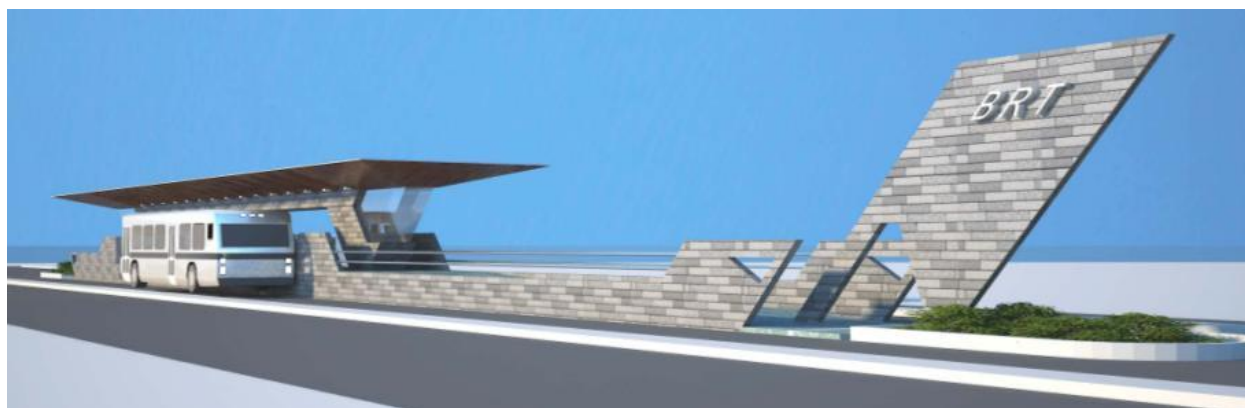


Directorate of Urban Land Transport

IMPLEMENTATION OF BUS RAPID TRANSIT SYSTEM IN HUBLI – DHARWAD

ENVIRONMENT IMPACT ASSESSMENT REPORT



HUBLI-DHARWAD BRTS COMPANY LIMITED

JANUARY 2012

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List of Abbreviation

AAQM	: Ambient Air Quality Monitoring
BRTS	: Bus Rapid Transit System
BSNL	: Bharat Sanchar Nigam Ltd
CBT	: Central Bus Terminal
CPCB	: Central Pollution Control Board
CSC	: Construction Supervision Consultant
CO	: Carbon Monoxide
CoI	: Corridor of Impact
DPR	: Detailed Project Report
DULT	: Directorate of Urban Land Transport
EA	: Environmental Assessment
EMP	: Environmental Management Plan
ESMF	: Environmental and Social Framework
FGDs	: Focus Group Discussions
GEF	: Global Environment Facility
GPS	: Global Positioning Systems
GoI	: Government of India
HC	: Hydro Carbon
HDMC	: Hubli Dharwad Municipal Corporation
ITS	: Intelligent Transport System
IRC	: Indian Roads Congress
KRDCL	: Karnataka Road development Corporation Ltd
KSPCB	: Karnataka State Pollution Control Board
LMV's	: Light Motor Vehicle
MoEF	: Ministry of Environment and Forest
MSL	: Mean Sea Level
MLD	: Million Litres Per Day
NAQMP	: National Air Quality Monitoring Programme
NGO	: Non-Government Organisation
NWKRTC	: North West Karnataka Road Transport Corporation
NoC	: No Objection Certificate
NO ₂	: Nitrogen Oxide
OCBS	: Old Central Bus Stand
PAP's	: Project Affected People
PUC	: Pollution under Control Certificate
PWD	: Public Works Department
RAP	: Resettlement Action Plan
RoW	: Right of Way
RTO	: Regional Transport Office
SPV	: Special Purpose Vehicle
SUTP	: Sustainable Urban Transport Project
SEIAA	: State/Union territory Environment Impact Assessment Authority
VUP's	: Vehicle Under Pass

1. INTRODUCTION

1.1 Project Background

1. Hubli – Dharwad state highway is the one of the most congested road stretches in North West Karnataka region. To ease the growing traffic from Hubli – Dharwad, the Government of Karnataka, through the Karnataka Road Development Corporation Limited has taken up the widening of the existing two lane state highway to a divided four lane carriageway. To provide better transportation facilities between the two urban areas of Hubli and Dharwad, and with an objective to improve travel speeds, reliability, and quality of public transport services, a BRT facility is proposed along the corridor.
2. A SPV- ‘Hubli-Dharwad BRTS Company Limited’ has been formed under the companies act to take up the construction of proposed infrastructure facilities for the BRTS. As a part of the BRTS, some of the existing facilities like workshop, depots, terminals etc are proposed to be upgraded.

1.2 Project Corridor

3. The project corridor starts from Hubli CBT to Dharwad CBT (22.25km); however, the segregated corridor starts from Hubli railway station and ends at Jubilee circle, Dharwad. The existing corridor is a two lane road on either side with median upto urban limit and two lane undivided between Hubli-Dharwad. Widening of 18.9 km of road to 7 lane carriage way (3 lane for BRTS and 4 lane for mixed traffic) in city limits and from 2 lane undivided carriage way to 8 lane carriage way (4 lane for BRTS and 4 lane for mixed traffic) between Unkal Lake to JSS college is under KRDCL road project. SPV will be responsible for developing the BRTS corridor within city limits between Hosur cross to CBT in Hubli and similarly between Jubilee circle to CBT in Dharwad. As per the revenue records, the project corridor traverses through 10 villages (MT Sagar (CTS), Unkal (CTS), Unakal Revenue, Bhairidevarakoppa, Amaragol, Rayapur, Sattur, Navalur, Lakkammanahalli and Dharwad (CTS). The corridor abuts many educational institutions and open land.
4. The presence of some of the best education institutions and rapid growing automobile market and other commercial business keeps the corridor busy throughout the day. The project corridor is also known for business in automobiles sector; all the major car brands / two wheeler showrooms can be observed along the corridor, which is followed by the banking sector. Environmental sensitive features include Unkal Lake (3+300), Pond (4+800 to 4+900) and Rayapur Lake (9+400). There are no notified reserved forests and/or protected areas in the vicinity of the project roads. The existing road condition in Hubli- Dharwad is a major cause of concern. The road is highly dangerous especially for two wheelers and LMV's due to the absence of median and the black top in many sections of the road and presence of potholes. Many of the sub arterial and collector roads linking the project corridor are also in poor condition. Pedestrian safety is poor with either no footpaths or footpaths in poor condition. Lighting is not sufficient as per standards.

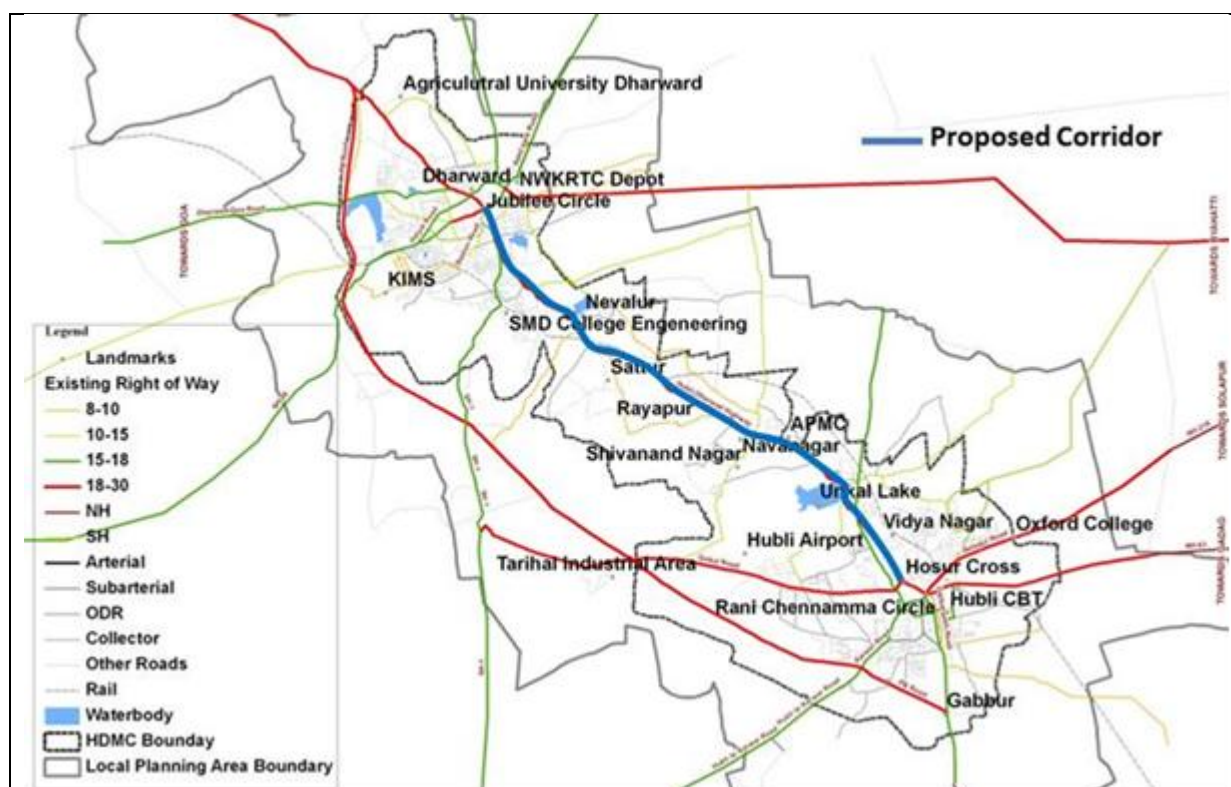


Figure 1-1: Proposed BRT Corridor

Components of a Bus Rapid Transit System

5. A BRTS system combines flexible service and new technologies to improve customer convenience and reduce delays. While specific BRTS applications vary, the components include:

- **Road way:** Exclusive guide ways or dedicated lanes generally along existing carriageways that allow BRTS vehicles to be free of conflicting automobile traffic, parked or stopped vehicles, and other obstructions – maximizing BRTS operating speeds.
- **Vehicles:** Modern, high capacity rubber-tired vehicles that accommodate a high volume of riders and allow fast boarding and alighting form another crucial component of the BRTS system.
- **Route Structure and Scheduling:** Involves strong technical skills for planning of service, its routing and scheduling, based on travel demand assessment.
- **BRTS operations:** Includes running of buses, driver management, routing and operational techniques form other important components of a BRTs.
- **Fare collection:** An advanced system of automated fare collection is a critical component of a BRTS system. Generally designed to make fare collection fast and easy to pay, often before boarding the vehicle. Collection system could be pre-paid or by the use of integrated smart cards.
- **Intelligent Transport System (ITS) and control systems/passenger information systems:** The use of advanced technologies or ITS is to improve customer convenience, speed, reliability and safety. Examples include systems that provide traffic signal preference for buses at intersections and cross streets, as well as Global Positioning Systems (GPS) to provide passenger information such as real-time bus arrival information.

- **Bus stops and terminals:** Ranging from protected shelters to large transit stations. BRTS stations need space along the corridor generally at a distance of 500m-750m. Transit stations require slightly larger areas as they act as interchange points for more than one route. Terminals need added turn around space and longer halting/parking space availability.
 - **Depots:** Depots are larger areas that are used for parking and maintenance facilities or workshop for the BRTS bus fleet. Usually they are dedicated for the BRTS buses alone and other buses do not use these facilities.
 - **Last mile connectivity:** Footpaths for pedestrians and infrastructure for NMT would also be improved as a part of this project.
6. In addition to the above components which would be part of the BRTS project taken up with World Bank - GEF- assisted SUTP, there will also be focus on integrating feeder services with the BRTS, implementing a parking policy and landuse transport integration.

1.3 Project Benefits

7. The proposed BRT system will offer the following advantages:

- Reduction in time of travel;
- Increase in economic productivity;
- Reduced air and noise emissions;
- Increased passenger safety;
- Increased safety on mixed traffic lane;
- Optimum utilization of infrastructure;
- Equitable access between the twin cities;

1.4 Objectives of Present Study

- The key objective of the present study is to prepare an Environmental Assessment for the proposed BRT corridor, including preparation of individual EMP's with mitigation measures for the identified impacts and environmental budget for (i) Road components and (ii) BRTS components.
- Any infrastructure projects within India have to undergo the environmental clearance from the Ministry of Environment and Forest (MoEF). The Ministry has stipulated its guideline for various types of projects; development of roads (State and National highways) is considered as one of the infrastructure project and it demands environmental clearance from the Ministry. However, later the EC has been relaxed for the existing state highways undergoing expansions / modernisation. Since the Hubli – Dharwad road falls in the state highways category it doesn't required EC from the ministry. However, as per the GEF STUP's Environmental and Social Framework (ESMF) and World Bank guidelines, the project requires Environmental Assessment. The Environmental and Social Management Framework (ESMF) of the operations manual of SUTP lays down the principles for addressing environmental and social impacts due to the implementation of demonstration project of SUTP. The environmental and social safeguard policies that are part of the ESMF will be applied in this case.
- Based on the policies, the project requires an Environmental Assessment (EA) report with effective Environmental Management Plan (EMP) for implementation along the project construction and operation.

8. Since the road component (widening of two lanes to four lanes) work has already been allocated to the contractor and on ground implementation for four lanes had already started before the BRTS project was initiated. Due to this, it has been decided to prepare (i) a common Environmental Impact Assessment Report (Road and BRT Infrastructure Component) with two separate EMP's (ii) Road Component EMP and (iii) BRT Infrastructure component EMP totalling 3 volumes.

1.5 Scope and Methodology

9. As part of the DPR, environmental and social assessment of the proposed project interventions was carried out to identify the environmental and social issues due to the proposed improvement works.

TASK 1: Secondary Data Collection

10. This task include collection of secondary data related to the project area in terms of demography, environmental features along the project roads, existing laws, legislations and policies, design reports and other studies.

TASK 2: Literature Review

11. Review of the secondary data collected was undertaken to understand the project area and identify sensitive environmental and social features along the project road. The existing Central and State level laws and legislations were reviewed to understand the requirements and level of environmental sensitivity of the proposed works. Policies related to environmental and social issues laid down by the lending agencies were also reviewed.

TASK 3: Reconnaissance Surveys

12. Field visits were undertaken to establish the authenticity of the secondary information and to establish the baseline environmental and social features of the project area. Discussions were also carried out with the local people who are likely to be affected by the project as per the preliminary surveys.

TASK 4: Identification of Impacts

13. Based on the analysis of the secondary information and the outcomes of the reconnaissance surveys and field discussions the environmental and social impacts of the proposed improvement works were identified. The task also includes the extent of land acquisition, identification of the project affected people (PAP's) and the status of land ownership.

TASK 5: Formulation of Environmental Management Plan

14. The task involves the formulation of the environmental management plan in order to mitigate/minimize the identified impacts. Scope for possible environmental enhancement measures was also studied.

TASK 6: Formulation of Resettlement Action Plan

15. The task involves the formulation of a Resettlement Action Plan (RAP) for the identified social impacts due to the proposed project and in finalizing the compensation to the identified project affected people (refer Resettlement Action Plan (RAP) for further details).

1.6 Structure of the Report

16. The Environmental Impact Assessment Report is based on field data generated at the site and data collected from secondary sources. The report has been organised as following sections:

Chapter 1: Gives a brief introduction of the proposed BRT project and its interventions

Chapter 2: Provides a brief description of the proposed project and its components

Chapter 3: Reviews the laws, legislation and policies to understand the requirements and level of the environmental assessment

Chapter 4: Presents the baseline environmental profile of the project area

Chapter 5: Discusses various analysis of alternative approach adopted

Chapter 6: Details the discussions and interviews conducted with various stakeholders

Chapter 7: Highlight the impacts of the proposed improvement works on the physical resources, environmental resources, ecological resources and the human use values and the environmental mitigation measures for the identified impact during the project construction and operation.

Chapter 8: Details the Environmental Monitoring Plan (EMP) and institutional mechanism for implementing the EMP.

2. PROJECT DESCRIPTION

2.1 Project Background

17. In 1962, Hubli and Dharwad were combined and recognized as twin cities. It is now an important commercial, industrial and educational centre in Karnataka. The present population of HDMC is 9.6 lakh and covers an area of 202 sq.km. Hubli is headquarters of the South West Railway Division. Dharwad is pre-dominantly an educational town and is the district quarter. Both centres are approximately 20 km apart and linked through a State Highway (PB road), National Highway (NH4) and the Mumbai Bangalore Railway Line. Hubli being the centre for trade and commerce and Dharwad, the educational seat, continue to attract large volumes of traffic both from outside and within the region. There is already a high volume of traffic between the two towns. Currently, this demand is catered to by the NWKRTC through a bus based system.

18. Several formal/informal consultations with each stakeholder to understand issues and cross cutting themes have been conducted during the past one and half year. The elected representatives opined that the BRTS would be truly successful if travel time between the two cities could be brought down to 30 minutes by BRTS. A SPV- Hubli - Dharwad BRTS Company Limited has been formed for managing BRTS planning, implementation and operations.

19. Hubli-Dharwad is growing at a moderate pace. The landuse proposed indicates many new activity areas and interaction between the two cities. Vacant land between the two cities will develop. The new upcoming activity areas will have implication on travel demand on the city for future.

2.1.1 Existing Transportation System

20. Hubli, being the commercial hub, has registered a higher vehicle growth rate compared to Dharwad. Two wheelers constitute 71% of the total vehicles in Hubli-Dharwad. The number of registered vehicles has grown by 20% from 309,455 in 2010 to 338,481 in 2011.

2.1.2 Travel Characteristics

21. Trip rates, trip length, trip purpose and travel modes are critical household choice elements influencing overall transport situation in the city. The characteristics and trends have been summarized based on the survey of 8800 households carried out by IMaCS as part of CTTS (year 2009). Per capita trip rate tends to be higher (i.e 1.48). Two wheelers dominate with a mode share of 67%. The bus passenger patronage is relatively high for the city size and the challenge is to maintain this share since the proportion of private vehicles is also considerably high. Given the typical characteristic of both cities, work and education trips dominate. The average trip length, including walking is about 5.1 km. However, the average trip length of motorised trips is high at 8.6, which is expected in linear cities. These trip lengths are suitable for bus based transit nodes. As part of the surveys, it was observed that while the bus accounts for 7% of the total passenger vehicles, its share in terms of passengers are over 70%. This clearly establishes the need for according priority to the bus in terms of space and operations.

22. Functionally, the twin cities of Hubli and Dharwad operate like three sub-systems managed by NWKRTC. The first and the second are Hubli city and Dharwad city systems. The third is the Hubli-Dharwad sub-system. Each of these sub-systems shows distinct operational characteristics. The speeds are generally low. Buses carry about 70-75% of people on this corridor. That justifies the decision of Government of Karnataka to implement BRTS.

2.2 BRT System: Concept, Evolution, Elements

23. Bus rapid transit system is a bus priority system that provides affordable, safe, and faster public transit. The system design can be flexible based on city context and demand. BRTS is affordable and is socially and economically viable choice for every city. The system can be expanded based on the city's growth directions and movement patterns. Several other successful 'BRTS' cities have demonstrated that political will and vision, stakeholder involvement, strong urban planning principles and innovations to meet local requirements are crucial ingredients for successful BRTS systems. The following principles have been followed for the final selection of BRTS corridors.

- It should connect important existing nodes in the city as well as serve potential future nodes
- It should reduce travel time for a large segment of people
- It should serve existing demand with higher quality infrastructure
- It should provide the most convenient and direct access to activity areas
- It should reduce road accidents and significantly increase safety
- It should accommodate BRTS treatment and be implemented quickly

24. Each potential corridor was assessed for connectivity and link to major nodes and possibility of taking BRTS infrastructure (RoW). The corridors were ranked based on their connectivity to destinations, right-of-way, spatial analysis considering wise density, employment density, trip attraction and production and demand assessment. It is recommend Hubli-CBT to Dharwad-CBT to be developed as final BRTS corridors for phase 1. The length of the corridor is 22.25 km.

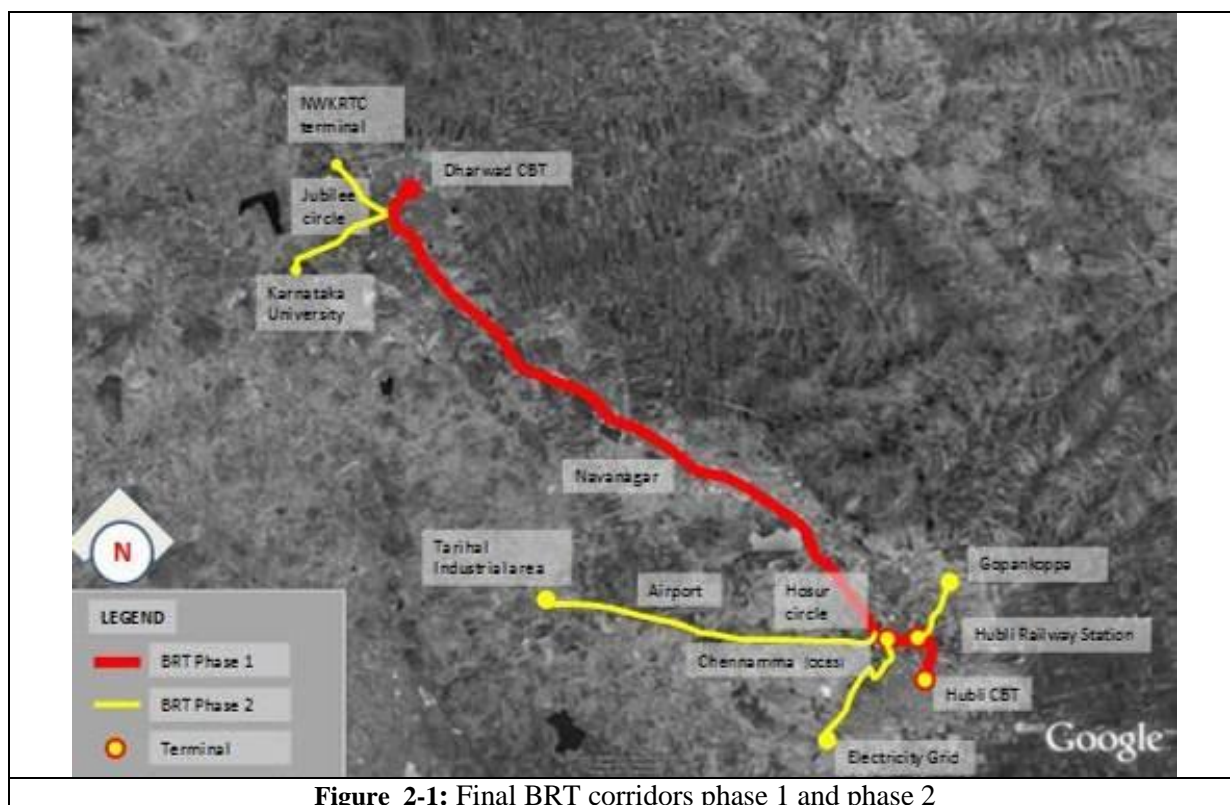


Figure 2-1: Final BRT corridors phase 1 and phase 2

2.2.1 BRTS Service Planning

25. The public transport services are offered mainly by NWKRTC which operates urban bus services in Hubli, Dharwad and connecting bus services between Hubli and Dharwad.

