with paver blocks and Kerb stones. RCC Bollards are proposed for Entry and Exit

For Magadi Road, HDPE lines of 2 numbers of 200mm dia and 2 numbers of 100mm dia pipes on both sides of the road are provided to carry the utility lines such as BESCOM lines and OFC cables. Also, dual cross ducts of 300mm dia at every 100m interval is provided in order to cross over the utility lines with cross duct chamber of 2.0m x 1.0m is provided on both side of the roads.

5.5 Green Hedging

To Improve the Aesthetics of HDCs Green Hedging on outer edge of the carriageways is considered. Work includes dismantling of exiting concrete/paver blocks, installation of Landscape kerbs, spreading of yard manure and planting of Plants

5.6 Traffic signs

Traffic signs are important features of traffic control devices and transmit visually vital information to drivers and ensure increased safety and efficiency in free flow of traffic. IRC: 67has standardized patterns for delineating the traffic signs which give information about highway routes, directions and destinations. These also give information on special obligations, prohibitions and restrictions and caution about the existence of any hazardous conditions on or adjacent to the roadway. Thermoplastic paint mixed with retro-reflective beads has long life, night visibility and its drying period is very short. In view of these advantages, retro-reflective thermoplastic paint is proposed for use. The major advantage of retro-reflectorized plastic sheet is that the colour and legend is as legible at night as during the day time.

High Raised Pedestrian Crossing at suitable locations are proposed in order to facilitate the Pedestrian/Non-Motorised Traffic to cross the road section with Refuge Islands

Following are the type of Traffic Signs, Road Markings, Road Safety and Road Furnitures and Other Appurtenances proposed

Table 5.3 Details of Traffic Signs, Road Markings, Road Safety and Road Furnitures and Other Appurtenances

Sl. No.	Items
1	Road Marking- Thermoplastic
2	Sign boards
2.1	(900mm Equilateral Triangle)
2.2	600mm Circle (Speed limit and Go slow)
2.3	600 x 450mm Chevron Signs
2.4	Informatory sign board 600x800mm (Petrol Pumps, hospitals police stations)
2.5	Road Delineator
2.6	Retro- reflective Hazard Marker signboards
2.7	Moulded Shank Raised Pavement Markers
3	High Raised Pedestrian Crossing
4	RCC Circular Bollards
5	RCC Crash Barrier
6	Provision of Traffic signal at Junctions

7	Provision of Traffic Umbrella/Kiosk for Traffic Police man
8	Overhead signs (Truss and Vertical Support)
9	Overhead sign board installation of retro reflective sheeting

5.7 Annual Maintenance Proposals includes

Annual Maintenance includes the activities required to maintain these road assets regularly to ensure the safety and hazzle free movement of traffic along these roads. annual maintenance activities include, regular cleaning of carriageways and footpaths, seasonal clearing of blockages in drains and culverts, painting of Kerbs and medians as and when required, ensuring road markings and signboards, to be intact over the maintenance period.

When roads are regularly maintained, the city is able to keep them in a safe condition and generally will only need to replace the top layer of asphalt in its Periodic overlay program. If a road is neglected for too long, all of the old asphalt must be removed, and then replaced by new asphalt depending on the roadways type and level of use. This complete rebuild can cost up to three times as much as an overlay. The goal of the program is to "do the right maintenance at the right time."

Routine road maintenance works are usually non-structural in nature and are meant to extend the life of the pavement, to enhance the performance and to reduce user delays in road use Non-preventive maintenance can also be described as routine. Where routine refers to the "fixed-cost" activities such as grass cutting, drainage maintenance and road markings and sign maintenance; along with activities required throughout the year such as pothole patching, crack sealing, and grading. Maintenance timelines proposed to follow for various parameters is tabulated below.

Table 5.4 Maintenance timelines proposed

Repair/ Rectification of Defects and Deficiencies		
Sl. No.	**Nature of Defect or Deficiency**	**Time limit for Repair/Rectification**
A	**Carriageway/Road surface**	
1	Maintaining a public relations unit to interface with and attend to suggestions from the Users, government agencies, media and other agencies	On or before 45 days from LOA
2	all surplus construction machinery and materials, waste materials (including hazardous materials and waste water), rubbish and other debris (including, without limitation, accident debris) and keep the Project in a clean, tidy and orderly condition, and in conformity with Applicable Laws, Applicable Permits and Good Industry Practice.	Daily
3	Carriageway Sweeping using mechanical sweepers, manual	Daily