26. As per the NWKRTC passenger demand data (stage to stage), the average weekday passenger boardings is 2.15 lakh on city bus services of NWKRTC. In the Base scenario, the bus frequencies particularly on major arterials in the city like Hubli-Dharwad highway, Hosur to CBT-Hubli and Airport road is very high. The passenger flows show link passenger volumes of around 55,000 per day in each direction on Hubli-Dharwad highway. The passenger volumes are even higher at around 70,000 per day between Hubli OCBS and railway station. In comparison to this corridor, the demand on Hosur-Airport road section, Jubilee to New CBT and Jubilee to Karnataka University is much lower with passenger flows of less than 10,000 passengers per day.

27. The major passenger boarding and alighting points are indicated in the figures 2-2 and 2-3. It can be seen that more than 50000 passengers board and alight in Hubli CBT stage every day. The other major stages for boards and alights are Hubli OCBS, NTTF, Dharwad OCBS and Dharwad CBT. Hence the proposal is suited to provide regular and express services as follows:

- Express service between Hubli and Dharwad with a few intermediate stops
- Regular service between Hubli and Dharwad stopping at all BRTS stations along the corridor

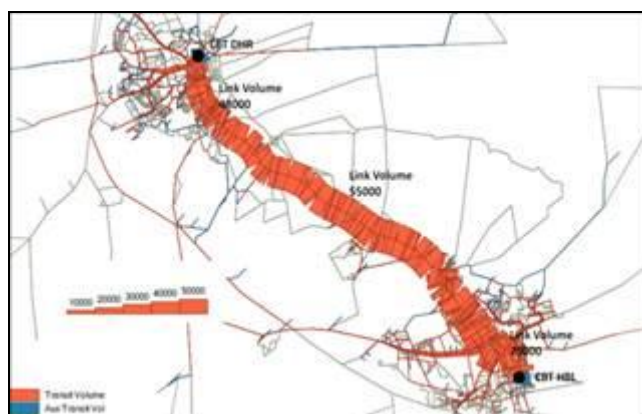


Figure 2-2: Transit Volumes

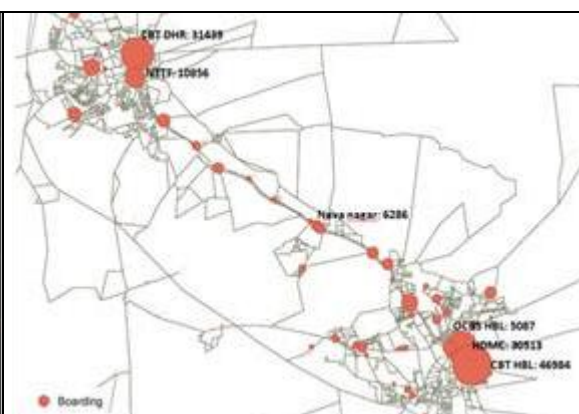


Figure 2-3: Passenger Boardings

2.2.2 Vehicle Choice for BRT Systems

28. Vehicles play a strong role in determining real performance in terms of speed, reliability, cost and operation plan. Considering flexibility in operation, ease in terms of market availability and availability of maintenance infrastructure, a mix of high quality standard size and articulated buses are recommended for proposed BRTS system.

2.2.3 Integrated Transit Management System

29. The Intelligent Transit Management System (ITMS) forms one of the sub-sectors of transportation system which has remained in focus during the recent years. ITMS is aimed at enabling stakeholders to automate its financial characteristics, operational characteristics, better insight into passenger profiles, perform route analysis to optimize on operational efficiency, service consumption, perform functional area productivity analysis, thereby creating Hubli-Dharwad BRTS as user choice.

30. Technology Perspective offers ITMS components as Automated Fare Collection System, Automated Vehicle Location System, Vehicle Scheduling and Dispatch System, Passenger Information System, Video Surveillance System, real time management, control centre and data recovery centre.

2.2.4 BRTS Plan – Roadway and Infrastructure Design

31. In Hubli-Dharwad, we are estimating demand of 7500 pphd in base year and more than 12000 in the next ten years. In base year, we are estimating 100 buses per hour in the peak hour.

Table 2-1: Cross Sections characteristics for proposed corridor

Sr. No.	Section	Length	Existing RoW	Proposed RoW	BRT Lane	Mixed Vehicle Lane	Foot-path	Utility Lane
1	Hubli CBT to Hubli railway station	870m	16.0m to 18.0m	18.0m	BRT to move in mixed traffic	6.0m	2.75m	Below footpath
2	Hubli railway station to Hosur Circle	2020m						
	@ bus-station location		24.0m to 27.0m	27.0m	3.3m x 2	6.0m	2.0m	Below footpath
	@ mid-block location			24.0m	7.3m	6.0m	2.15m	Below

Sr. No.	Section	Length	Existing RoW	Proposed RoW	BRT Lane	Mixed Vehicle Lane	Foot-path	Utility Lane
								footpath
3	Hosur circle to Unkal Lake & JSS College to Jubilee circle	7100m						
	@ bus-station location		24.0m to 30.0m(in Hubli) & 18.0m to 24.0m(in Dharwad)	35.0m	6.75m + 3.3m	7.5m	1.725m	Below footpath
	@ mid-block location			35.0m	10.6m	7.5m	2.5m	Below footpath
4	Unkal Lake to JSS College	11800m						
	@ bus-station location		24.0m to 50.0m	44.0m	7.25m	7.5m	2.0m	1.75m
	@ mid-block location			44.0m	7.25m	7.5m	2.0m	1.75m
5	Jubilee circle to Dharwad CBT	460m	18.0m & 22.0m	35.0m / 18.0m (one-way loop)	3.5m for one way loop	7.0m	2.0m	Below footpath

2.2.5 BRTS Stations

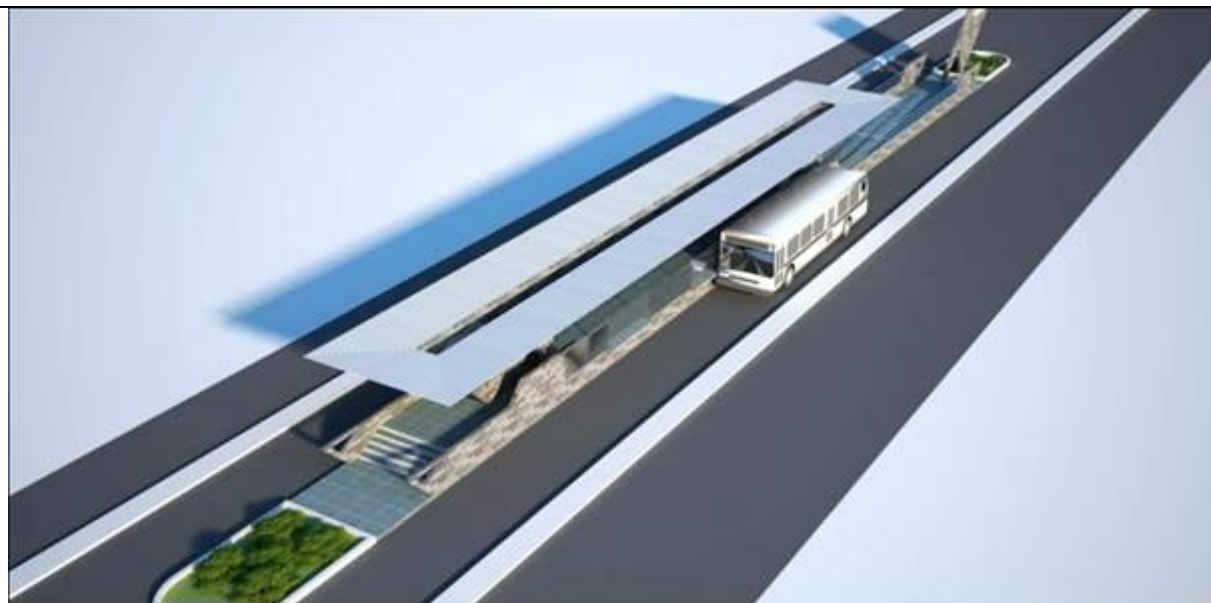
32. Bus stations in a BRTS system typically give the system its identity. There are 43 bus-shelter locations for Hubli-Dharwad inter-city Bus service. BRTS had rationalized them for 35 destinations for BRTS service (33-BRT-stations + 2-Terminals). Following criteria have been adopted to rationalise location for BRT-Stations:

- Distance between two consecutive existing bus stops is less than 300 mtr. (approx.) then it is proposed as one BRTS stop to reduce infrastructure cost and increase system speed
- Demand on existing bus stop is less than 1000 boarding per day would have merged with its consecutive bus stop for proposing BRTS stop.
- Average distance between two bus stop 630m (500m in city limits)
- Geographical constraints of rolling contour (flat FRL required for level boarding and straight horizontal alignment)

2.2.6 BRTS Station Design

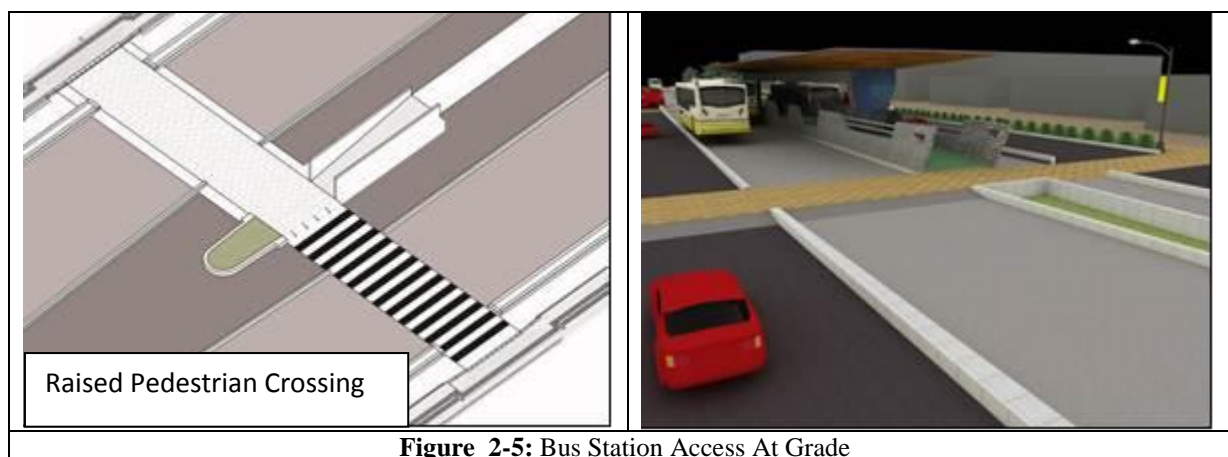
33. The design of the bus station is very critical towards establishing the BRTS brand image, since it is the first point of interaction between commuters and BRTS. Design has considered for ease of access, convenient ticketing with very less waiting time, protection from rains, temperature, dust, sheltered space for queuing, a safe and comfortable environment & aesthetic design.

34. Based on the operations planning, it is proposed that 7 bus stations will have three bus bays per direction, while the remaining 26 will have two bays per direction.

**Figure 2-4:** View of Bus Station

2.2.7 BRT Station Access

35. In the at grade option, bus stations would be accessed through zebra crossing. Both sides of the bus stations would have this access. Flat topped humps, at same level as footpaths, will be provided at one entry to provide convenient access to commuters. Bollards would be provided between mixed traffic lanes and bus lanes to prevent other traffic from getting in. BRT median would be widened at pedestrian entry to provide secure zone. FOBs are provided at 7 locations.

**Figure 2-5:** Bus Station Access At Grade

2.2.8 Junction Design

36. Junction design is a critical element of BRTS design. Conflict resolution and safe movement of all vehicles and pedestrians is crucial. Buses get delayed if they have to wait for a long time at junctions. Therefore, priority for buses is essential. An Area Traffic Control System would be installed along the corridor. This would enable that all signals in the same direction along the corridor are synchronised.

37. Out of the 42 junctions identified, 4 junctions are grade separated. This is done by designing vehicle underpasses boxes at these locations. These locations have been identified by assessing the existing road profile. (Refer: Section 9.3.4 of HDBRTS DFR)

2.2.9 BRTS Feeder

38. To increase the catchment for BRTS, feeder services will enable transfers from trunk services. Feeder service will typically be of short lengths (6-10 km) and will offer the last mile connectivity. Buses will run in mixed traffic with no segregation. Physical integration will happen at terminals only. 3-routes have been identified as BRT Feeder corridors which will be upgraded to BRTS in second phase (figure 2.1).

2.2.10 Last Mile Connectivity

39. Last mile connectivity proposal includes providing high quality pedestrian infrastructure near all terminals, interchanges and important bus stations. It focuses on disabled friendly elements, comfortable walking environment for all and enhanced quality of life. It will feature use of paver blocks, street furniture, road signage's, dust bins, lane markings, designated parking etc. The figures below show the kind of infrastructure envisioned for these streets.



Figure 2-6: Seating spaces near Kankaria BRT

Figure2-7: Pedestrian facilities

40. Street furniture will include elements such as benches and dust bins, pedestrian signages, space and design for kiosks, stands for bicycle parking, landscaping etc. Tree pits will be provided at an interval of 6 to 8m c/c on the pedestrian path. Landscaping options would be provided wherever possible such as junction corners, public spaces, approaches to bus stops etc.

41. Street lighting design of the proposed BRT corridor assumes special significance as it has to cater to various lighting requirement such as BRT buses plying on BRT lane, other motorized traffic on mixed lane, slow moving and motorized traffic on service lanes and pedestrians on footpath. The lighting design therefore should cater to all these users simultaneously taking care of the basic design parameters of luminous intensity, the contrast, glare, light uniformity over the pavements and aesthetic.

2.2.11 Transit Infrastructure and Design

42. A BRTS system requires support transit facilities for efficient system. Planning and design of these facilities are critical for passenger convenience and operational efficiency. BRTS in Hubli-Dharwad has been done in comprehensive outlook where it deals with developing supporting infrastructure. The various supporting infrastructure being developed are BRTS Terminals at Hubli CBT and Dharwad CBT, Non-BRT Terminals at Hubli-OCBS and Dharwad-OCBS, BRTS Depot at Hubli&Dharwad, Hosur Depot, and Divisional Workshop.

43. BRTS Hubli-Dharwad has been proposed to provide convenient and quality public transit service for local residents. Therefore the supporting infrastructure is designed to provide efficient transit system. The overall strategy is focused on optimizing land and human resource, reducing traffic congestion, increasing efficiency of the system, reducing dead kilometres, sharing common infrastructure, improving level of service for commuters and locals & maximizing efficiency over operation & management. The strategic network for Hubli-Dharwad public transit system has been identified considering the overall efficiency of the system. The figure below depicts the schematic network for transit facility infrastructure in Hubli-Dharwad.

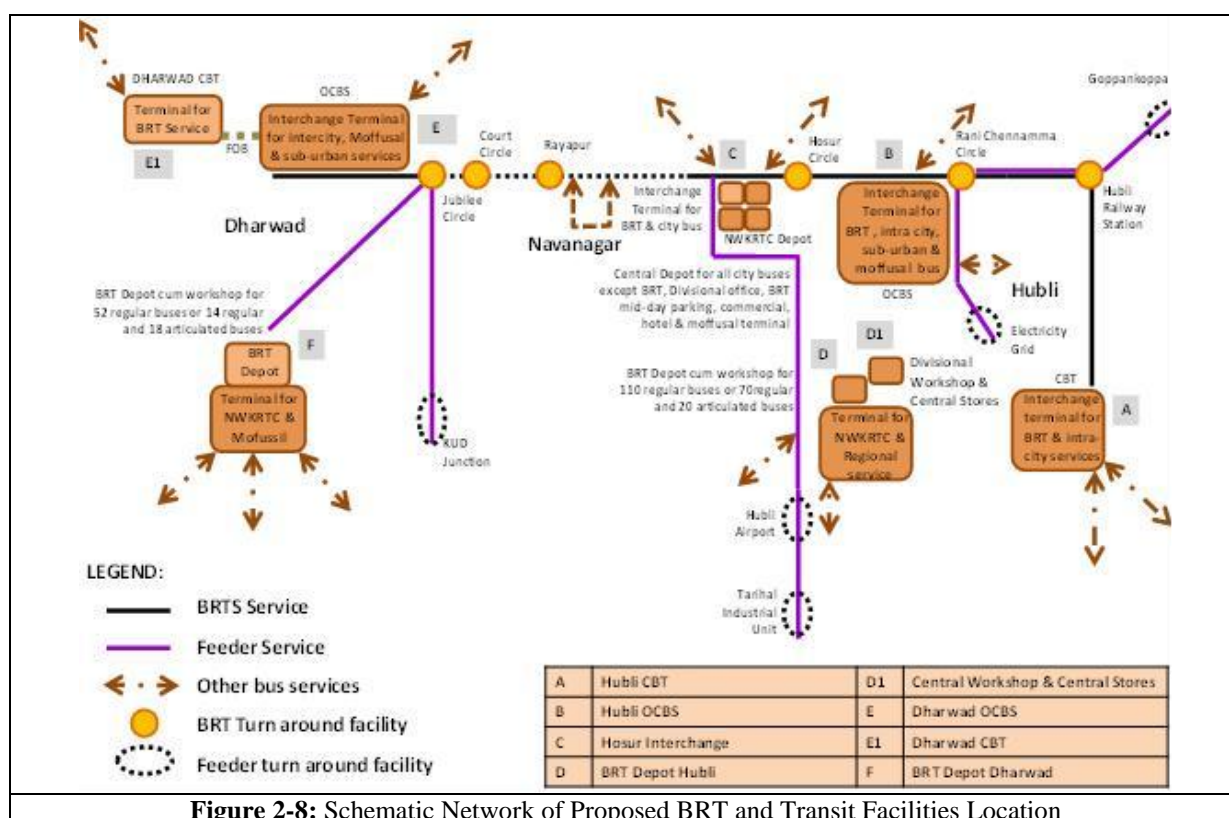


Figure 2-8: Schematic Network of Proposed BRT and Transit Facilities Location

44. Route rationalization plan for city and sub-urban services would be worked out as a separate exercise to develop an efficient transit system.

45. Overall, project has been found to be sound to be implemented over technical and economic feasibility. The Social Impact Assessment (SIA) and Environmental Impact Assessment (EIA) have been worked out based on guidance document of GoK and World Bank. The project has been approved by DULT, GoK, GoI, and went to approval process of World Bank.

2.2.12 Proposed Infrastructure in the Terminals and Depots

a) Water Treatment / Recycling systems

46. **Rain Water Harvesting:** The project corridor is known for drought condition during summer and being a rolling terrain, it is hard to harvest rainwater under normal conditions. As an environmental enhancement measure, it has been decided to have rainwater harvesting structures at all bus transit infrastructure's including BRTS-stations. Percolation wells shall be used for RWH for all transit infrastructures and it shall be provided with primary and secondary filtrations.

47. **DEWATS:** Decentralised Wastewater Treatment Systems shall be provided for treating the waste water generated from toilet facilities in the terminals, depots and workshop. The DEWATS shall adopt four treatment systems:

- Sedimentation and primary treatment in settlers, septic tanks or Imhoff tanks.
- Secondary Anaerobic Treatment in fixed bed filters or Baffled Reactors.
- Secondary and tertiary aerobic/anaerobic treatment in Planted Gravel Filters and
- Secondary and tertiary anaerobic /aerobic treatment in ponds.

48. The selection of the DEWATS Treatment System is based on the characteristics of generated waste water. The DEWATS is reliable, efficient and low-cost system for organic wastewater treatment. The system is also non-dependent on energy consumption.

49. **Wastewater Treatment Plant (WTP):** The treated waste water from the DEWATS and wash water generated from the terminals and depots shall be treated in the Wastewater Treatment Plant (WTP). It is estimated that about 250L of water is required to wash each bus. The WTP shall have compact design to treat waste water between 5 cum to 50 cum per day with primary, secondary treatment & tertiary treatment. The treated water shall be utilized for washing buses, water for urinals and gardening purposes. Following figure depicts the size of the compact water treatment unit.



Figure 2-9: Compact Water Treatment Unit for Industries

b) Utilising Solar Energy

50. Harvesting of Solar energy was evaluated for transit infrastructure and concluded that it is not viable due to the following reasons:

- Roof panel area is not sufficient to provide required electrical energy to transit infrastructure;
- High amount of battery and its storage is required as depot infrastructure will be operational @ night, and
- it is not economically viable.

51. However as an alternative energy saving electrical system, the following approach shall be adopted for all the terminals and depot:

- Electrical fitting with low energy consumption is proposed to be installed in transit infrastructure.
- Natural light and ventilation is maximised to reduce energy consumption load on infrastructure site.

c) Landscaping

52. Tree plantation is suggested as part of the landscape at all infrastructure sites (except CBT due to space constraints). The details of tree plantations are given in the following table.

Sl.no	Infrastructure Site	Trees to be planted within proposed landscape area
1.	CBT Hubli	0
2.	Hubli OCBS - Ranichennamma	239
3.	BRTS Depot Hubli – Airport Road	260
4.	Divisional Workshop - Hubli	210
5.	Depot and Regional Terminal at Hosur Circle	342
6.	BRT Depot Dharwad	167
7.	OCBS Dharwad	78
	Total	1296

2.3 Road Component**2.3.1 Evaluation of Existing Pavement**

53. The existing pavement is of two lane¹ configuration (7m wide) with hard shoulder of 1.5-2.0m width on either side. The crust thickness of existing pavement as per DPR was verified, though most of the length is getting consideration for construction as rigid pavement and needs dismantling. The average thickness of the existing pavement is about 300mm.

¹ Section near Unkal Lake is recorded as having Four Lane road configuration.

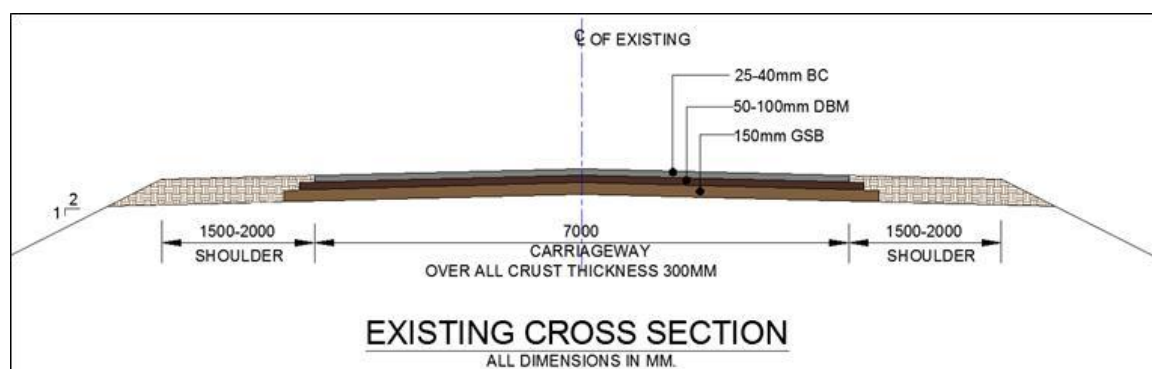


Figure 2-10: Existing Pavement

2.3.2 Pavement Design Options

54. Various options have been screened before choosing the pavement type:

- Flexible pavement for the entire roadway (Mixed Carriageway and BRT corridor) and Rigid carriageway at Bus stops
- Rigid pavement for the entire roadway (Mixed Carriageway and BRT corridor)
- Possible combination length wise addressing RoW and extent of existing road way.

55. Considering the site conditions and as per the RoW availability along the project corridor a pavement strategy has been finalised which is presented in table below. In section I and Section III mentioned in table below, rigid pavement is provided at bus stops, in order to sustain the frequent breaking and accelerating load from buses.

Table 2-2: Pavement Strategy

Section	Chainage	Right of Way (m)	Proposed Pavement Type	
			Mixed CW & BRTS	Bus Stop
I	Hubli CBT to Hosur Circle	18/24/27	Flexible/Overlay	Rigid
II	0.000 Km to 4.200 Km	35	Flexible/Overlay	Rigid
III	4.200 Km to 15.900 Km	44	Rigid	Rigid
IV	15.900 Km to 18.840Km	35	Flexible/Overlay	Rigid
V	Jubilee Circle to Dharwad Circle	24	Flexible/Overlay	Rigid

2.3.3 Material Investigation

Soil Investigation is carried out at three selected location and one at borrow area location

Table 2-3: Material Investigation Findings

Location	Soaked CBR	Soil Classification
Road Way Sample		
Km 10.150	3.3	MH (Silts of High Plasticity)
Km 13.100	6.9	SM(Silty Sands)
Km 15.900	7.1	SM(Silty Sands)
Barrow Area Sample		
From Gamangatti, Navanagar, Hubli	10.9	GC (Clayey Gravels)

2.3.4 Flexible Pavement Design for Section II and IV

56. Flexible pavement is being designed in accordance with IRC: 37-2001 and the parameters considered are discussed below:

- **Traffic:** The commercial vehicles per day considered for the pavement design is 8314 commercial vehicles per day.
- **Vehicle Damage Factor:** A vehicle damage factor of 3.5 for mixed traffic is adopted as per IRC Standards for project location.
- **Design Period:** Pavement design is done for a design period of 20 years
 - For Granular layers 20 year design period
 - For Bituminous layers 10 years design period
- **Design CBR:** The CBR of 8% is adopted as per KRDCL DPR.
- **Adopted MSA**

57. It is estimated that by the end of design life of 20 years the cumulative number of standards axle would be well over 130 MSA for the main carriageway and bus lanes.

58. From economic consideration it is preferable to carry out construction in stages for project of such nature where the investment is high. It is therefore proposed to provide granular base course and sub base course for full cumulative number of standard axles i.e. maximum 130 MSA as per IRC 37:2001 and provide bituminous course for 40 MSA (as per 10 year design life). The flexible pavements are designed as a multi-layer system consisting of typical component layers, namely sub-base, base course, binder course and surface course.

59. Flexible pavement for main carriageway and bus lane as per IRC: 37-2001 is presented in Table and Figure below presents the designed pavement at midblock and at bus stop

Table 2-4: Flexible Pavement Design

Chainage (km)		CBR of Sub-grade (%)	Pavement Thickness (mm)					Subgrade (mm)
From	To		40 MSA		130 MSA		Total (mm)	
			BC (mm)	DBM (mm)	WMM (mm)	Granular Sub-base (mm)		
0.000	4.200	8	40	110	250	200	640	500
15.900	20.00	8	40	110	250	200	640	500

2.3.5 Overlay Design for Section I, II, IV and V

60. From Benkelman beam Deflection Survey² a characteristic deflection of 2.5mm was assessed. For 50

61. MSA and 2.5mm deflection the overlay thickness from the chart is 220mm. The equivalent overlay thickness determined as:

Bituminous Concrete:	40mm
Dense Bituminous Macadam:	110mm
Total:	150mm

²As per DPR prepared by Kadiyali Associates for four laning of Hubli-Dharwad

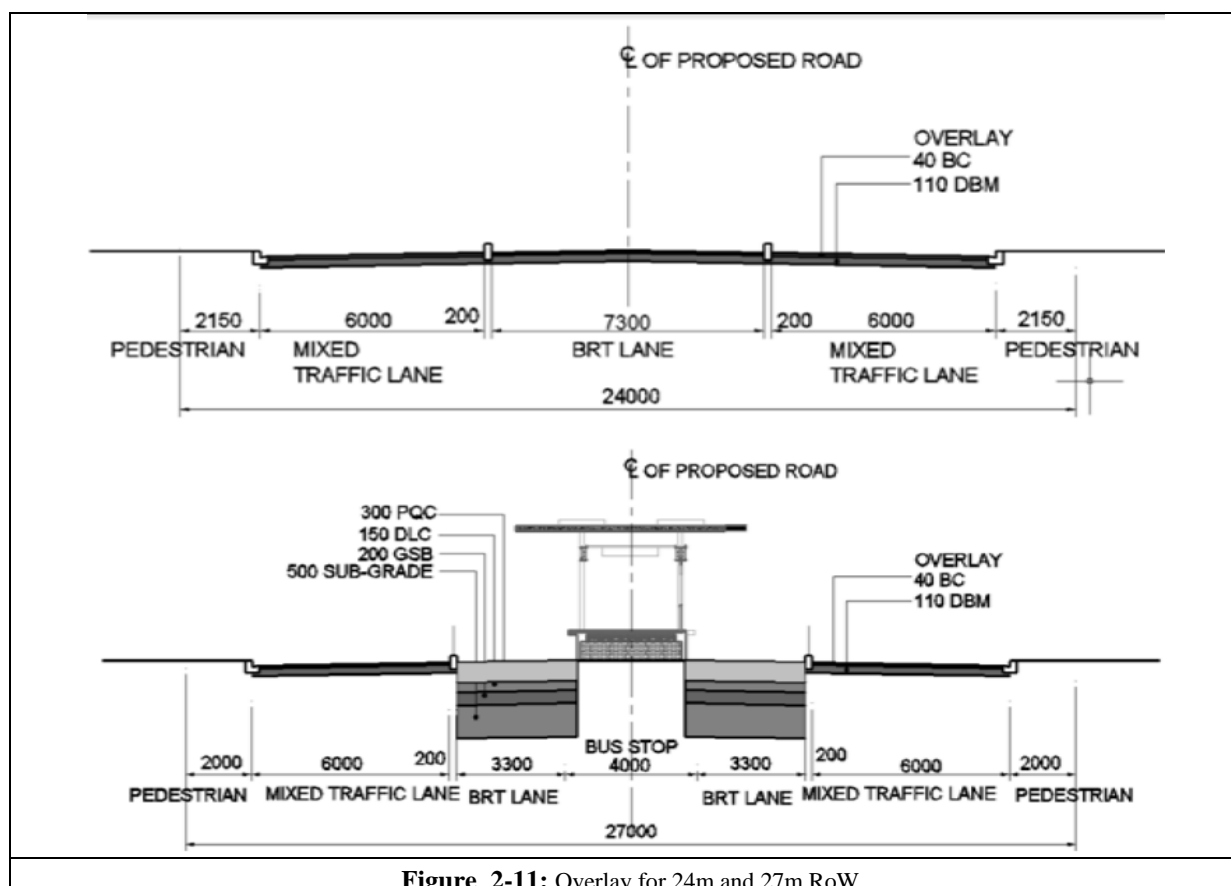
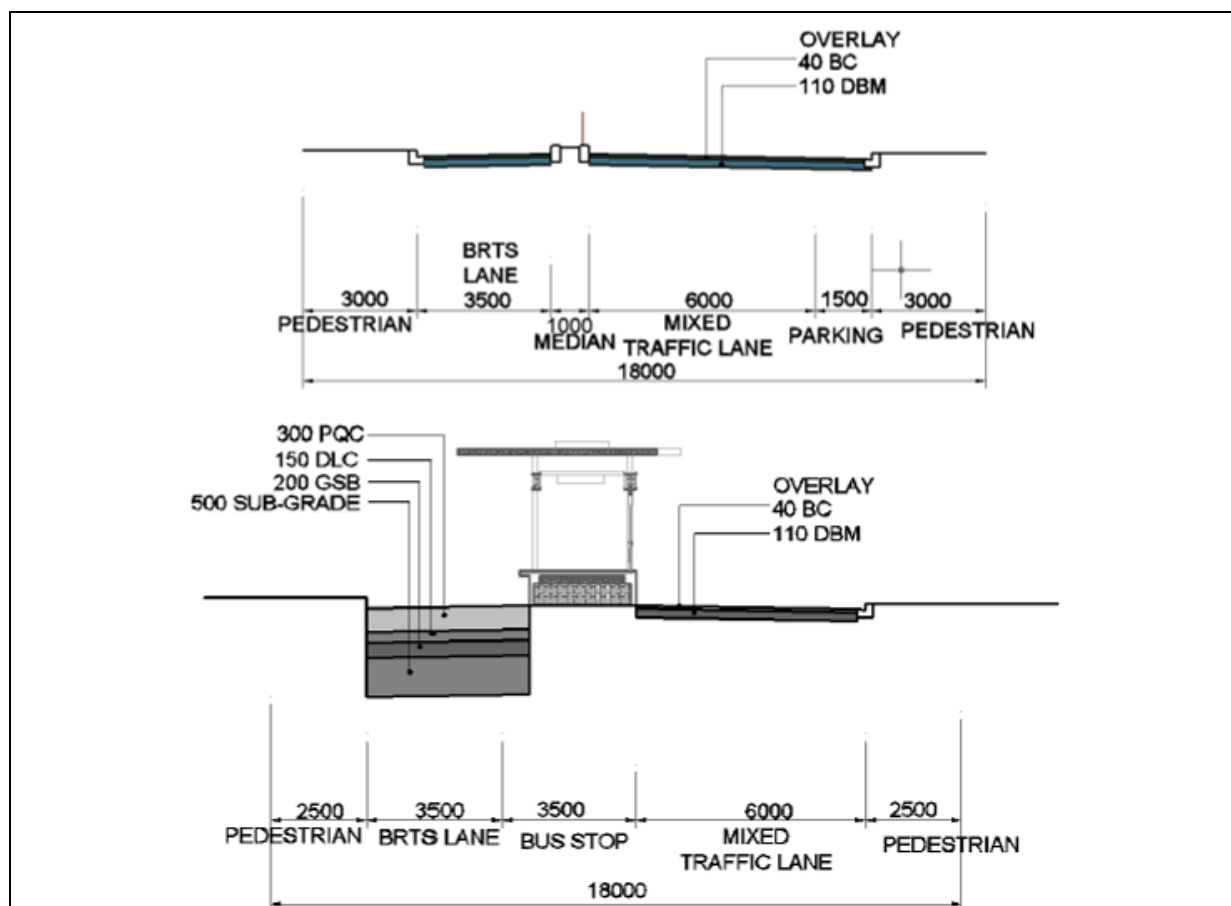


Figure 2-11: Overlay for 24m and 27m RoW

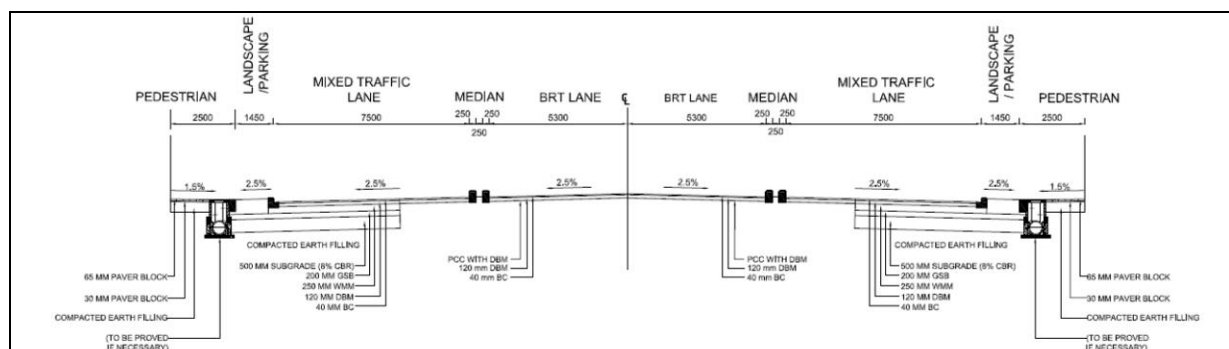


Figure 2-12: New Flexible Pavement for Mix Traffic and Overlay for BRT Corridor for 35m RoW

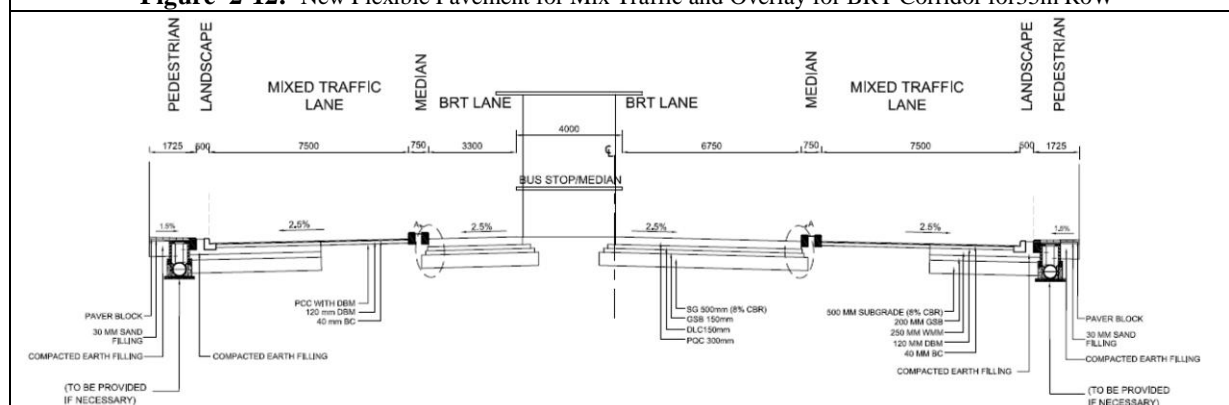


Figure 2-13: Flexible Pavement for Mix traffic and Rigid Pavement at Bus Stop for 35m RoW

2.3.6 Rigid Pavement Design for Section II

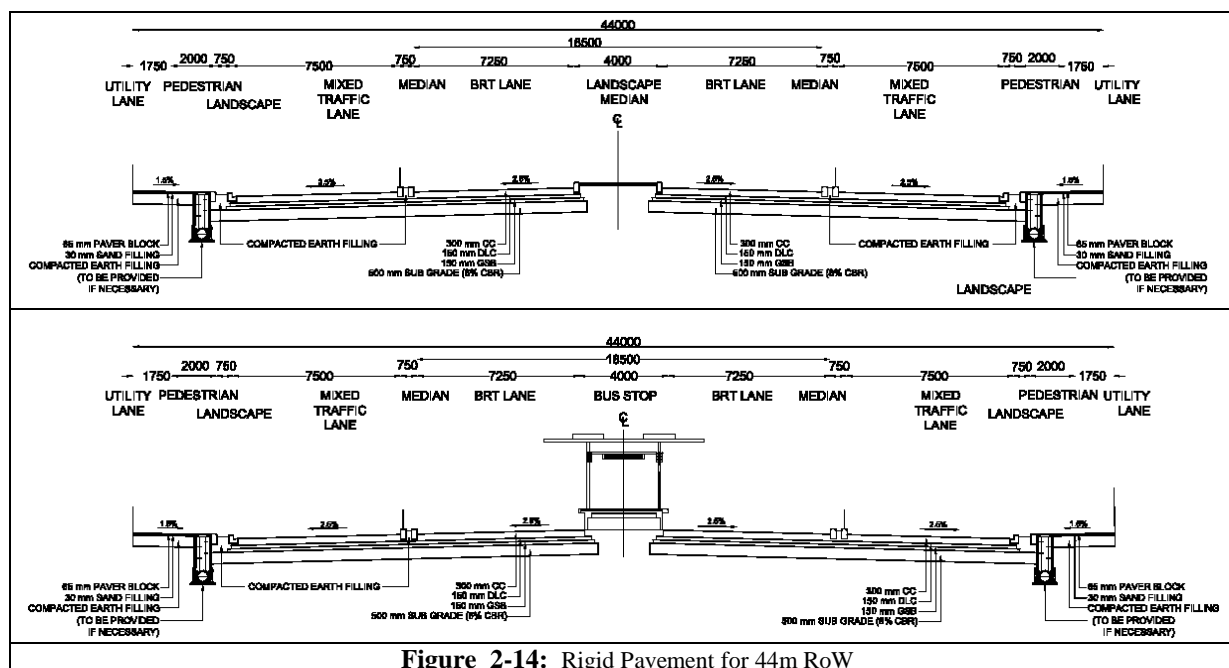
62. Rigid pavement design for mixed traffic and for BRTS from Km 4.200 to 15.900 as per IRC: 58-2002. The design parameters considered for rigid pavement design are as follows:

Parameter:	Values
Traffic growth rate per annum:	8.0%
Design life of pavement, years:	20
Design CBR :	8%
Design traffic:	25.00% of the total repetitions of commercial vehicles
Grade of concrete:	M-40
Elastic modulus of concrete, KG/sq cm:	300000
Type pressure, kg/sqcm:	8
Load safety factor :	1.2
Temperature differential zone:	ZONE -III
Axel Load:	18T

The designed rigid pavement thickness is:

Paving Quality Concrete (PQC)	300mm
Dry Lean Concrete	150mm
Granular Sub-base	200mm

63. Figure below presents the designed pavement at midblock and at bus stop



3. REVIEW OF LAWS, LEGISLATION AND POLICIES

In order to understand the extent of the environmental assessment for the proposed improvement works, applicable laws, legislation and policies were reviewed and presented in the following sections

3.1 Environmental Policy and Regulatory Frameworks in India

64. The following key environmental regulations / policies in India that may affect / influence the project environment both during preparation and implementation stages were reviewed.

- Constitutional Provisions
- Environment (Protection) Act, 1986
- Water (Prevention & Control) Act, 1974
- Air (Prevention & Control) Act 1981
- Forest (Conservation) Act 1980
- Manufacture, Storage and Import of Hazardous Chemicals Rules 1989

3.2 Constitutional Provisions

65. The Constitution of India in its Article 48 provides for the protection and preservation of the environment and states that “the state shall endeavour to protect and improve the environment and to safeguard forests and wild life of the country.”

66. Further Article 51-A (g) on fundamental duties emphasizes that, “It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.” These two provisions of the constitution are the guiding principles for various environmental legislations in the country and to safeguard the environment.

67. A summary of the applicable laws and legislation for road projects is presented below:

Table 3-1: Summary of environmental legislation applicable for proposed project

National Act	Year	Objective	Responsible Institution
Environment (Protection) Act.	1986	To protect and improve the overall environment	MoEF, CPCB
Notification on Environment Impact Assessment of Development projects (and amendments) (referred to as the Notification on Environmental Clearance)	2006 2009	To provide environmental clearance to new development activities following environmental impact assessment.	MoEF, CPCB
Wildlife Protection Act	1972	To protect wild animals and birds through the creation of National Parks and Sanctuaries	MoEF
Forest (Conservation) Act	1980	To protect and manage forests	MoEF
Karnataka Tree Preservation Act	1976	To protect the trees within the state	Forest Department , Govt of Karnataka
Water (Prevention and Control of Pollution) Act (and subsequent amendments)	1974	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	CPCB , KSPCB
Air (Prevention and Control of Pollution) Act (and subsequent	1981	To provide for the prevention, control and abatement of air pollution, and for	CPCB , KSPCB

amendments)		the establishment of boards to carry out these purposes.	
The Land Acquisition Act	1894 1984	Set out procedures for acquisition of land by government	Land Revenue Department, Karnataka
Central Motor Vehicle Act Central Motor Vehicle Rules	1988 1989	To control vehicular air and noise pollution. To regulate development of the transport sector, check and control vehicular air and noise pollution.	Road Transport Department of Karnataka
National Resettlement and Rehabilitation Policy	2007	Addressing impacts on affected persons due to all development projects	MoRD and respective state institutions undertaking the development projects
Ancient Monuments and Archaeological sites and Remains Act	1958	Conservation of cultural and historical remains found in India.	Archaeological Dept. GOI, Indian Heritage Society and Indian National Trust for Art & Culture Heritage (INTACH)

Legal Framework

- **Ministry of Environment and Forests (MoEF):** The primary responsibility for administration and implementation of the GoI policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the MoEF Established in 1985; the MoEF is the agency primarily responsible for review and approval of EIA's pursuant to GoI legislation. The MoEF has set up regional offices responsible for collecting and furnishing information relating to EIA projects, pollution control measures, enforcement of legislations and environmental protection in special conservation areas such as wetlands, mangroves and biological reserves.
- **Karnataka State Pollution Control Board (KSPCB):** The objective of KSPCB is to control, prevent and abate pollution in the State to protect the environment from any degradation by effective monitoring and implementation of state pollution control legislations and are also involved in Implementation, supervision and monitoring activities pertaining to Central Pollution Control Acts and Rules vests with the Central Pollution Control Board (CPCB), Government of India.