Repair/ Rectification of Defects and Deficiencies		
Sl. No.	**Nature of Defect or Deficiency**	**Time limit for Repair/Rectification**
	cleaning of footpaths	
4	Breach or blockade	Temporary restoration of traffic within 3 hours' permanent restoration within 7 days
5	Roughness value exceeding 2600mm (Fair) in a stretch of 1 km (as measured by a standardized rough meter/bump integrator)	7 days
6	Potholes	24 hours
7	Cracking all types in less than 5% of road surface in a stretch of 1 km	3 (Three) days
8	Raveling/Stripping of bitumen and all types in less than 5% of road surface in a stretch of 1 km	3 (Three) days
9	Settlement all types in less than 5% of road surface in a stretch of 1 km	3 (Three) days
10	Rutting exceeding 10 mm in more than 2% of road surface in a stretch of 1 km (measured with 3 m straight edge)	7 (Seven) days
11	Bleeding/skidding	3 (Three) days
12	Damage to pavement edges exceeding 100 mm	24 hours
13	Painting of kerb, railing, parapets, crash barriers,	As and when required / Twice every year
14	All types of Road Marking	Retro reflectivity mcd/m2/lux of 150 during the contract period / Twice every year
15	Joint Sealing in concrete pavement	7 (Seven) days
16	Replacement of Pavement Quality Concrete slabs	15 (fifteen) days
B	**Hard shoulders, Drains and Cross Drainage works**	
17	Rain cuts/gullies in slope	3 (Three) days
18	Damage to or silting of culverts and side drains during and immediately preceding the rainy season	3 (Three) days
19	Desilting of drains in Road side Drains	3 (Three) days
C	**Bridges / Interchanges / Grade Separators (Fly Overs/ RUB/ ROB/ Under Pass / any other Road structure)**	
20	Cracks Temporary measures Permanent measures	Within 48 hours Within 3 days
21	Spalling/scaling	3 (Three) days
22	Foundations-cavitation	3 (Three) days
23	Piers, abutments, return walls, RE-walls Cracks and damages including settlement and tilting	10 (Ten) days

Repair/ Rectification of Defects and Deficiencies		
Sl. No.	**Nature of Defect or Deficiency**	**Time limit for Repair/Rectification**
24	Bearings All type- Deformation	30 (Thirty) days
25	Joints in bridges: Loosening and malfunctioning of joints	30 (Thirty) days
26	Deforming of pads in elastomeric bearings	30 (Thirty) days
27	Gathering of dirt in bearings and joints or clogging of spouts, weep holes and vent-holes	3 (Three) days
28	Damage or deterioration in parapets and handrails	3 (Three) days
29	Rain-cuts or erosion of banks of the side slopes of approaches	3 (Three) days
30	Damage to wearing coat / Resurfacing	10 (Ten) days
31	Damage or deterioration in approach slabs	3 (Three) days
32	Growth of vegetation affecting the structure or obstructing the waterway	3 (Three) days
D	**Trees and Plantation**	
33	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
34	Deterioration in health of trees and bushes	Timely watering and treatment
35	Replacement of trees and bushes	3 (Three) days
36	Removal of vegetation affecting sight line and road structures	3 (Three) days
E	**Other Project Facilities and Approach roads**	
37	Manual cleaning of footpaths	Daily
38	Damage to paver blocks or concrete surface or tiles of footpath	3 (Three) days
39	Damage to Kerbs, bollards, tree guards, pedestrian railings	3 (Three) days
40	Road side Drains and inlets	Should be Clean at all times
41	Damage to drain cover, walls	3 (Three) days
F	**Road safety and furniture including all road sign boards and pavement raised marking (road studs)**	
42	Damage to shape or position, poor visibility or loss of retro-reflectivity	48 hours
43	Damaged/missing road signs requiring replacement	7 (seven) days
44	Painting of railing, parapets, crash barriers	As and when required/ Once every year
45	Reflective Pavement Markers (Road Studs) Numbers and Functionality as per specification in IRC: SP:84-2014 and IRC :35-2015, unless specified	At all times
46	Pedestrian Guard rail: Functionality: Functioning of guardrail as intended	At all times
47	Traffic Safety Barriers: Functionality: Functioning of Safety Barriers as intended	At all times
48	Overhead Sign Structures shall be structurally and	At all times

Repair/ Rectification of Defects and Deficiencies		
Sl. No.	**Nature of Defect or Deficiency**	**Time limit for Repair/Rectification**
	functionally adequate	
G	**Road lighting**	
49	Any major failure of the system	24 hours
50	Replacement of bulbs, LED's, damaged light arms, poles	8 hours
H	**Emergency Works**	
51	Removal of Fallen Trees	3 hours
52	Towing of Accident vehicle / Breakdown vehicle / Abandoned vehicle	1 hour
53	Water logging / Ponding on road surface / grade separators	1 hour
54	Fallen Street pole / Sign Boards / any other structure	1 hour

CHAPTER - 6

PRELIMINARY COST ESTIMATES

6.1 General

Cost estimation is important for the feasibility study as it provides vital input to the economic and financial evaluation of the project. The cost estimates have been prepared the project corridor separately for improvements to the existing road including reconstruction/widening of few cross-drainage structures, longitudinal drains, etc.

6.2 Methodology

Estimation of Preliminary cost, a primary pre-requisite for Economic and Financial evaluation, has been carried out. The process involved in the preliminary cost estimation has been described under the following sections.

6.2.1 Basic rates

The basic rates for each construction items were analyzed on the basis of MORTH Standard Data Book and Karnataka PW,P&IWTD Standard Schedule of Rates 2018-19 of Bengaluru Circle adopted.

6.2.2 Quantification of Items

The quantification of most of the items that are uniformly occurring is calculated per km, based on the typical cross sections. The construction items covered in cost estimates are: site clearance; earthwork cutting, Loosening and recomposing, Pavement in carriageways and shoulders; culverts; Drainage and Miscellaneous items which includes Pavement markings, Signage's, Guard Rails, etc. Special consideration was given for the stretches passing through hazardous conditions.