Key Environmental Laws and Regulations

Table 3-2: Applicable Laws and Regulations

Sl. No	Clearances	Acts	Approving Agency	Applicability to the Project	Time Required	Responsibility	
						Execution	Supervision
PROJECT PREPARATION STAGE							
1	No Objection Certificate (NOC)	Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981	Karnataka Pollution Control Board	Applicable	3 months	KRDCL	SPV/ KRDCL, WB Projects, CSC
2	Permission for removal of tree growth within the PROW Felling conversion and removal from stump site	Forest Conservation Act 1980 Karnataka Tree Preservation Act 1976	Local Divisional Forest Officer	Applicable	1 month for each workout area	KRDCL	SPV/ KRDCL, WB Projects, CSC
PROJECT IMPLEMENTATION STAGE							
3	Permission for Withdrawal of Ground Water	Environment Protection Act 1986	Central Ground Water Board	Applicable	2 months	Contractor	SPV/ KRDCL, WB Projects, CSC

Sl. No	Clearances	Acts	Approving Agency	Applicability to the Project	Time Required	Responsibility	
						Execution	Supervision
4	Permission for Withdrawal of Surface Water from Rivers, Nala, Water harvesting structure/ Reservoirs/Ponds/ Irrigation canals	Karnataka State Water Policy, 2002	Irrigation Department, Karnataka	Applicable (If the contractor is extracting surface water)	3 months	Contractor	SPV/ KRDCL, WB Projects, CSC
5	Hot mix plant, Crushers, Cement Batching Plant	Air (Prevention and Control of Pollution) Act. 1981	Karnataka Pollution Control Board	Applicable	3 months	Contractor	SPV/ KRDCL, WB Projects, CSC
6	Storage of Hazardous Chemicals	Hazardous Waste (Management and Handling) Rules 1989 and Manufacturing Storage and Import of Hazardous Chemicals Rules 1989	Karnataka Pollution Control Board	Applicable	3 months	Contractor	SPV/ KRDCL, WB Projects, CSC
7	Disposal of Hazardous Waste	Hazardous Waste (Management and Handling) Rules 1989	Karnataka Pollution Control Board	Applicable	2 months	Contractor	SPV/ KRDCL, WB Projects, CSC
8	Disposal of Construction Waste and liquid effluent from Labour camps	Water (Prevention and Control of Pollution) Act 1974	Karnataka Pollution Control Board	Applicable	2 months	Contractor	SPV/ KRDCL, WB Projects, CSC
9	Pollution Under Control Certificate	Central Motor Vehicles Act 1988	Department of Transport, Govt. of Karnataka	Applicable	1 Month	Contractor	SPV/ KRDCL, WB Projects, CSC
10	Employing Labour	Executing Agency of Building and other construction act, 1996	District Labour Commissioner	Applicable	1 Week	Contractor	SPV/ KRDCL, WB Projects, CSC
11	Registration of Workers	Labour welfare Acts.	District Labour Commissioner	Applicable	1 Month	Contractor	SPV/ KRDCL, WB Projects, CSC

Source: Acts, Rules and Regulation from Central and State Government

3.2.1 The Environment (Protection) Act, 1986

68. The Environment (Protection) Act, popularly known as EP Act, is an umbrella legislation that supplements existing environmental regulations. Empowered by the EP Act, the Ministry of Environment & Forests (MoEF), Government of India has issued the following notifications regulating siting of industry and operations, procuring clearance to establish industries and development of projects with appropriate EIA studies, coastal zone regulations and other aspects of environment are:

- Empowers the Government of India (section 6) to make rules to regulate environmental pollution by stipulating standards and maximum allowable limits to prevent air, water, noise, soil and other environmental pollutants.
- Prohibits operations that emit pollutants in excess of standards (*section 7*).
- Regulates handling of hazardous substances and identifies persons responsible for discharges and pollution prevention (*section 9*).
- *Section 17* deals with offences committed by Government Departments.
- Formulated Environmental (Protection) Rules, 1986, Hazardous Wastes (Management and Handling) Rules, 1989 and Manufacture, Storage & Import of Hazardous Chemical Rules, 1989 in accordance with the sections 6, 8 and 25 of EP Act.
- The act has been supplemented with EIA notification 2006

3.2.2 Environmental Impact Assessment Notification, 2006

69. EIA notification of the MoEF dated the 14th September 2006 provides for the following:

- All projects and activities are broadly categorized into two categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and manmade resources.
- All projects or activities included as **Category 'A'** in the schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) to be constituted by the Central Government for the purposes of this notification;
- All projects or activities included as **Category 'B'** in the Schedule, including expansion and modernization of existing projects or activities as specified in sub paragraph (ii) of paragraph 2, or change in product mix as specified in sub paragraph (iii) of paragraph 2, but excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification.

Environmental Impact Assessment Notification - 2006, amendment 2009

70. EIA notification 2006 amendment 2009 explicates 'All state Highways and State expansion projects in hilly terrain (above 1,000m AMSL) and or ecologically sensitive areas' will be categorized as 'B' type project and demands for environmental clearance from SEIAA.

Environmental Impact Assessment Notification - 2006, amendment 2011

71. Amendment 2011 to EIA notification 2006 explains "All new state highway projects should obtain environmental clearance from SEIAA". The new amendment allows carrying out widening, strengthening and improvement works on the existing state highways (**Refer Annexure -1**).

3.2.3 Water (Prevention and Control of Pollution) Act, 1974

72. Water Act is the first environmental regulation that brought at the state and centre levels, pollution control boards to control / regulate environmental pollution in India. Amended twice in 1978 and 88, the Act vests regulatory authority on the State Pollution Control Boards and empowers them to establish and enforce effluent standards for industries and local authorities discharging effluents.

73. Vests regulatory authority on the State Pollution Control Boards and empowers them to enforce effluent discharge standards to prevent water pollution (both for industries and local authorities)

- **Section 24** of the act prohibits use of stream or well or on land disposal for polluting substances that violate disposal standards laid down by the board
- **Section 25** of the act requires an application to be made to the state board to establish any

treatment and disposal system that is likely to discharge sewage or trade effluent in to a stream or well or sewer on land

- **Sections 41 and 44** provide for penalties for not complying with the various provisions or directives of the board
- **Section 48** deals with offences committed by Government Departments
- **Section 55** asserts that all local authorities shall render help & assistance and furnish information to the board as required for discharge of functions, and shall make available to the board, for inspection and examination, such records, maps, plans and other documents as may be necessary

74. The act empowers the board to levy and collect cess on water consumed by the industry or local authority and to utilise and augment resources for the Pollution Control Boards. In line with this provision, The Water (Prevention & Control of Pollution) Rules, 1975 were formulated

3.2.4 Air (Prevention and Control of Pollution) Act, 1981

75. Similar to Water Act, the Air Act vests regulatory authority on the State Pollution Control Boards and empowers them to enforce air quality standards to prevent air pollution in the country. *Section 21* of the act requires an application to be made to the state board to establish or operate any industrial operation.

3.2.5 Forest (Conservation) Act, 1980(as Amended In 1988)

76. As per *Section 26* of Indian Forest Act, 1927 a number of activities are prohibited in forest areas and prior approval is required from the Central government to use forest land for non-forest purposes.

77. The Forest (Conservation) Act, 1980 prohibits large-scale diversion of forestland for non-forest use. As amended in 1988, no State Government or authority shall make such diversions except with the prior approval of the Central Government. Salient features of the act are summarised in the box below.

Box 3-1 Salient features of the Forest act

The Indian Forest Act, 1927: **Section 5** states that after declaring a particular land as reserved forest, no fresh clearings for any purpose shall be made, except in accordance with such rules as made by the state government.

Section 26 states the acts prohibited in such forests, in addition to section 5.

Sections 30, 32 furnish power to the State government to regulate certain acts (clearing for cultivation, building or any other purpose) in such forests as specified in the section

Section 35 furnishes power to the State government to prohibit certain acts (clearing of vegetation etc) in lands not being the property of the government.

The Forest (Conservation) Act, 1980: **Section 2** of the Act restricts the state government on the de-reservation of forests or use of forestland for non-forest purposes

The Forest (Conservation) Rules, 1981: **Rule 4** states that the procedure for state governments to make a proposal seeking prior approval to de-reserve a forest for non-forest purposes (section 2 of Forest Act, 1980), provided all proposals involving clearing of naturally grown trees in forest land or portion thereof, for the purpose of using it for afforestation, shall be sent in the form of a working plan / management plan

3.2.6 Wildlife Protection Act, 1972

78. This act is promulgated to provide for the protection of wild animals, birds and plants and for matters connected therewith. The provisions under this act are as below:

- **Section 9** of the Act mentions that no person shall hunt any wild animal specified in Schedule
- The act prohibits picking, uprooting, damaging, destroying, acquiring any specified plant from any forestland
- It bans the use of injurious substances, chemicals, explosives that may cause injury or endanger wildlife in a sanctuary
- No alteration of the boundaries of a National Park shall be made except on a resolution passed by the Legislature of State
- Destruction or damage of wildlife property in a National Park is prohibited

3.2.7 Manufacture, Storage and Import of Hazardous Chemical Rules, 1989

79. These rules aim at controlling the generation, storage and import of hazardous chemicals. According to these rules, the user of hazardous chemicals has to perform the following and dispose hazardous waste as mentioned in the rules:

- Identify the potential hazards of the chemicals and take adequate steps to prevent and control such hazards
- Develop or provide information about the chemical in the form of safety data sheets
- Label the specified information on the container of the hazardous chemical

3.2.8 The Motor Vehicles Act, 1988

80. In 1988, the Indian Motor Vehicles Act empowered the State Transport Authority (usually the Road Transport Office) to enforce standards for vehicular pollution prevention and control. The authority also checks the emission standards of registered vehicles, collects road taxes and issues licenses. In August 1997, the Pollution Under Control certificate (PUC) programme was launched as an attempt to crackdown on the vehicular emissions in the States. Since this act is applicable for all states, this will be applicable for this project.

3.2.9 Ancient Monuments and Archaeological sites and Remains Act, 1958

81. An Act formulated for the preservation of ancient and historical monuments and archaeological sites and remains of national importance, for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects.

3.2.9.1 Ancient Monuments and Archaeological sites and Remains (Amendment and Validation) Act, 2010

82. This act clearly demarcates the buffer area surrounding the protected monument into prohibited area (100m) and regulated area (200m). Thus, the construction related activities shall be prohibited within the buffer area.

3.3 Operational Policies and Directives of the World Bank

83. A review of all applicable operational policies / directives of The World Bank and environmental laws / regulations in India, was carried out in this task. This included review of the following operational policies of The World Bank.

- OP 4.01 - Environmental Assessment
- OP 4.04 – Natural Habitats
- OP 4.11 – Cultural Properties
- OP 4.36 – Forests

3.3.1 OP/BP 4.01 - Environmental Assessment

84. Operational Policy 4.01 (OP 4.01) is one of the ten safeguard policies of the World Bank, which provides the Environmental Assessment (EA) guidance for the lending operations. The OP 4.01 requires the borrower to screen projects upstream in the project cycle for potential impacts. Thereafter, an appropriate EA approach to assess, minimize / enhance and mitigate potentially adverse impacts is selected depending on nature and scale of project. The EA needs to be integrated in the project development process such that timely measures can be applied to address identified impacts. The policy requires consultation with affected groups and NGOs to recognise community concerns and the need to address the same as part of EA. DULT has adopted the principles of the above policy and has evolved a management framework to address the environmental issues in its lending operations

3.3.2 OP 4.04 - Natural Habitats

85. OP 4.04 sets out the World Bank's policy on supporting and emphasizing the precautionary approach to natural resource management and ensuring opportunities for environmentally sustainable development. As per this policy, the Bank does not support projects that involve significant conversion or degradation of critical natural habitats. As per this policy, the Bank does not support projects that involve significant conversion or degradation of critical natural habitats. Projects involving non-critical habitats are supported if no alternatives are available and if acceptable mitigation measures are in place.

3.3.3 OP 4.11 - Cultural Property

86. Guided by Operational Policy Note 11.03, this OP sets out the Bank's policy to assist in preservation and avoiding elimination of cultural properties with archaeological (prehistoric), paleontological, historical, religious and other unique natural values. Projects that could significantly damage non-replicable cultural properties are declined for funding and the Bank will in turn assist protection and enhancement of cultural properties encountered in the project rather than leave that protection to chance.

3.3.4 OP 4.36 - Forests

87. This policy of the bank aims to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively for sustainable economic development and protect vital local and global environmental services and values of forests. According to this policy, the bank does not finance projects involving significant conversion or degradation of critical forest areas or critical natural habitats. The potential impacts on forests resources are addressed as per OP/BP 4.01 and projects are financed only after incorporating appropriate mitigation measures.

3.4 Environmental and Social Framework (GEF SUTP)

88. In line with the requirements of the World Bank, the Bank's environmental and social safeguards policies shall be applied to all projects to be taken up under GEF-SUTP. The ESMF spells out the potential impacts in the project cities due to the planning, design, implementation and operation of the Green Transport projects and outlines the management measures required for an effective addressal of the same. Appropriate institutional arrangements towards implementing the measures proposed and the capacity building efforts required have been detailed in the framework. The adoption of this framework shall ensure that the projects meet the national and state level environmental and social requirements and are also consistent with the applicable safeguards policies and provisions of the World Bank.

89. The key objectives of the ESMF are to:

- Provide a framework for the integration of social and environmental aspects at all stages of the project planning, design, execution and operation of various sub-components

- Ensuring positive social and environmental impacts of sub-projects and avoid/minimize and manages any potential adverse impacts

3.5 MORTH & IRC SPECIFICATIONS

3.5.1 Specifications for Road and Bridge Works, Fourth Revision, MoRTH, Published by IRC, 2001

90. All road works in India are to be in accordance with the MoRTH specifications for road and bridge works and guidelines of Indian Roads Congress (IRC). The MoRTH specifications have special provisions towards protection of environment under Clause 501, **Annexure A** and the contractor is to satisfy the provisions. Apart from the **Annexure A** to clause 501, there are provisions for control of erosion, drainage, dust suppression, borrow area and haul road management under relevant sections. Provisions of clause 501 **Annexure A**, cover the environmental aspects as:

General	<ul style="list-style-type: none"> • The contractor shall take all necessary measures and precautions to carry out the work in conformity with the statutory and regulatory environmental requirements • The contractor shall take all measures and precautions to avoid nuisance or disturbance from the work. It shall be precautionary measures than abatement measures taken after generation of nuisance • In the event of any spoil, debris, waste or any deleterious material from site being deposited on adjacent land, the same shall be removed and affected area shall be restored to its original state
Water	<ul style="list-style-type: none"> • The contractor shall prevent any interference with supply/abstraction of water resources • Water used for dust suppression shall be reused after settlement of material in collected water • Liquid waste products to be disposed off such that it does not cause pollution • No debris is to be deposited or disposed into/adjacent to water courses
Air	<ul style="list-style-type: none"> • The contractor to devise and arrange methods to control dust, gaseous or other airborne emissions in such a way that adverse impacts on air quality is minimized • Dust shall be minimized from stored material and stockpiles by spraying water • Covering of material likely to rise dust during transport is to be covered with tarpaulin • Spraying of water on haul roads if found necessary
Noise	<ul style="list-style-type: none"> • The contractor shall use all necessary measures to reduce noise from construction equipment and maintain all silencing equipment in good condition
Control of wastes	<ul style="list-style-type: none"> • No uncontrolled disposal of wastes shall be permitted. The contractor shall make specific provisions for disposal of all forms of fuel and engine oil, all types of bitumen, cement, surplus aggregate, gravels, bituminous mixtures etc. conforming to local regulations and acceptance of the engineer
Emergency Response	<ul style="list-style-type: none"> • The contractor shall plan and provide for remedial measures in case of occurrence of emergencies as spillages of oil, bitumen or chemicals

In addition to the above conditions, avoidance measures and control of activities having potential for generation of environmental impacts are devised. These include:

Section 111	<ul style="list-style-type: none"> • Precautions for safeguarding the environment
Clause 201.2	<ul style="list-style-type: none"> • Preservation of Property/Amenities during clearing and grubbing
Clause 301.3.2	<ul style="list-style-type: none"> • Stripping and storing of topsoil for reuse during excavation for roadway and drains
Clause 302.4	<ul style="list-style-type: none"> • Restriction on timings for blasting operations
Clause 304.3.6	<ul style="list-style-type: none"> • Public safety near towns and villages where excavation is carried out
Clause 305.2.2.2	<ul style="list-style-type: none"> • Locations of borrowing and relevant regulations
Clause 305.3.3	<ul style="list-style-type: none"> • Stripping and storing of topsoil at borrow locations
Section 306	<ul style="list-style-type: none"> • Soil erosion and sedimentation control
Clause 407.4.2	<ul style="list-style-type: none"> • Provisions for turfing on median and islands
Section 517	<ul style="list-style-type: none"> • Recycling of bituminous pavement and excavated material
Clause 701.2.1	<ul style="list-style-type: none"> • Use of geotextiles for control of soil erosion
Section 810	<ul style="list-style-type: none"> • Use of Metal beam crash barriers for safety, relevant regulations and specifications

Clause 1010	<ul style="list-style-type: none">• Quality of water for curing and construction
Clause 2501	<ul style="list-style-type: none">• Precaution during river training works

3.5.2 Guidelines for Environmental Impact Assessment, IRC: 104-1988

91. The guidelines endorse application of Environmental Protection Act, 1986 for highway projects. It recommends that the methods of measuring air pollution should be in conformance with IS: 5182-1977 and in case of noise pollution: IS: 3028-1980, Measurement of noise emitted by moving road vehicles; IS: 4758-1968, Method of measurement of noise emitted by machines; IS: 10399-1982, Method of measurement of noise emitted by stationary road vehicles are to be followed. As regards Highway aesthetics, use of provisions made in IRC: SP: 21-1979, Manual on landscaping of roads are to be followed.

3.6 Environmental Clearance Procedure

92. As per the new amendment dated 6th April, 2011 to EIA notification 2006, environmental clearance has been made mandatory only for new state highways. Hence, the widening / strengthening and improvement works on existing state highways are not covered under the ambit of the notification and are not categorized either as Category A or Category B.

93. However, the project shall require obtaining consent from competent authorities such as the KSPCB, for '*Consent to Establish*' by submitting a Common Application (as per Schedule-I), under Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981) and authorization under Hazardous Wastes (Management and Handling) Rules, 1989, as amended.

4. ENVIRONMENTAL DESCRIPTION

4.1 Study Area

94. Hubli and Dharwad cities lie in Dharwad district. The geographical location of the project corridor lies between latitude 15°22'01 to 15°28'20N and longitude 75°08'49 to 75°01'00E. Dharwad district lies in the catchment area of the Tungabhadra and the Malaprabha rivers. The soil has been formed due to the mixture of many types of disintegrated rocks. The main food crops cultivated are jowar, paddy and wheat. Among the non-food crops cotton, groundnut, chillies, sugarcane and safflower are important. This district is famous right from the beginning for cotton. Grapes of Dharwad, jumb-jums of Navilur wild fruit (bore) of Vasana, cashew and mango of Malnad are also famous. The district is renowned for cotton industry. Next to agriculture the main vocation is business. Hubli is the main business centre. The district has achieved tremendous progress in education. In the northern Karnataka region. Dharwad district is the centre of higher education. Many public and religious organizations have played an important role in the establishment of educational institutions in the district.

4.2 Land Environment

4.2.1 Physiography

95. Hubli is located at an altitude of 2,200 feet (670.75 m) and Dharwad at an altitude of 2,500 feet (762.19 m), above MSL. The project road elevation ranges from 621m to 742m above MSL. The elevation of the project corridor at Hubli (start point) is 621m and it reaches a maximum at Vidhyagiri (742m) and the elevation is 714m at Dharwad (end point). The elevation clearly shows the terrain from Dharwad is sloping towards Hubli. Dharwad has better climatic condition than Hubli, reason being the altitude difference of 400 feet (122 m). Dharwad has a number of hillocks. Hubli city is located on either side of a natural valley leading to Unkal tank.

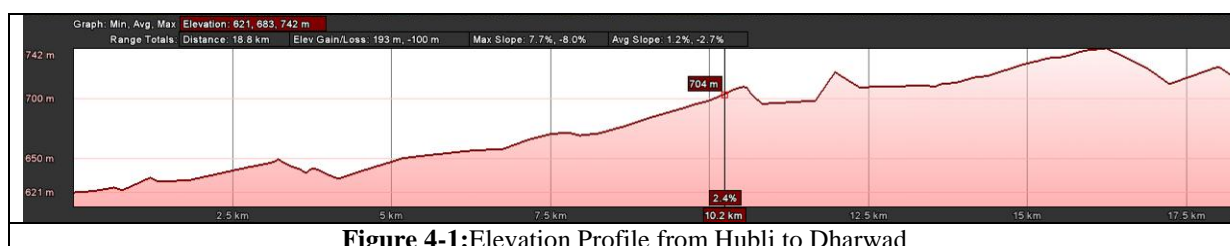


Figure 4-1: Elevation Profile from Hubli to Dharwad

4.2.2 Geology and Soil

96. The study area falls in the Western-Ghat section (Sahyadris) of the peninsula within the rugged foothills. An undulating central pediplain and the eastern maidan is the prominent feature. It situated at an altitude of 753 mamsl (N-W Dharwad Tk) to 558 mamsl. Mineral deposits like manganese, iron and copper are available here, but not in sufficient quantity for economic exploitation.

97. There is a variation on the quality and type of soils between different parts of the region. The soil towards the northern and eastern sides is mostly black cotton soil (high humus and low phosphate content, with normal pH-value and very low infiltration characteristic) and that on the southern and western regions of the city is medium red and gravelly.

4.2.3 Seismology

98. As per the seismic zoning map of India, Dharwad district falls under the Zone II, which is referred to as low damage earth quake risk zone in India.

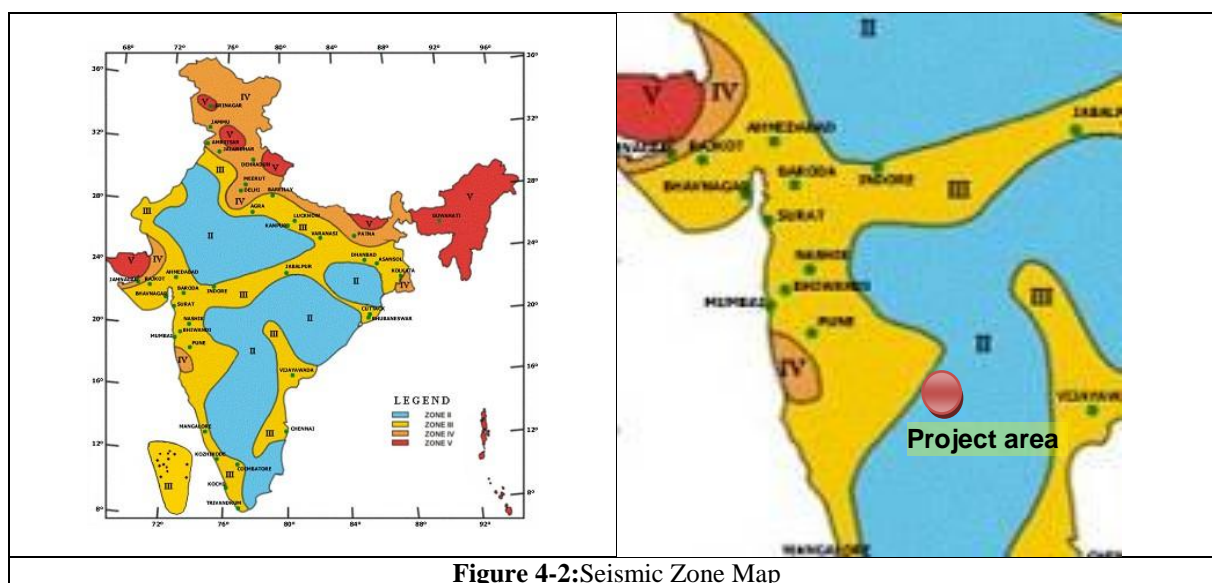


Figure 4-2: Seismic Zone Map

4.2.4 Climatic Conditions

99. Dharwad district is characterized with hot summer months and low rainfalls during monsoon. The temperature varies between 42°C during summer and 17°C during winter. Generally, April and May are the hottest months while December to February is the coldest. The following **Table 4-1** shows the mean maximum and minimum temperature recorded in the region. As there was no meteorological observatory present at the two HDMC cities, the data presented here is of the observatory located at Gadag, around 68 km and 54 km east from Hubli and Dharwad respectively. This data is considered as representative data as both the cities are located in the same physiographical zone and also they are closely located.

100. The cities experience southwest monsoon from June to September and the period between the months of October and November can be termed as post monsoon months. The cities experience scanty rainfall and the long term annual average rainfall is 696 mm. The rainfall is confined and about 60% of the annual rainfall is received during the months of June to September. The maximum rainfall is registered during the month of August. The morning relative humidity (RH) varies from 51 to 87% while evening RH varies from 16 to 67%; and the RH is generally higher during the southwest monsoon.

Table 4-1: Mean Maximum and Mean Minimum Temperature in Gadag Observatory

Month	Long term normal (30 Years) - Mean (in ° C)				2004 (Actual) - Mean (in ° C)	
	Daily Max	Daily Min	Highest in a month	Lowest in a month	Max daily	Min Daily
Jan	30.2	16.6	32.5	13.9	31.0	16.1
Feb	33	18.7	35.6	15.2	33.0	18.3
Mar	36.1	21.1	38.1	17.9	37.2	21.4
April	37.3	22.5	39.4	19.9	37.8	22.3
May	36.1	22.3	39.6	19.7	34.0	22.4
June	31.0	21.6	35.8	20.0	30.0	21.3
July	28.4	21.1	31.6	20.0	29.6	20.8
Aug	28.6	20.8	31.8	19.7	28.5	20.4
Sep	29.8	20.5	33.3	18.8	29.4	20.5
Oct	30.6	20.5	33.4	18.3	30.6	19.9
Nov	29.8	18.4	32.0	15.0	30.4	18.3
Dec	29.1	16.4	31.4	13.6	29.8	14.6

Source: Meteorological Centre, Bangalore

101. The region is continuously experiencing below normal rainfall from the last few years. The actual rainfall recorded in the year 2002 was 490 mm as against the normal rainfall of 696 mm marking a departure of -30 percent while in 2004 the actual rainfall was 511 mm marking a departure from normal of -26 percent. The region experiences moderate winds; as shown in **Figure 4-3**. The wind blows predominantly from west during May to September while during November and December predominant wind direction is from east. Most of the winds occur in the range of 12 – 19 kmph, however during the period of June to August winds of more than 19 kmph also occur. The following **Table 4-2** shows the climatological details.

Table 4-2: Climatological characteristic of Dharwad District

Month	Long Term Avg. (30 Years) - Mean				2004 - Actual			
	RH Max	RH Min	Wind Speed	Total Rainfall	Mean RH 0830 Hrs	Mean RH 1730 Hrs	Wind speed	Total Rainfall
	%	%	Kmph	mm	%	%	kmph	mm
Jan	68	41	7.1	2.6	71	36	8.7	0.0
Feb	61	35	7.1	1.1	51	25	9.3	0.0
Mar	62	32	7.7	5.3	55	16	10.1	Trace
April	70	37	9.6	43.4	65	25	10.2	17.6
May	78	45	13.4	85.8	75	51	14.2	105.4
June	84	66	18.1	83.9	83	63	16.5	59.8
July	88	75	18.8	72.4	87	67	14.0	72.8
Aug	88	73	17.2	81.5	87	67	15.4	52.4
Sep	87	69	12.8	134.3	86	65	9.2	166.2
Oct	82	60	7.6	130.1	80	51	10.3	37.1
Nov	73	51	6.9	34.5	67	38	11.9	Trace
Dec	72	48	7.3	7.7	62	29	9.6	0.0
Total / annual mean	76	53	11.1	695.6	72	44	11.6	511.3

Source: Meteorological Centre, Bangalore

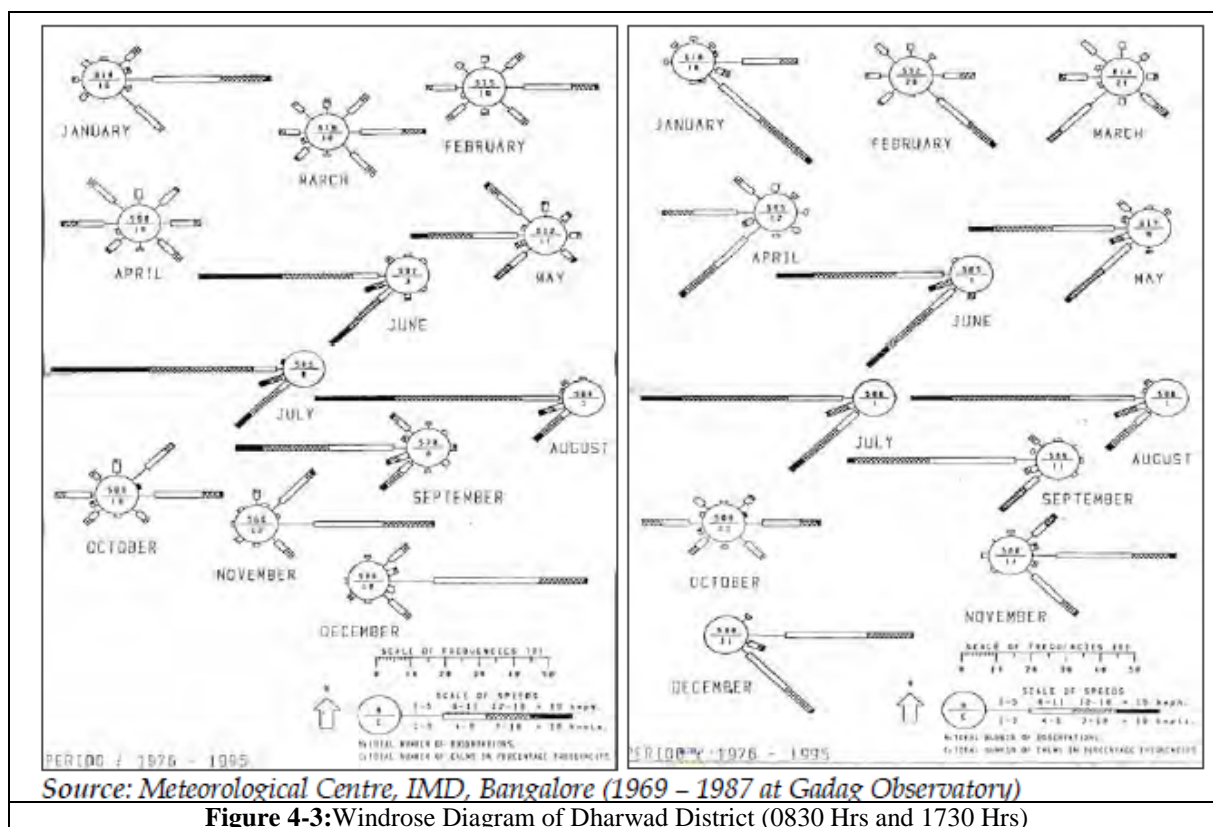


Figure 4-3: Windrose Diagram of Dharwad District (0830 Hrs and 1730 Hrs)

4.2.5 Surface Water

102. The Hubli Dharwad cities are mainly drained by two major river systems namely the Malaprabha in the north and the Tungabhadra in the south. The Tungabhadra river system covers about one third of the total area of the Dharwad district. The main rivers of Dharwad are the Tungabhadra, Malaprabha, Varada, Kumudvathi and the Bedthi. Even though the rainfall in this region is scanty. The rivers that originate in Western Ghats flow here and as such water resources are plenty and the land adjoining the rivers is fertile.

103. There are two main sources of water in the HDMC cities – Renukasagar Reservoir (on Malaprabha River) and Neerasagar Tank. Until recently, the former had a design capacity of 68 cu.m, of which 41 MLD was used; the latter had a design capacity of 40.9 cu.m, of which 33.5 MLD was used. Currently, Hubli-Dharwad draws about 110 MLD, although the daily requirement as per prevailing government norms is 130 MLD.

104. There are no river crossings along the project corridor. However, very few surface water bodies were identified during the reconnaissance survey. The details of the water bodies are given in the **Table 4-3**.

Table 4-3: Surface water Bodies along proposed BRT

Sl.no	Water Body	Chainage	Status
1	Unkal Lake	3/300 to 4/200	Perennial
2	Pond	4/800 to 4/900	Seasonal
3	Rayanpura Tank	9/300 to 9/500	Seasonal
4	Navalur Lake (200m away from BRT)	14/100 to 14/200	Perennial

Source: Reconnaissance survey



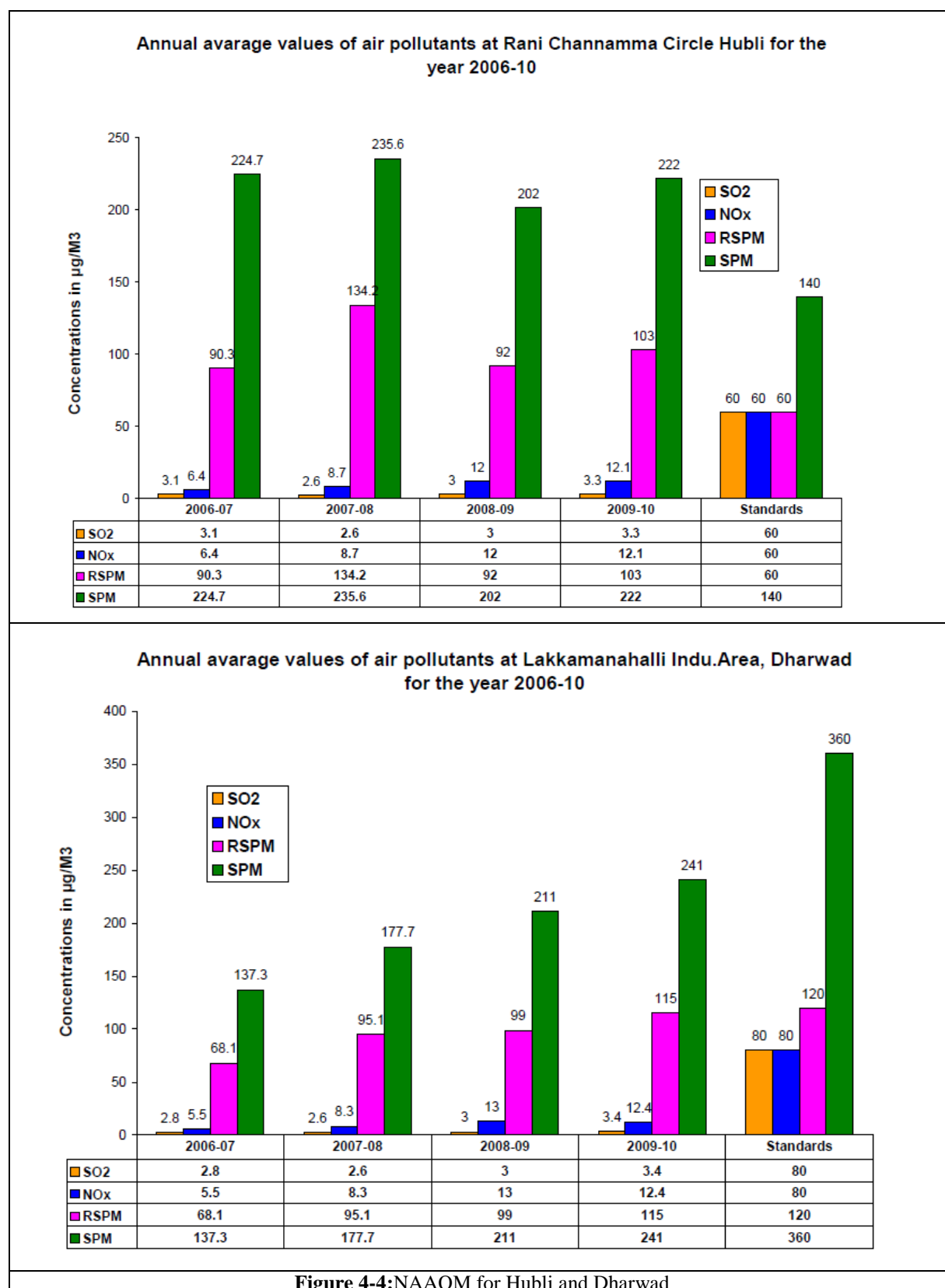
4.2.6 Groundwater

105. Top soil of the Delta region that helps in the storage of underground water is very less in this district. In places where basaltic flow is closed and in places where weathering of rocks has taken place, underground water is available. The quantity of underground water depends on the structure, type and extent of rocks and is available in plenty where soft rocks are located and available in less quantity where rocks are hard. Dharwad district has an annual renewable ground water source of about 1,24,882 hectare metre (ham) of which up to 1.1.1991 only about 23% (24.392 ham) has been exploited and 77% is still unexploited.

106. Since 1956 Hubli-Dharwad has relied on piped reservoir sources, while the rural areas have increasingly relied on boreholes. Increasing amounts of water are now being abstracted for irrigation in rural areas and many boreholes are now dry or have hard mineral waters which are bad for human health and damage some crops. In the Hubli – Dharwad urban area 40% of the water supplied by the water supply network leaks into the ground. There are no sewage treatment facilities and hence 30% of sewage goes to cesspits and then seeps into the ground. 70% of sewage enters the sewerage network where it leaks into the ground or drains into local rivers, some of which is used for irrigation in rural areas.

4.2.7 Air Quality

107. Under National Air Quality Monitoring Programme (NAQMP), Karnataka state pollution control board (KSPCB) had performed air quality monitoring for Hubli (at Rani Channamma circle) and Dharwad (Lakkamanahalli Industrial area). The outcome of the monitoring shows that the RSPM and SPM concentration were recorded high in comparison at Hubli when compared with AAQ standards for residential areas. In contrary, the monitoring results of Dharwad are well within the standards stipulated for industrial area. The monitored ambient air quality is depicted in **Figure 4-4** for various assessment years.



4.2.8 Forest

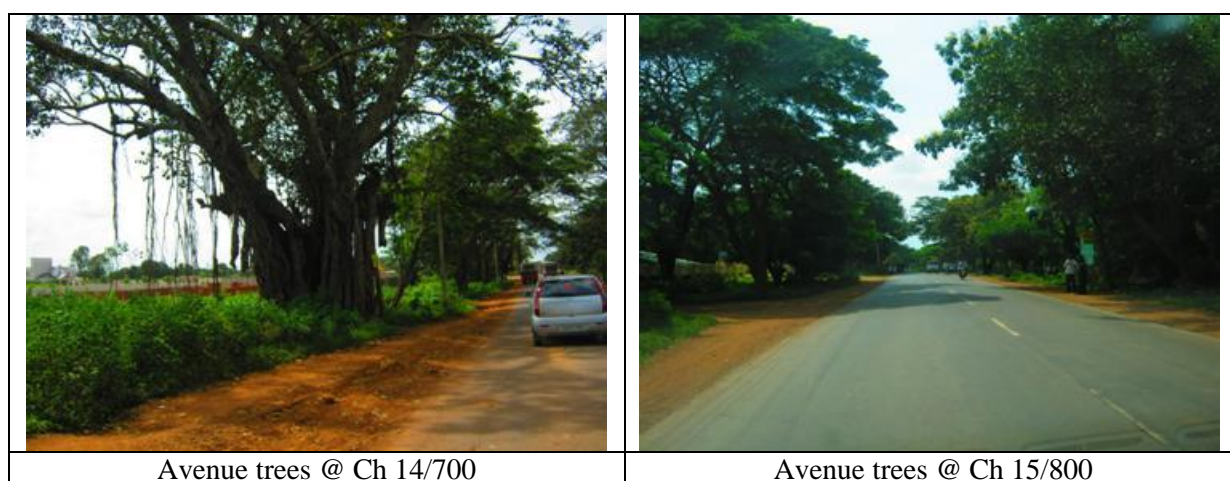
108. The two main types of forests in this region are moist deciduous forests and thorn and scrub forests. These types of forests have plenty of timber yielding trees. It is conducive for the

growth of timber yielding trees like Rose wood, Teak, Honne, and Nandi. These forests are important from the point of view of timber. Scrub and thorn forests are also more in the district. Sandalwood and other trees yielding minor forest products. The requirements here put tremendous pressure on the limited forest resources available. None of the forests within the Dharwad district falls within the HDMC limits.

4.2.9 Flora and Fauna

109. The forest areas include big trees such as Teak, Bamboo, Banyan etc. Because of dry weather and poor soil quality trees and herbs grow sparsely. Along the roadsides Neem trees are common. In sandy soil Toddy Palm and in gardens Banana, Guava, Sapota, Mango, Jackfruit. Custard apple, Lime, Coconut and Arecanut trees grow usually.

110. The district has a very rich fauna especially in its western portion. Although the district is rich in flora and fauna, none of the sensitive environmental features such as National Parks, Wetlands, and Biosphere Reserves fall within or nearby the HDMC limits. However, significant number of avenue trees belongs to Banyan (*Ficus benghalensis*); Neem (*Azadirachta indica*) and Acacia (*Acacia pennata*) are observed along the project corridor.



4.3 Socio Economic Profile

4.3.1 Demography

111. As per the Census 2011, the total population of HDMC was 9,60,824. In spite of being the second largest urban centre, the city has experienced a low population growth during the past two decades when compared with the decades 1961-81. The population growth rate was the highest during the decade 1961-71 due to increased migration. Since 1981, growth rate has been declining primarily due to lack of new economic activities and development of other district centres in the region.

4.3.2 Population density

112. The population density has shown consistent growth during the past three decades in Hubli- Dharwad. The density has increased from 1837 persons/sq. km in 1971 to 4756

persons/sq. km in 2011. While the overall density of both cities together has increased uniformly in the last two decades, the density of Hubli at 5169 persons/ sq. km is more than two times that of Dharwad's density at 2464 persons/sq. km.

4.3.3 Sex ratio

113. Between 1901 and 1981, the ratio has recorded a continuous decline from 950 to 912. But, significant improvement is shown in the last 2 decades to reach 949. As per the provisional reports of Census 2011, the sex ratio of Hubli and Dharwad city is 983 per 1000 males.

4.3.4 Literacy

114. According to the 2001 census, the literacy rate in HDMC is 82%. The male literacy rate is 88.1 percent while the female literacy rate is 75%. As per the provisional reports of Census 2011, total literates in Hubli and Dharwad city are 736,506 of which 389,290 are males while 347,216 are females. Average literacy rate of Hubli and Dharwad city is 87% of which male and female literacy was 92% and 83% respectively.

4.3.5 Workforce participation

115. According to census 2001, Dharwad district urban workforce participation rate i.e. total workers to total population, is 33%. The workforce participation rate of Urban Dharwad (Hubli-Dharwad) in 1991 was 30%. The positive factor is the growth in workforce participation rate in urban areas by about 4% over the last decade. In terms of classification of workers, the percentage of marginal workers seems to have gone up in 2001 as compared to 1991, as given in **Table 4-4**

Table 4-4: Details of workers, non-workers and other workers

Classification of workers	1991		2001	
	Population	%	Population	%
Main workers	181723	28.0	232120	29.5
Marginal workers	4083	0.6	18692	2.4
Non workers	462492	71.3	535206	68.1
Grand total	648298	100.0	786018	100.0

4.4 Cultural and Historic Places

116. Hubli is well known as a commercial as well as industrial centre, where as Dharwad is seat of learning. Historic in origin, there are some majestic historical monuments such as the Chandramouleshwara Temple (0.5km from project corridor) at Unkal near Unkal Lake on the old Pune – Bangalore Highway, NH 4, Siddharoodha Math (2.86km from project corridor) an eminent religious institution located at the outskirts of Hubli and Banashankari Temple (1.8km from project corridor) Amargol between Hubli and Dharwad, are the other cultural sites present in this region. The project corridor does not fall within the limit of the protected area as defined in the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation)

Act, 2010. Hence, the construction activity does not have any impact on any of the historic places mentioned above.

117. From the reconnaissance survey, it has been identified that there are around twelve temples along the proposed BRT corridor. The locations of these temples with respect to the chainage are given in the following **Table 4-5**.

Table 4-5: Cultural properties along the proposed BRT

Sl.no	Temple	Chainage	Distance from centerline (m)
1.	Lakshmi temple	1/400	11.0
2.	Temple unkal cross	2/600	13.0
3.	Ramalingeshwarar Temple	2/700	6.0
4.	Anjaneya Temple	3/200	14.2
5.	Temple	4/400	22.0
6.	Rukmani Temple	4/700	20.0
7.	Ganapathy Temple	4/700	15.4
8.	Mosque	5/300	14.8
9.	Balaruti Prajama Temple	7/800	10.5
10.	Iskcon Temple	9/200	11.3
11.	Temple	9/800	12.2
12.	Jai Sri Ram Temple	10/300	18.3
13.	Temple	16/500	22.2

Source: detailed assessment



Figure 4-5:Anjaneya Temple @ 3/200



Figure 4-6:Iskcon Temple @ 9/200

5. ANALYSES OF ALTERNATIVES

5.1 No Project Scenario

118. The '*No project scenario*' is analyzed with respect to the development of the city by the backdrop of requirement of reliable quality infrastructure for sustained growth economy and consequent wellbeing of its citizens. Providing better connectivity between Hubli and Dharwad will ensure that goods and people from areas covered by the road can commute quicker and save time. Increase in trade and commerce activity is expected. The savings in the Vehicle Operating Costs (VOC) makes the project viable.

119. The commercial activity will be getting a good boost due to proposed BRT roads. The commercial activity will give rise to employment potential for people in and around these places. However, there would be an increase in the vehicular pollution-air and noise, in the vicinity of the road. Some agricultural lands have been diverted for BRT road to accommodate the proposed widening. However, for the acquired land; suitable compensation shall be paid as per the entitlement framework.

120. If the project is not implemented, there is every likelihood that the existing road network roads will deteriorate further. In the absence of the proposed BRT project, the both cities (Hubli and Dharwad) will also find it difficult to have good transportation. Increased air pollution, due to slow moving traffic and congestion, will follow. Noise levels will rise due to traffic congestion with increased honking. Without the project, the traffic would continue to pose a safety risk for the road users.

121. Therefore, the '*project with* scenarios', with its minor impacts is more acceptable than the '*without project scenario*' which would mean slow down development in these cities. Hence, it is clear that the implementation of the project will be a definite advantage to these cities in order to achieve all-round development of its economy and progress for its people.

5.1.1 Project with Alternatives

122. In this project, the project alternatives in terms of location, option are very limited, as the BRT project is coming on the existing road network, which is already in use. However, options with respect to having at-grade corridor or elevated corridor are studied in detail and elaborated in the DPR. With respect to the environmental impact of the proposed options; both the options are taken for study. The comparison study is detailed in the following **Table 5-1**. From the analysis, Option -1 has more advantages and less negative impacts than Option -2.

Table 5-1: Comparison of alternatives in term of Environmental Aspects

Item	Option 1 – At-grade	Option 2 – Elevated
Aesthetic view and landscape	Good	Not good due to the view will be limited by high elevation of the road

Item	Option 1 – At-grade	Option 2 – Elevated
Working conditions	Low risk of accidents for the worker and surrounding areas due to work at ground level.	High risk of accidents for the worker and surrounding areas due to work at high elevation.
Air Pollution	Construction phase: Medium impacts caused by dust concentration caused by during the demolition activities, material transportation, the earth works and other construction activities; Impacts CO, NO ₂ emission from transport trucks, vehicles and construction machinery.	Construction phase: Major impacts caused by dust concentration during the piling, transportation of construction material ; CO, NO ₂ emission from transport trucks, vehicles and construction machinery
	Operation phase: CO, NO ₂ , HC concentration due to increasing of traffic flow	Operation phase: Impacts by CO, NO ₂ , HC increasing of traffic flow.
Noise Pollution	Construction phase: Increasing of noise levels during the transportation of construction material ;	Construction phase: Increasing of noise levels during the piling, transportation of construction material ;
	Operation phase: Impacts by noise levels due to increasing of traffic flow.	Operation phase: Impacts by noise levels due to increasing of traffic flow.
Vibration	Construction phase: Less impact due to construction activities will be at ground level (max. noise level 64 dB(A) at 10 m from the source).	Construction phase: In case of using bored pile industry, heavy truck is likely to cause biggest vibration (about 79dB(A) at 10 m far from source).
	Operation phase: Impact level can be neglected	Operation phase: Impact level is not significant
Water quality	Limited impact on water quality	Limited impact on water quality

5.1.2 Vehicular under Passes (VUP's)

123. Safety for the road users is an important aspect that needs to be fulfilled in all road infrastructure projects. For this BRTS project, four VUP's have been recommended based on the settlements abutting the project road, number of vehicle crossings, pedestrian crossing etc. The existing topography of the project corridor adds advantage for finalizing the VUP designs.

124. Two options were considered before finalizing the VUP's i.e. BRTS with VUP's (Grade Separated Crossing) and BRTS without VUP's (At-grade Crossing). The following table distinguishes the advantage and the disadvantage of both the options.

Table 5-2: Comparison of Alternatives in term of VUP's

Sl.no	BRTS with VUP's (Grade Separated Crossing)	BRTS without VUP's (At-grade Crossing)
1.	Pedestrian and vehicular traffic are channelized separately allowing traffic to move freely, with less interruption.	Disrupts the flow of both pedestrian and vehicular traffic by making them to wait for traffic signal changes
2.	Conflicts between modes are eliminated; the potential for accidents are reduced.	Potential conflict will exist between pedestrians and vehicular traffic making it less safe than a grade separated crossing.
3.	Expensive because of new grade separator constructions	Typically will have a substantially lower construction cost than above grade facilities
4.	Impacts on road network and likely disruption of access to businesses during construction	Construction time is much less than other crossing types. This will mean less impact on existing traffic, on both pedestrian and vehicular
5.	Safety fear will be less among the pedestrians using VUP's during project operation	Potential safety concerns to the pedestrians during the project operation
6.	Drainage/ storm water handling requires	Minimal or no impact on existing in-ground utilities

Sl.no	BRTS with VUP's (Grade Separated Crossing)	BRTS without VUP's (At-grade Crossing)
	special concern.	
7.	Maintenance issues	Minimal or no maintenance issues
8.	Adding facility to the kiosks and rest area are limited	Able to incorporate a destination by adding facilities on to paths such as kiosks and rest areas

125. From the comparison study it is suggested that, BRTs with VUP's are having more advantage over BRTS without VUP's; especially with respect to road safety. The suggested VUP's are shown in the following **Figure 5-1 to Figure 5-4**.

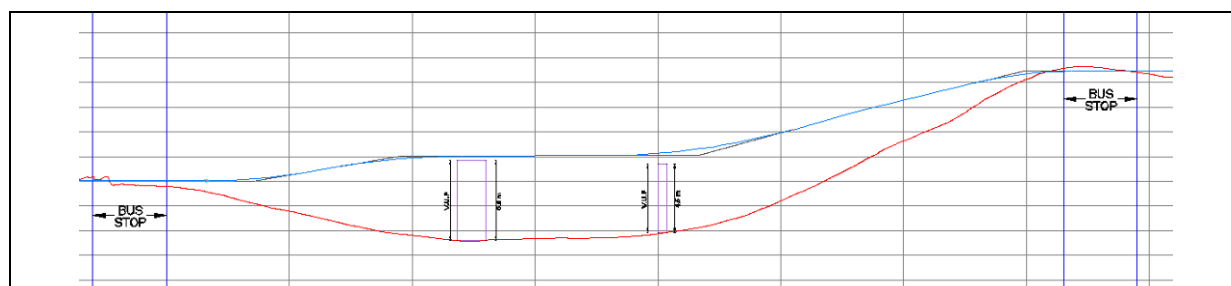


Figure 5-1:Unkal cross VUP at Ch 2/320 to 2/960 (640 mts)

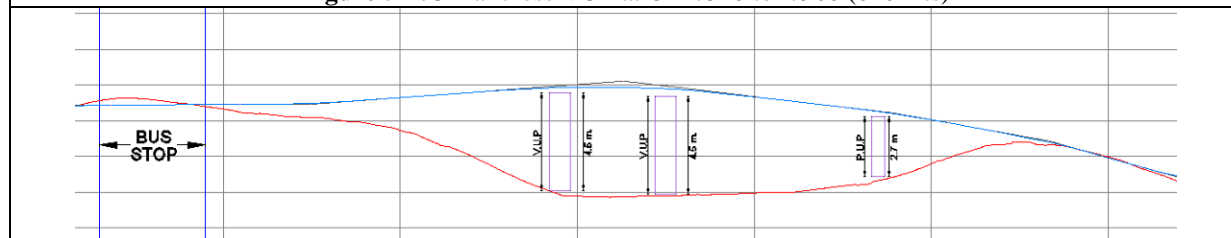


Figure 5-2:Unkal Village VUP at Ch 3/180 to 3/550

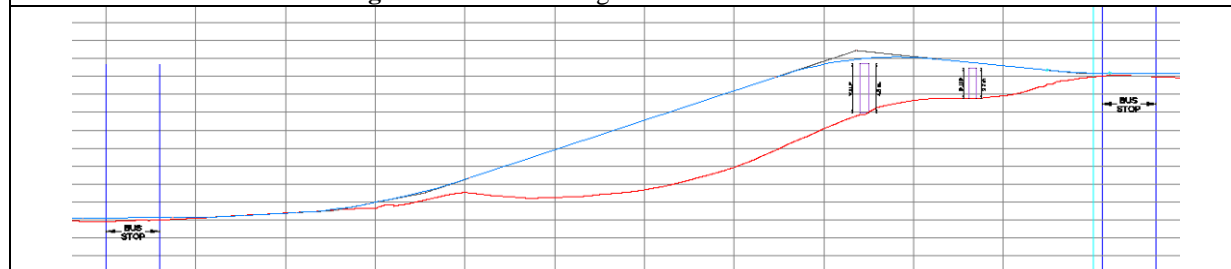


Figure 5-3:Bairikoppa VUP at Ch 4/450 to 4/990

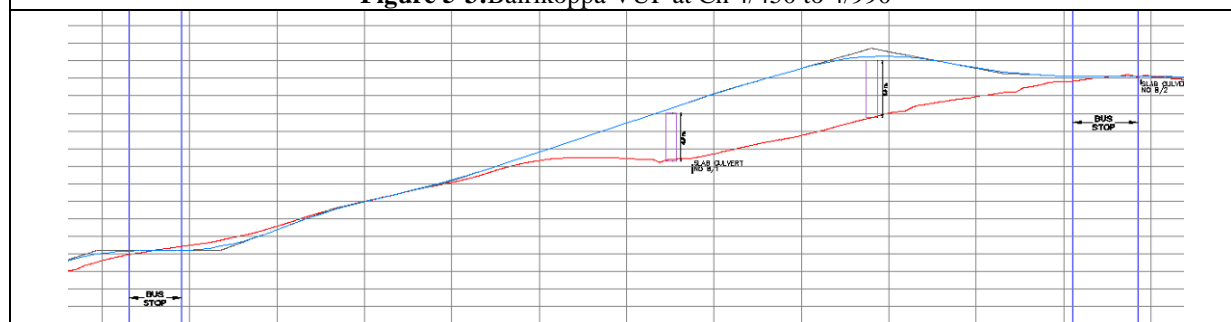


Figure 5-4:Navanagar VUP at Ch 6/910 to 7/480

5.1.3 Alternate Analysis for Location of BRT Station

126. There are two issues to be addressed before deciding the bus station location. The first is the location with respect to the junction and the second is its location on the bus lane; kerb side or median.

5.1.3.1 Junction Accessible vs Midblock Station

127. Locating bus stations nearer the junctions is a good idea, since it would be enable commuters from cross roads to also access the station. However, care has to be taken that it is not too close to the junction. Bringing it very close to the junctions can create queuing of buses. This is because buses which have completed offloading and taking on new passengers will not be able to move, if the signal is at red. This will block the bus station for other buses. In Hubli Dharwad, where headway of one minute and less is planned, this will lead to queuing. If some space is kept between the bus station and junction, it will enable buses which have completed their halt to move ahead and wait at junction. It is recommended to keep a distance of at least 24-36m (2 standard buses or 2 articulated buses)) from the stop line and bus station. Since the access is from signalized junction, pedestrians would get a clear signal phase for safe crossing opportunity. In case, locating bus station near junction is not possible, mid-block location is also preferable.

5.1.3.2 Kerb Side Station vs Median Station (Left Side Docking vs Right Side Docking)

128. Location of bus stations on the bus lane is also a much debated issue. There are two options available. In the first option, bus stations may be located on the left hand side of the lane with access through the left hand side door as in a conventional bus system. In this design, two bus stations have to be provided for each direction of travel. In the second option, one median bus station is provided. This bus station can be accessed through specially constructed doors on the right hand side of the bus. In this option, one bus station has to be constructed at each location. The figure below explains the two options.

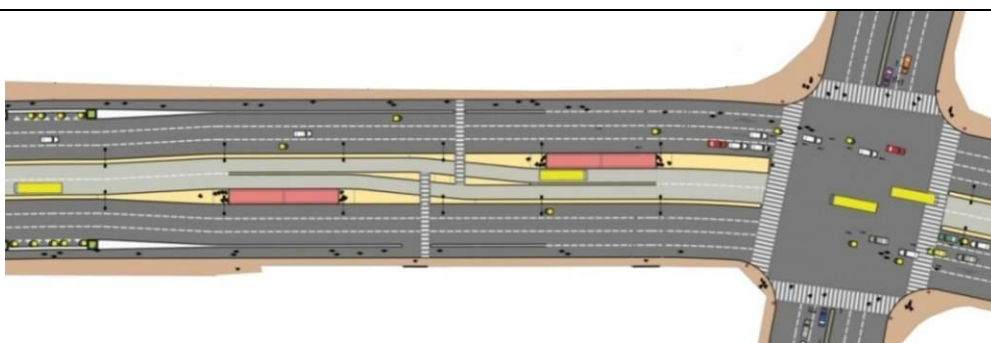


Figure 5-5: Kerb side Bus station location option

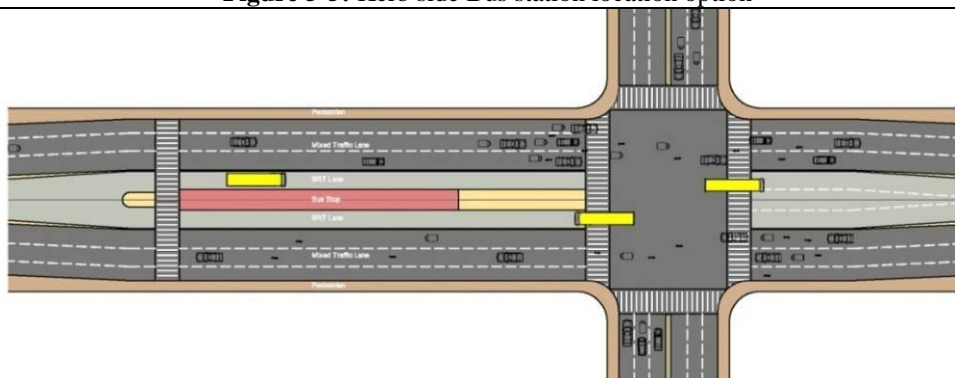


Figure 5-6: Median side Bus station location option

129. Both options have their advantages and disadvantages. These are explained in the table below.

5.1.3.3 Comparison between kerb and median bus stations

Kerb side	Median
Two structures at each location	Single station structure at each location
Higher construction costs	Lower construction costs
Higher operation and maintenance cost	Lower operation and maintenance cost
Commuters have to move out of one station and cross the carriageway for transfer	Transfers are easy
Normal buses with LHS doors can be used	Special buses with RHS doors have to be used
Delhi, Pune, Guangzhou, Curitiba	Bogota, Ahmedabad, Istanbul, Pereira

130. In Hubli Dharwad, it is suggested that median bus lanes with median stations to be adopted so as to minimize interference with service lanes, activities on the sides and turning movements at junctions. This will also provide opportunity to access bus stop from either side of road.

5.1.3.4 Bus Station Access

131. In the at grade option, bus stations would be accessed through zebra crossing. Both sides of the bus stations would have this access. Flat topped humps, at same level as footpaths, will be provided at one entry to provide convenient access to commuters. Bollards would be provided between mixed traffic lanes and bus lanes to prevent other traffic from getting in. Pelican signals can be used at mid-block locations to enable commuters to cross safely. The median between BRT and mixed traffic would be increased from 0.75m to 1.25m / 1.5m as per site situation at BRT station access which will further provide sufficient rescue space for pedestrian crossing.

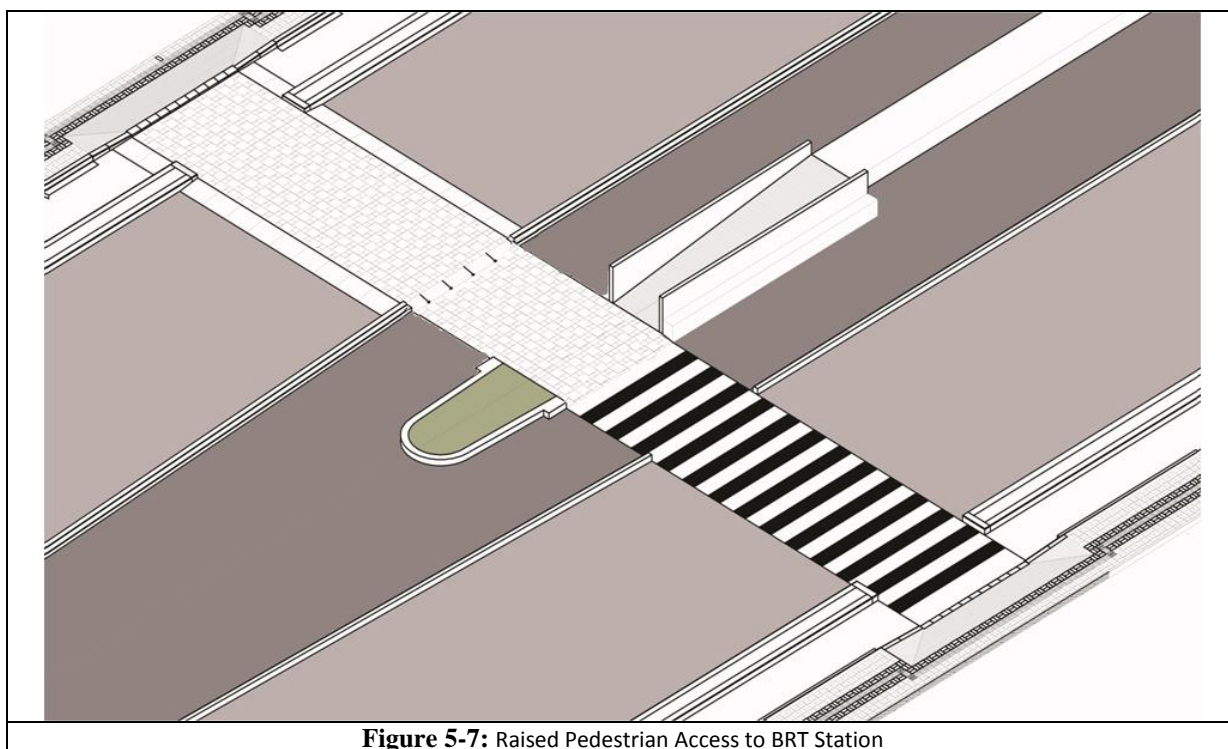


Figure 5-7: Raised Pedestrian Access to BRT Station

5.1.3.5 Concept of Raised Pedestrian Access to BRT Station

132. At some bus station locations, where pedestrian crossing is high, an option for grade separating the crossing was considered. Generally, two options are available. The first is by means of a foot over bridge (FOB) and the second through underground subways. However, both have their disadvantages. The FOB means that pedestrians have to climb almost 7 m before crossing and then get down on the other side. Pedestrians do not prefer this option. Escalators and elevators may be considered for easier access, but the cost goes up. In many Indian cities, FOBs have generally not been well received and are not patronized. In the subway option, utilities management is a big issue. Drainage during monsoon is a problem. Many pedestrians, especially women, are concerned about safety and security. Keeping these issues in mind, at grade option is considered to be a better alternative. Grade separated pedestrian crossings are also proposed at seven locations. In case of the elevated bus-way, BRT stations would be on top and would be accessed through elevators, pair of escalators and staircase.

5.1.4 Design and construction of bus stops in BRT Corridor:

133. The BRT stations are designed keeping in view functionality and the terrain. The BRT station designed are 4 m wide and have ramps (slopes 1:14) on one side and steps on other side.

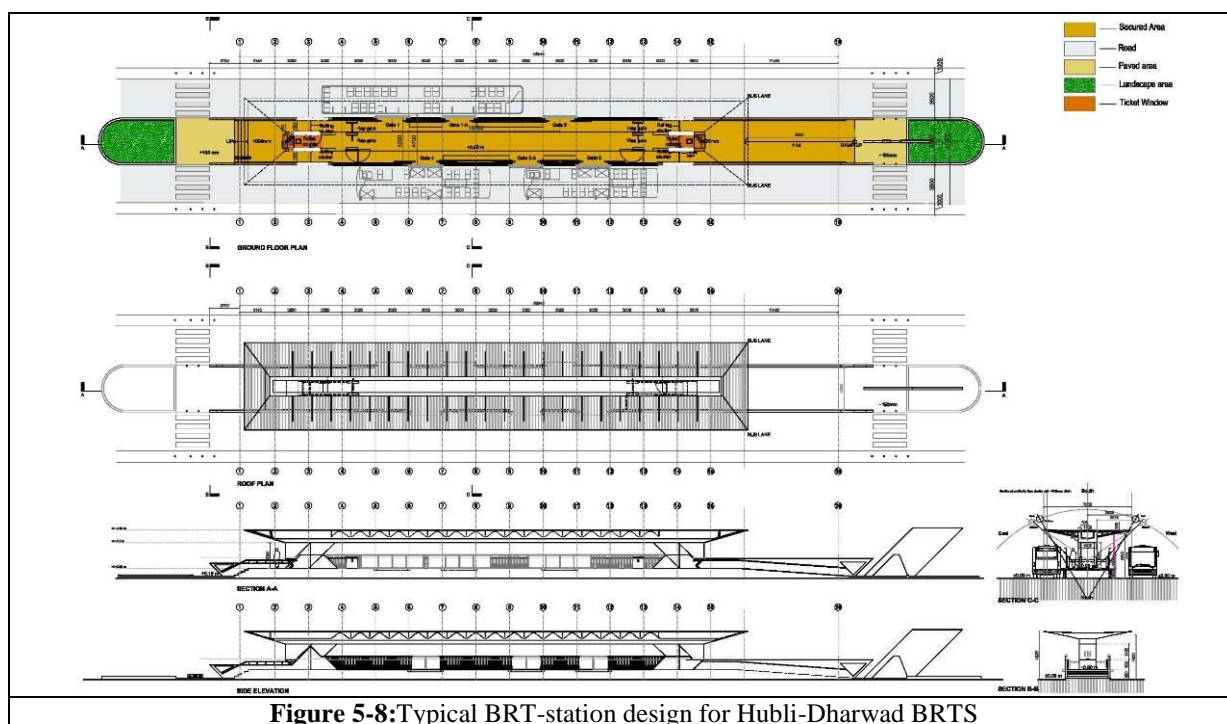


Figure 5-8: Typical BRT-station design for Hubli-Dharwad BRTS

The design would be modular to make future expansion easier. The illustration above shows the typical bus station design of BRTS bus station.

Construction of BRTS Facilities

134. The existing facilities like bus depot, workshops, terminals and stations are found to be sufficient for the proposed BRT system and hence it is decided to upgrade the existing facilities to high quality and hence construction related environmental and social impacts are expected to be limited.

6. STAKE HOLDER CONSULTATIONS AND PLANNING

6.1 Consultation with stake holders

135. Several formal/informal consultations with each stakeholder to understand issues and cross cutting themes have been conducted during the past one year. The table below lists out various meetings/ discussions between various stakeholders over the last one year.

Table 6-1: Meetings/Discussions between various stake holders

Sl.no	Date	Details
1	29-30 July, 2010	Visit to Ahmedabad by a team of DULT led by the Commissioner, DULT to see the BRT system being implemented by Janmarg. Discussions with CEPT for a pre-feasibility report for a BRT corridor between Hubli and Dharwad.
2	27/8/2010	Proposal of NWKRTC for assistance for improvements to public transport (bus fleet augmentation, modernization of depots/terminals, ITS) under the SUTP recommended to MOUD.
3	15-09-2010	CEPT initiates pre-feasibility study of BRT corridor between Hubli and Dharwad.
4	16-12-2010	Meeting under the chairmanship of Chief Secretary, Govt. of Karnataka on implementation of BRT in Karnataka. Decisions taken include creating a separate budget head for BRT; expediting the proposals for BRT in Mysore, Bangalore and Hubli-Dharwad.
5	21-12-2010	CEPT completes the pre-feasibility report and present the findings to Commissioner, DULT, NWKRTC and HDMC.
6	29-12-2010	Meeting with World Bank and Project Management Unit (PMU) of Sustainable Urban Transport Project (SUTP), MoUD on the proposal sent by NWKRTC. Decision taken to make it an integrated project including BRT.
7	07-02-2011 & 08-02-2011	Visit of World Bank SUTP mission to Hubli – Dharwad and meeting with all the concerned stake holders.
8	17-02-2011	Meeting under the chairmanship of Commissioner DULT with Managing Director, KRDCCL to decide on the cross-sections for BRT.
9	28-02-2011	Meeting under the chairmanship of Hon'ble District In-charge minister, Dharwad. Cross-sections discussed and approved.
10	09-03-2011	10 th Meeting of the steering Committee of World Bank GEF-UNDP assisted sustainable project, wherein approval in principle was accorded for the proposal of preparation of DFR for Hubli-Dharwad.
11	10-03-2011	Submissions of draft GAD to KRDCCL and discussion with officials of KRDCCL.
12	14-03-2011	TOR submitted to MoUD for approval and sanction of 80% of the project cost for DFR preparation.
13	22-03-2011 & 23-03-2011	Meeting of the team of consultant from UMTC with all stakeholders in Bangalore and Hubli – Dharwad for planning of institutional arrangements for implementation of BRT.
14	26/5/2011	Meeting in Delhi for presentation on the draft report submitted on institutional arrangements.
15	28/6/2011	Stakeholder consultation meeting in Hubli Dharwad to present preliminary plan

136. As part of the effort to make the planning process more transparent, a major city level consultation was organised in Hubli Dharwad on June 28, 2011. The meeting was chaired by the District in charge Minister and also had the local MP, local MLAs, mayor and local leaders. Other participants included representatives from the DULT, District Administration, HDMC, traffic police, HDUDA, KRDCCL, RTO, PWD, NWKRTC, Chamber of Commerce and the truck owners association.

137. The BRT plan and concept was explained to all. Present demand and the likely future demand between Hubli Dharwad were presented. The suggested design was also presented. Videos of different elements of the BRT and their applicability in Hubli-Dharwad were discussed. There were questions and concerns from stakeholders about pedestrian crossings for accessing BRT stations and suggestions were given on appropriate locations to grade separate these crossings. Discussions also focused on the need to improve pedestrian infrastructure, especially in the vicinity of the proposed BRT corridor. The elected representatives opined that the BRT would be truly successful if travel time between the two cities could be brought down to 35-40 minutes approximately for BRT.

138. Another critical issue to be discussed was the need to create a SPV to manage BRT planning and operations and the composition of the SPV.

139. After submission of the DFR for approval, a major exhibition is planned in Hubli Dharwad for all citizens to understand various elements of the project and record their objections and suggestions.



Figure 6-1: Stakeholder meeting in Dharwad

6.2 Consultations with the Affected Community

140. Focus Group Discussions (FGDs) were carried out at various locations along the project corridor. Some of the common concerns of the PAPs expressed during the consultation process have been outlined below. Chainage-wise details of the FGDs have been given in the **Table 6-2**. The consultation methodology and the levels of consultation are detailed in RAP.

6.2.1 Methodology

141. The methodology followed for consultations with the community was:

- The PAFs were informed about the meeting on the basis of affected category, such that separate meeting with commercial category, residential category etc., were done. Altogether 10 consultations were conducted in which officials from DULT, peoples' representatives, social activists, owners or tenants of commercial and residential properties had participated.

6.2.2 Key Findings of the Consultation

142. The consultations have helped in not only achieving the social assessment objectives, but also assisted in gathering suggestions for mitigation of adverse impacts, improvement in designs and facilitating inputs for the resettlement plan preparation and implementation.

- In general, the community welcomed the proposed project and was of the opinion that they have the obligation to part with their land or structures for a public cause. PAPs have requested for adequate time in case if the structure requires to be removed.
- The people wanted to know more details about the project, the likely time of land and structure acquisition, the probable time of project initiation and completion and also more about compensation for affected structures.
- Owners of land/structure have expressed their doubt whether the compensation amount would be sufficient to meet the actual loss. Owners of commercial buildings near Jubilee Circle suggested constructing a fly-over to avoid dense shop areas and also suggested to reduce the proposed road width as an alternative.

Table 6-2: Details of Consultation Meetings Key Outcomes of Public Consultations

Sl. No	Details	
1	Hubli-Dharwad City Level Consultation Date: 28.06.2011; Participants: District-in-charge Minister, MP, MLAs, Mayor and local leaders	
2	Chainage 0+080; Near Hosur Circle, Hubli Date: 29.09.2011; Number of Participants: 16	
3	Chainage 1+400; Near Sushruta Hospital Date: 29.09.2011; Number of Participants: 26	
4	Chainage 1+200; Opposite HDMC Park Date: 29.09.2011; Number of Participants: 11	
5	Chainage 3+100; Opposite Sidheswar Swamy Temple Date: 29.09.2011; Number of Participants: 16	
6	Chainage 4+700; Bhairidevarakoppa Date: 29.09.2011; Number of Participants: 18	
7	Chainage 5+400; Bhairidevarakoppa Date: 29.09.2011; Number of Participants: 12	
8	Chainage 12+400; Near Sattur Cross Date: 30.09.2011; Number of Participants: 38	
9	Chainage 17+400; Near Tolnaka Date: 30.09.2011; Number of Participants: 21	
10	Chainage 18+800; Near Jubilee Circle, Dharwad Date: 30.09.2011; Number of Participants: 32	
Chainage/ Location	Key Outcomes	Integration into Project Design and Action Plan
0+080 Near Hosur Circle, Hubli [commercial category]	<ul style="list-style-type: none"> • Owner of the building expressed his concern about demolishing the front portion of building. Age of the structure is about 16 years and tearing down a portion would affect the entire building. Owner opined that compensation be given at market rate rather than based on government rate which is usually very low and would not be sufficient to make up the actual loss. • About two years before, as per the instruction from Hubli-Dharwad Municipal Corporation (HDMC), the boundary wall of the present building was removed. The building has been built about 16ft away from the footpath. • Small shops like pan shops, electric shops, telephone booths, eatery shops could continue even if a portion is acquired. However, one restaurant functioning on G+1 level would not be able to continue with their business. 	<ul style="list-style-type: none"> • The price of land based on consent award will be negotiated and is expected to compensate for the actual loss to the PAPs. Affected structures will be compensated

	<p>For the restaurant, the margin of profit reduces with the reduction in business area and he pays a rent of Rs.15000 per month. All other shops pay a rent between Rs.4000 and Rs.6000.</p> <ul style="list-style-type: none"> Majority of the shops are occupied by tenants and they are aware that they are not entitled for any compensation and only owners of the building are eligible. However, they request for providing adequate notice period. Notice should be served at least 3 months prior to the actual acquisition. 	<p>based on PWD Schedule of Rates.</p> <ul style="list-style-type: none"> Owners/Tenants will be given the right to salvage material from structure and land Notice period of 3 months will be provided to PAPs and the notices will be served together to all respective PAPs Construction of drainage is considered as part of the proposed project All categories of Affected Households will get shifting allowance. For those who are losing livelihood (one male/female of the affected family) will receive a Livelihood Restoration Allowance of Rs.15000, if the affected person is interested, then necessary training will be provided for development of entrepreneurship skills by coordinating with HDMC/other government departments to take up self-employment projects It was explained that design was based on technical feasibility. In some cases, the design will impact structures and land and it is
1+400 Near Sushruta Hospital [commercial category]	<ul style="list-style-type: none"> Owner of an affected G+3 building opined that he had constructed the building after following all the standard formalities of the Corporation and have even renovated the building in 2010. At the time of construction of these types of structures the concerned authorities would have given adequate awareness or clear instructions about the actual width to be kept from the road side, many losses could have been avoided. All the shops could continue functioning in the same building as about 1m front portion of the shops will be affected. A Reliance Telephone Tower fixed atop the G+3 building, will also be affected. The community suggested straightening the curve at chainage 1+200 and acquiring more land along LHS since more government land is available on LHS. This could save many shops on RHS. Construction and maintenance of a proper drainage system shall be considered as part of the proposed project. At least 3-months notice period should be given to shop owners and tenants. One restaurant owner opined that notice should be served together to every affected person. 	
1+200 Opposite HDMC Park [residential category]	<ul style="list-style-type: none"> Owner and tenants of 4 residential buildings have asked details of the compensation packages and likely commencement of the project. The owners acknowledged that the residential property is under litigation and enquired whether they are eligible for any sort of compensation. Out of the six blocks of the continuous stretch of building two are abandoned. The building is about 70 years old and the participants opined that it wouldn't be liveable even if only front portion is demolished. A tenant enquired whether any additional benefits available for widow and aged people. The participants demanded for one-month notice period prior to acquisition. 	
3+100 Opposite Sidheswar Swamy Temple [residential category]	<ul style="list-style-type: none"> The participants welcomed the proposed development project and enquired about the likely initiation of the project and also asked about the compensation packages. Some participants opined that they will abide by government rules with respect to compensation and assistance. The front room of four houses in the building block would be affected. Of this, owners reside in 2 houses and they enquired about the exact area of acquisition and the likely date of acquisition. One household opined that he would shift to the back row. The other households could continue living in the same house, if the impact is less than 2 meter from the edge of the house. The participants requested for three-month notice period. 	
4+700 Bhairidevara-koppa [commercial and residential-cum-commercial category]	<ul style="list-style-type: none"> People asked for safety measures in the school zone. Two schools are located in the vicinity. The semi-pucca structures include grocery shops, hair-cutting saloons, tea-shop, cement trading, restaurant, and open land area of several vehicle repair shops. The repair-shop owners opined that their business would be drastically affected due to the project. If the parking area in front of the repair shops is acquired, vehicles cannot park for repair works thereby reduce their business. Three repair shops each having about 5 employees will face the same problem. Majority of the participants were tenants and they pay on average Rs.4000/monthly (repair shops) and Rs.2500/monthly for other shops. The participants enquired whether the project gives compensation to anybody other than owners. One restaurant owner who resides beside his shop itself said that he will 	

	<p>continue his business in the same building.</p> <ul style="list-style-type: none"> The participants enquired about exact date of acquisition and also suggested for a notice period of at least 20 days. 	<p>unavoidable.</p> <ul style="list-style-type: none"> During the process of notification under Land Acquisition, the exact extent of land to be acquired will be notified.
5+400 Bhairidevarakoppa [commercial category]	<ul style="list-style-type: none"> The shops are of kutch/semi-pucca structures and mostly engaged in manufacturing of wooden furniture. The participants asked whether the project provides any special benefits for these types 'carpentry' shops. Some carpentry shops are temporary structures and could be shifted to the back row within the land owned by respective shop owners. Two pan-shop owners (squatters) acknowledged that they are ready to remove the structure at the time of acquisition of major shops. A prior intimation regarding the likely date of acquisition requested by the participants. A notice period of at least 1 month requested by the participants. 	<ul style="list-style-type: none"> As part of project design adequate safety measure has been integrated to prevent accidents. Attention will be given school and hospital zones. VUP has been proposed at location with service lane on either side. Thus, Pedestrians can cross road at grade avoiding the high speed traffic through VUP.
12+400 Near Sattur Cross] [commercial category]	<ul style="list-style-type: none"> A total number of 14 shops will be affected in a single row of building and all the participants were tenants. The shops include confectionary shops, medicine shop, grocery shop, restaurant, telephone booth-cum-photocopier shop and pan shops. The participants asked about the date of commencement of acquisition and also date of initiation of the project. 5 shop owners were of the opinion that depending upon the extent of acquisition they will try to continue in the same building, if not demolished fully. The tenants pay rent of Rs.3000-4000 monthly. It would be difficult to find such a good structure elsewhere within this rate. Moreover, business in a new place will take more than one year to get established. One medicine shop owner was concerned about the likely loss associated with shifting as he needs to invest at least Rs.10 lakh to start the business in a new place. He enquired whether the project provides any assistance to tenants and for those who fully depend on their business for livelihood. He was of the opinion that shifting of the shop would be disastrous for a person like him aged more than 60 years. The participants requested for a notice period of at least 6 months 	<ul style="list-style-type: none"> In case of land under dispute, compensation amount will be deposited in the Court.
17+400 Near Tolnaka [commercial category]	<ul style="list-style-type: none"> 8 shops in a row on LHS and 12 shops on RHS will be affected, each shop having an average size of 8x8 feet. The shops include grocery shops, bakery, pan shop, cement trader, telephone booth, tyre repair shop and tea-shop. The LHS shops are owned by the Corporation and RHS shops are private owned. The shop owners opined that they will demand compensation only if the shops are fully acquired. If only a portion of the shop is acquired, say 2 feet inside their shop, they could continue business. The participants asked about the likely dates of acquisition and project initiation. They also requested for a one-month notice period. 	<ul style="list-style-type: none"> Elevated BRT near Jubilee Circle not feasible. In view of the present design requirements, there would be continuous flow of buses 2m away from structures which will not provide suitable sound barrier to habitable areas along elevated section.
18+800 Near Jubilee Circle, Dharwad [commercial and residential category]	<ul style="list-style-type: none"> 8 major commercial buildings (includes G+2, G+3 and G+4) will be affected along LHS and RHS. The tenants were of opinion that since these are concrete structures demolition or acquisition in part will affect the whole structure. One two-wheeler (TVS) shop manager opined that he had spent more than Rs.2 lakh for interior works of show-room and pays about Rs.55000 monthly as rent. He further said that government cannot anyway give compensation for a tenant like him and hence the acquisition will severely affect his livelihood. Moreover he will not be able to find a suitable place in Dharwad. He started the dealership about 2 months back and about 13 people are employed. The building-owner suggested for the construction of a fly-over which will avoid the impact on structures. If fly-over is not provided, the owner suggested reducing the road width. The proposed road width could be limited to 16m from centreline to avoid major impacts. The affected commercial structures could be compensated preferably with commercial land or building developed by Urban Development Authority. If such land/building provided by the Authority is larger than the area lost, the building-owner is ready to pay for the additional land depending upon the prevailing land rates in such locations. The residential property of the building-owner will be affected. The owner is 	<ul style="list-style-type: none"> The project authorities will hold further meetings to resolve issues where there is no consensus.

	of the opinion that, if the authority goes by 35m width his house will become uninhabitable. The house was built about 100 years back.	
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6.2.3 Major Issues and Action Taken: Summary

143. The major issues discussed during the consultation and specific mitigation measures provided is presented in the **Table 6-3**.

Table 6-3: Key Outcomes of Public Consultations

Major Issues	Action Taken	Remarks
Compensation for land and structure to be provided at market rate since government rate is lower	Compensation will be paid through consent award as per the provisions of the Land Acquisition Act/ The Karnataka Highways Act, 1964.	The minimum negotiated price will be at the rate of 1.5 times the guidance value
	compensation will be paid through negotiation	PWD Schedule of Rates will be followed and final rate will be arrived at through negotiation
Serving of adequate notice period (1 month to 6 months as per respective consultations)	3-months advance notice period will be served	Right to salvage materials from demolished structures
Construction and maintenance of proper drainage system	Construction of drainage is considered as part of the design	
Road safety measures in school zone	Adequate safety measures have been integrated into project design including school and hospital zones.	VUP has been proposed at location with service lane on either side
Construction of a fly-over which will avoid the impact on structures near Jubilee Circle	Not incorporated in the project design since the option is not feasible	In view of the present design requirements, there would be continuous flow of buses 2m away from structures which will not provide suitable sound barrier to habitable areas along elevated section





Figure 6-2: Public Consultation along the Project Corridor

6.2.4 Other stages of Consultation

144. **Formal consultations:** As soon as the project is granted by the World Bank, the approved Environmental Management Plan (EMP), Entitlement Matrix and the RAP will be shared with the PAP's and Public. Formal consultation shall be arranged at 4 locations (preferably 2 locations at Hubli and 2 locations at Dharwad) along the corridor and will be conducted in the presence of government officials; during consultation the approved EMP and RAP will be disclosed.

- The key environmental and social impacts identified during the assessment and the suggested mitigation measures in the EMP and the RAP shall be shared during consultation.
- The social issues like loss of land, structures and livelihood for both title and non-title holders with the expected compensations as per the Entitlement Matrix shall be disclosed.
- The environmental impact like the loss of trees, water bodies and construction related impact shall be discussed and the suggested mitigation measures like afforestation measures, construction of noise barriers for sensitive receptors shall be disclosed and further suggestion if any shall be recorded and appropriate measure shall be taken.
- Executive summary of EMP and RAP, Entitlement Matrix and grievance process (in English and Kanada) will be disclosed through consultation and will be made available through DULT and SPV website.

145. **Public Consultations with land losers/PAPs post land acquisition notification:** The public consultations with the project affected persons were organised in Hubli and Dharwad on 28-11-2012 and 29-11-2012 respectively. The objective of the consultations was to explain to the public about the project and its benefits, the land acquisition details, RAP, EIA and EMP. A paper notification was issued in local newspapers to inform the public about the scheduled public consultations. The local revenue department officers were requested to publicise the meetings through tom-tom in the concerned villages. A copy of the public notice was also put on the notice boards of important offices like Office of the Deputy Commissioner, Dharwad; Office of the Executive Engineer, KRDCL, HDMC etc.

The attendance of the people who participated in the public consultation meetings has been duly taken and the details of the same are available in the project file. 175 people attended public consultations meeting in Dharwad and 200 people attended in Hubli. The participation of women in public consultation meetings is on a lower side. However, it is planned to have separate focus group discussions with women during the implementation of the project.

During the Public Consultation Meetings, the following issues were raised:

- There was a request that safe crossings for pedestrians should be provided as a number of schools, colleges have been located along the road.

It was explained to the participants that pedestrian cycle will be part of signal cycle along all junctions and adequate signage, table top crossings etc would also be incorporated in the design to ensure pedestrian safety.

- The participants wanted to know whether Unkal lake would be affected and brought to the notice of the authorities that a park has already been developed adjoining the lake.

It was clarified that there is no impact on Unkal lake, and that measures would be taken to minimize the acquisition impact, if any, of land adjoining Unkal lake through design interventions.

The minutes of the public consultation meetings held at Hubli and Dharwad are enclosed in Annexure 3 and 4 respectively. The list of officers present during the public consultations is in Annexure 5.

A list of frequently asked questions on BRT including resettlement plan was compiled in Kannada and circulated in the meetings. Copies of the same in English is placed in the Annexure 6.

7. POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

7.1 Project Impacts and Issues

146. The project impacts and issues, related to environment and social due to implementation of BRTS in Hubli – Dharwad Road has been structured as per the discussions in **Chapter 4: Description of Environment**. The environmental impacts could be direct as well as indirect. The direct area of influence includes the Corridor of Impact (CoI) and the construction sites for the project. The indirect area of influence includes areas with potential indirect impacts, for example areas impacted from sediment-loaded runoff or areas impacted due to location of labour camps. The impacts on various environmental components can occur at any of the following stages of the project planning and implementation: (i) Planning and design stage; (ii) Construction stage; and (iii) Operation stage. The description and magnitude of impacts for the various environmental components of the project are presented in the following sections.

7.2 Project Intervention

7.2.1 Land Acquisition

147. The available RoW along the project corridor varies from 15 m to 50 m. However, for the proposed project, a RoW of 35m to 44m for respective sub-sections is required. The total land to be acquired / transferred to achieve the proposed RoW is approximately 73.06 acre spread across 10 villages/settlements (MT Sagar CTS, Unakal CTS, Unakal Revenue, Bhairidevarakoppa, Amaragol, Rayapur, Sattur, Navalur, Lakkammanahalli, Dharwad CTS). This includes 59.51 acre of private land, 13.55 acre of government land. Village-wise details of land to be acquired / transferred are given in **Table 7-1**.

Table 7-1: Land Acquisition for BRTS

SL.No	Village name	Private land	Government land	Total land
		A-G-An	A-G-An	A-G-An
1	Dharwad	05-28-12	----	05-28-12
2	Lakamanahalli	03-26-02	00-24-00	09-18-11
3	Navalur	03-5-0	01-13-00	07-24-00
4	Sattur	05-20-00	05-38-00	11-18-00
5	Rayapur	0-5.6-10.8	06-00-00	10-37-14
6	Amaragol	09-14-08	03-10-00	10-04-08
7	Bairidevarkoppa	06-02-6.4	04-00-00	13-31-00
8	Unakal	04-35-00	00-00-00	04-35-00
9	M T Sagar	04-32-6	----	4-362-6
10	Unakal (Village)	07-39-2	----	07-39-2
Grand Total		51-36.6-15.2	21-05-00	73-1.6-15.2
Revised Estimates*		59-19.6-15.2	13-22-00	73-1.6-15.2

Source: Revenue Department

7.2.2 Removal of Pavement & Road side Structures

148. From the reconnaissance survey, the existing road is two lane with bituminous pavement. Few stretches of the road is damaged with pot holes and no storm drainage system. The existing

ROW available in open area is between 20 m to 50 m and in built up area is between 15 m to 40 m. Geometry of the existing road is good except at few places where reverse curves or sharp curves are observed along the corridor. The overall condition of the pavement throughout the project corridor is fair. Hence removal of pavement for construction purpose will not impose any major impact. But can causes temporary hindrance to the local populace.

149. Temporary and kutcha structures are likely to get affected due to widening of the existing Hubli-Dharwad road. The proposed project is likely to affect their livelihood and causes an indirect impact on local community. But its magnitude of impact is less and temporary



Figure 7-1: Cracks in the Pavement @ 4/200



Figure 7-2: Weathered pavement @8/400

7.2.3 Removal of Trees and Vegetation

150. Right of Way for the road needs to be cleared of vegetation for construction of the road. These will involve cutting of the trees within the proposed RoW. The trees felling in this region will have significant impact on the environment. However, mitigation measures will be taken with utmost care. In the long term, the proposed plantation will have direct positive impact on the ecological resources. The number of trees which would be felled is 1750 as identified by the Forest Department. Accordingly, KRDCL has deposited Rs 27.24 Lakhs with the Forest Department for compensatory afforestation, out of identified trees 10% are fruit bearing will be affected due to the project. These are mostly Banyan Trees (*Ficus benghalensis*), Eucalyptus (*E. angophoroides*), Common Fig Tree (*F. carica*), Plantain (*Musa paradisiaca*), Coconut Trees (*Cocos nucifera*), Sal (*Shorea robusta*), Teak (*Tectona grandis*), Bamboo Trees (*Graminaceous plant*), Pine (*Pinus pinea*) and Mango Tree (*Mangifera indica*) (**Figure 7-3 & Figure 7-4**). The compensation for cutting/ felling avenue trees has been paid by the KRDCL to the forest department and afforestation measures now lies with the Forest Department. It shall be executed elsewhere in the state based on the forest land availability. Only 12 trees are proposed to be cut at the infrastructures sites. About 1296 trees are proposed to be planted as a part of afforestation/ landscaping at depots and terminals (section 2.2.12(c)).



Figure 7-3: View of avenue trees @ 16/200



Figure 7-4: View of avenue trees @ 14/800

7.2.4 Machinery and Plant for Construction Activity

151. The following **Table 7-2** presents the quantum of vehicles & machinery required for project intervention and their influence area. These machineries will have its bearing on surrounding environment especially on air quality subject to emission level of machinery and noise environment, however strict guideline has been prepared to minimize the adverse impact, some of these guidelines are as follows:

- Construction equipment and machineries deployed for construction will be regularly maintained and not older than 3 years.
- Vehicles / equipment will be regularly subjected for emission tests and will have valid “Pollution under Control” certificate.
- All vehicles deployed for material haulage will be spill proof.
- Water tankers with suitable sprinkling system will be deployed along the haulage road and in the work site.

Table 7-2: Machinery and plant for construction activity

Sl. No.	Construction Machinery	Quantity (no.s)	Influence area
1	Dumpers	35	Quarry approach and project road
2	Excavators	10	Quarry sites & project road
3	Road Rollers	8	Project road
4	Graders/ Pavers	4	Project road
5	Stone Crusher /BT Plant	1 each	Plant site
6	Concrete Mixer	5	BRTS Infrastructure site

7.2.5 Manpower for Construction Activity

152. As large quantities of earthwork and rock excavation works are involved in the present projects, it is proposed that 25% of earth work will only be carried out manually and the rest 75% will be done by machinery. Exact number of skilled, semi-skilled and unskilled labours has not been worked out. However, it is expected that large force of such labourers are available in the vicinity of the project areas.

7.3 Land Environment

7.3.1 Impact on Topography

153. Construction phase starts from taking possession of the site. The work in this phase comprises of site clearance, land development, building of infrastructural facilities and all construction work till commissioning. Duration of this phase is dependent on many factors such as finance, size of the project, location and infrastructural support, etc. The project implementation involves construction of office buildings, labour camps, mixing plants etc during construction period. This may result in a change in the local land use. However, these impacts are marginal and exist only during the construction phase. Similarly the construction of the resettlement site for rehabilitating the project affected families will cause local land use changes in the identified location.

154. Disposal of the construction waste can also affect the local topography of the area if accumulated or indiscriminately dumped in the project area. However these excavated waste will be tested for their CBR values and if found suitable will be used for subgrade or else will be used for filling in identified designated dumping site and low lying areas to avoid major impacts.

7.3.2 Impact on Geology

155. As the proposed road passes through flat terrain and hilly area, no significant impact on geology is anticipated from activities involved in construction of proposed road. However, road construction from activities will require supply of road building materials, which should be collected from approved quarry sites. Likely impact on the geology is due to the uncontrolled blasting in the quarries supplying aggregates for construction at these sites. As these quarries are licensed, the prevalent rules on blasting will be adhered to. Hence, the impact on general geology of the region is insignificant. At the construction sites, no blasting is envisaged.

7.3.3 Impact on Seismology

156. The proposed project corridor attracts under seismic zone-2. Seismicity in this zone is considered as the plate-boundary zone activity (Refer Section 4.2.2). Seismic activity is quite low in this zone (Figure 4-2). Thus the project will not have any significant impact due to seismic stability of the area.

7.3.4 Impact on Land

157. The proposed project is planned to develop with the available Right of Way (RoW) with no realignment options. However, at some stretches the proposed alignment moves out of the RoW and leads to land acquisition. However, the impact on land caused by the design is inevitable.

Quarries and borrow pits

158. The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction cause direct and indirect long-term adverse impacts on the

environment. The proposed project envisages use of significant quantities of earth, stone and grit and sand along with bitumen. The principal construction materials required for the corridor includes:

- Quarry materials, used in asphalt and aggregate for upper pavement layers
- Sand, gravel, laterite, clay and other materials for fill and lower pavement layers

159. Contract documents specify the materials to be used, but not specific quarries, pits or borrow sites for obtaining the various materials. The contractor shall identify the source of materials and use them with the consent of the Engineer. The principal sources of construction material the contractor needs to tap include:

- Quarry materials from licensed existing quarries
- Sand from riverbeds, normally dry and accessible except during the northeast monsoon (approvals for this extraction are necessary, as it is not permissible everywhere)
- Clays from tanks, many of which are near the project area
- Laterites available in the vicinity of project area

7.3.5 Contamination of Soil

160. In this project contamination of the soil may take place, from the following activities at the construction zones, construction labour camps, construction plant sites and other auxiliary facilities required for the construction. Details of the activities from which the contamination can occur are presented below;

- Scarified bitumen wastes, over production of bituminous product,
- Debris generation due to dismantling of structures,
- Maintenance of the machinery and operation of the diesel generator sets on site,
- Oil spill from the operation of the diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets,
- Operation of the emulsion sprayer and laying of hot mix,
- Operation of the residential facilities for the labor and officers,
- Storage and stock yards of bitumen and emulsion,
- Excess production of hot mix and rejected materials

MITIGATION MEASURES

7.3.6 Change in Topography

161. As indicated in section 7.3.1 Impact on topography, there is not much impact on topography though cutting and filling is anticipated. Blasting activity will induce a local impact on topography.

7.3.7 Change in Geology

162. Though no major impacts on geological profile of the project area are anticipated, requirement of construction material from quarries will induce pressure on the local geological

deposits. The contractor is to ensure procurement of the construction material from licensed quarries only. It is envisaged that no new quarries will be proposed.

163. The quarries that would be used for procuring construction material should be established under “Mines and Mineral Concession Rules, 1959”. The act lays down guidelines for establishing quarries and obtaining quarry lease. It also specifies the conditions to be maintained for operating the quarry or for obtaining renewal of quarry lease. In respect of quarrying in environmentally sensitive areas certain restrictions have been imposed to avoid any detrimental impact due to irresponsible quarrying. The rules lay down various precautionary measures during blasting, safety of workers, management measures within quarries, approval of the village heads prior to material leaving the village, precautionary measures to avoid spillage during transport of quarry materials.

164. The contractor is free to choose the quarries from amongst this list of quarries or any other existing quarry, which is already operational with the relevant clearances and compliance to environmental requirements. In case the whole quarry is taken up by the contractor then the contractor will be responsible for environmental management.

7.3.8 Change in Seismology

165. As discussed in section 7.3.7 and section 4.2.2, the project corridor falls under zone-2 indicating low intensity of earthquake; hence changes in seismology due to proposed BRTS project is not envisaged.

7.3.9 Change in Land Environment

166. As far as possible the land acquisition has been kept to the minimum, by restricting the geometric improvement within the available right of way (RoW). The same can be seen as only **73.06 hectare** land is required for project road upgradation. However the land acquisition will be done at sections having width, insufficient to accommodate the approved cross-sections & geometric improvements. For Land acquisition sections refer **RAP (Resettlement Action Plan)**.

Quarries and borrow pits

167. Specific locations of borrow areas to be used will be identified by contractor. The selection and recommendations for borrow areas will be based on environmental as well as civil engineering considerations. Location and source of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoRTH and as specified in IRC: 10-1961 areas to mitigate the impacts will be the responsibility of the contractor. Redevelopment of the borrow, the contractor shall evolve site-specific redevelopment plan for each borrow area location, which shall be implemented after the approval of the Engineer (**Refer Annexure-7 (OP-2)**).

168. Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. The haul roads and borrow areas will be managed and maintained by the

contractor. Since dust rising is the only impact along the haul roads sprinkling of water will be carried out twice a day along such roads during their period of use.

169. Borrowing of earth shall be avoided on productive lands and within or 1 km of settlement areas. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside. At locations where private owners desire their fields to be levelled, the borrowing shall be done to a depth of not more than 2 m or up to the level of surrounding fields.

7.3.10 Contamination of Soil

170. Soil contamination is likely due to the possible leakage of fuel/lubricants and dumping of construction wastes during construction stage. The contractor will be required to initiate measures to reduce/prevent waste generation from all activities. The measures would include

- Identifying landfill sites for disposal of debris and a plan for disposal needs to be prepared by the contractor with approval of Project Management Consultant (PMC)
- Undertake measures for minimization of waste and recycling of surplus materials for use by local communities
- Methods of collection and disposal of domestic waste
- Follow established procedures for storage of hazardous goods and chemicals
- Prepare plans for cleanup of any accidental spillage
- Checks for ensuring erosion control structures are in place before earthworks are started

7.3.11 Soil Quality – Mitigation

171. All arrangement for transportation during construction including provision, maintenance, and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the Engineer. Disposal of all waste materials is responsibility of the contractor and provisions to this effect are provided in the engineering budget.

172. At various construction sites, the vehicles and equipment will be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refuelling sites are kept away from drainage channels and important water bodies. At the wash down and refuelling areas, “oil interceptors” shall be provided. All spills and petroleum products shall be disposed off in accordance to the KSPCB Guidelines. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies. In all fuel storage and refuelling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

173. To minimize the dumping of construction wastes from the project, the debris generated due excavation and site preparation shall be suitably reused in the proposed construction, subject to the suitability of the material and the approval of the Engineer.

174. Unusable debris material shall be suitably disposed off by the contractor at pre-designated disposal locations, subject to the approval of the Engineer. The bituminous wastes shall be dumped in secure landfill sites only. At such locations dumping will be carried out over a 60 mm thick layer of rammed clay so as to eliminate any chances of leaching. The identification of such landfill sites shall be carried out by the Contractor (before start of construction activity) and duly approved by the SPV/ KRDCL.

175. During the operation stage, the probability of contamination of soil is only from the road runoff. The design of the road has been worked out such that the runoff is directed into nearest water bodies through well-designed drains. Impacts are anticipated only in case of accidents involving large spill over of hazardous materials or petroleum products. Monitoring shall be done at the locations where these have occurred and further course of action to reduce the pollution shall be worked out.

Productive Agriculture lands

176. As part of the finalization of the design for the project, efforts have been made to minimize the intake of productive lands. The borrow areas; construction camp locations; traffic detours and other construction sites shall be selected carefully in consultation with the engineer to minimize the agricultural land acquisition. To conserve the productive topsoil of all areas affected due to project, the following measures have been proposed:

- The topsoil from all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil
- The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile will be restricted to 2m
- Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum and shall be covered with gunny bags or tarpaulin
- It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to CoI

177. The stored topsoil will be utilized for:

- Covering all disturbed areas including for the redevelopment of borrow areas
- Top dressing of the road embankments and fill slopes
- Filling up of tree pits, proposed as part of compensatory plantation

178. The contractor shall be responsible for working out haul roads with the minimal loss of productive soils, in consultation with the Engineer (Refer **Annexure-7** Environmental monitoring Format, EM-6).

7.4 Air Environment

7.4.1 Meteorological Factors and Climate

179. Project activities in the area in all stages of the project planning, construction (or) operation do not involve major or long term impacts on the macro climate and meteorology of the area. Temporary changes in these aspects during the project operation would mostly be attributed to micro climatic changes due to addition of hard surfaces and related induced development. This would contribute to marginal rise in temperatures in the vicinity of the project corridor and is a permanent impact.

7.4.2 Air Quality Emissions

180. Air quality along the project road alignment will be adversely impacted at congested locations and major urban settlements like Unakal Revenue, Bairidevarakoppa, Amaragol, Rayapur, Sattur, Navalur and Lakkammanahalli. Vehicular emissions are one of the major sources of air quality impacts of highway projects. As the project envisages improvement of road conditions for smooth traffic flow, the project will have beneficial impact on air quality of the region during its operation. However, when viewed with respect to the existing ambient air quality or with respect to compliance of ambient air quality standards during the post improvement phase of the road stretch, due to the increase in the traffic volume, the impact on air quality along the project road is likely to be minor.

181. Impacts on air quality during the construction phase of the project will be considerable as the amount of work involved in improvement of the road is significant, but any possible impacts will be temporary. However, provision of adequate air pollution control equipment, like dust filters and measures like dust suppression by water sprinkling and planting of green belt may further help to significantly reduce the impact.

182. Emission of CO₂ and NO_x due to the combustion of diesel will be a principal cause of air pollution during the construction phase. The data on fuel utilization rates of units likely to be in operation during the road improvement are provided in **Table 7-3**.

Table 7-3: Fuel Consumption Rates for Construction Machinery

Sl. no	Machines	Fuel Consumption (Litres/Hour)
1	Cement concrete mixer	7
2	Truck	8
3	Bulldozer	20
4	Grader	12
5	Roller	20
6	Dumpers & Tippers	18
7	Water Tanker	8
8	Paver	12

183. Due to ground level temperature inversion at site during winter months, meteorological conditions after the sunset tend to become stable. The overall meteorological parameters thus constitute adverse conditions for dispersion of ground based air pollution emissions. Under

adverse meteorological conditions, it may be possible that the NO_x standards (80 µg/m³ for 24 hourly average) may be violated only if the construction work is carried out round the clock. However, this scenario is not envisaged, as the construction is not proposed to be carried out throughout the day. There will also be a rise in SPM levels due to construction activities. The SPM standards, however, are not expected to be exceeding the permissible limits as the background levels are very low and the particulates tend to settle during low wind and stable conditions. However, implementation of mitigation measures as given in the EMP will mitigate or minimize these impacts.

184. After improvement of the existing road, the traffic is expected to move smoothly at higher designed speeds, which will assure lower emissions of gaseous pollutants, further improving air quality in the region and hence not expected to affect the air quality adversely.

185. The rate of emissions of various types of vehicles is presented in **Table 7-4**. However, the extent of these impacts, at any given time will depend upon the rate of vehicular emission within a given stretch of the road; and the prevailing meteorological conditions. The impacts will have strong temporal dependence as both of these factors vary with time. The temporal dependence would have diurnal, seasonal, as well as long-term components.

Table 7-4: Rate of Emissions of Various Types of Vehicles

Emissions	Emission Factors in gm/km/Vehicle					
Speed (km/hr)	30	40	50	60	70	80
1. For Diesel Vehicles						
CO	12.53	9.40	7.52	6.27	5.37	4.70
NO _x	22.28	16.71	13.37	11.14	9.55	8.36
2. For Petrol Vehicles						
	Car	2 Wheeler	3 Wheeler			
CO	2.72	2.0	4.0			
NO _x	0.58	0.5	0.5			

Source: Indian Institute of Petroleum

MITIGATION MEASURES

7.4.3 Meteorological Factors and Climate

186. Marginal changes in micro climatic conditions of the project area as increase in temperature due to introduction of additional pavement surfaces etc. will be offset through developing roadside plantation in the road RoW. Plantation scheme adopted for the section is discussed in subsequent sections of the report. Tree plantation will bring about lowering of temperature levels offsetting any rise in temperature due to introduction of pavement surface and other constructions.

7.4.4 Air Quality Emissions

187. During construction stage, the asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up including:

188. Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads.

189. Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.

190. The hot mix plant will be fitted with dust extraction units. It shall be ensured that the dust emissions from the crusher and vibrating screen from the stone quarries do not exceed the standards.

191. To ensure the control of exhaust gas emissions from various construction activities, the contractor shall take up the following mitigation measures:

- An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided in the event of the emissions exceeding the KSPCB norms.
- To ensure the efficiency of the mitigation measures suggested, air quality monitoring shall be carried out at least once every season during the period for which the plant is in operation.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the KSPCB norms. A vehicle management schedule prepared by the contractor and approved by the Engineer shall be adhered to.

192. Some of the measures during operation stage would be to planting of pollution resistant species; which can grow in high pollutant concentrations or even absorb pollutants, can be planted in the first row. Broad-leaved tree species can help settle particulates with their higher surface areas along with thick foliage, which can reduce the distance for which particulates are carried from the road itself.

193. **Other measures:** Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and up-keep, educating drivers about driving behaviour/methods that will reduce emissions are beyond the scope of the project but will be far more effective in reducing the pollutant levels. The project could assist implementation of these programmes only by putting up signboards and drawing attention to air pollution problems.

194. Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the pollutant levels with increase in traffic shall be monitored. A monitoring plan has been prepared (**Table 8-5**).

7.5 Water Environment

7.5.1 Loss of Water Bodies

195. The typical impacts on water quality during road construction are summarized in **Table 7-5**.

Table 7-5: Impacts on water resources due to construction activities

Sl. No	Impacts Due To Construction	Indicators
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Sl. No	Impacts Due To Construction	Indicators
1	Impact on water bodies	Offset distance from the CoI from the edge of the embankment
2	Loss of other water supply sources	Number of wells, hand pumps (if any) affected
3	Alteration of drainage, run off, flooding	No. of cross drainage channels
4	Depletion of ground water recharge	Area rendered impervious
5	Contamination from fuel and lubricants	Nature and quantum of contaminants
6	Contamination from improper sanitation and waste disposal in construction camps	Area of camp / disposal site and proximity to water bodies / channels
7	Use of water supply for construction	Quantum of water used

7.5.1.1 Surface water resources

196. Based on the detailed assessment, only very few surface water bodies were identified along the project corridor. The details of the water bodies are given in the **Table 7-6**.

Table 7-6: Surface water Bodies along proposed BRT

Sl.no	Water Body	Chainage	Status
1	Unkal Lake	3/300 to 4/200	Perennial
2	Pond	4/800 to 4/900	Seasonal
3	Rayanpura Tank	9/300 to 9/500	Seasonal
4	Navalur Lake (200m away from BRT)	14/100 to 14/200	Perennial

Source: Detailed survey

197. As per the proposed widening options, it can be concluded that no other water bodies except Rayanpura Tank, are getting affected. Due to the widening activity, out of 4.53 acres of land only 1.70 acres of land are getting affected in the Rayanpura tank area. However, it being a seasonal tank, the construction activity is expected to have minimum impact.

198. The proposed cross section near Unkal Lake has been designed in such a way that no impact to the water front or drains to the lake is envisaged. All the culverts guiding towards the lake area are strengthened and widened. Hence no impact is envisaged.

7.5.1.2 Ground water Resources

199. Apart from these surface water bodies, a significant numbers of wells located within the Corridor of Impact would be impacted. The loss of these community ground water supplies would be a direct negative impact. The project envisages replacement of these sources prior to removing them. Similarly, the owners of private wells impacted by the project will be adequately compensated. Therefore, the eventual impact of the proposed widening will be negated to a considerable extent.

7.5.2 Alteration of Cross Drainage

200. Impacts of road construction, which lead to alteration of drainage, are generally due to construction of bridges and cross drainage locations. The project road traverses 36 no's of culverts and irrigation canals. Construction along the watercourses is to be carried out in the lean flow periods. The construction activities will not necessitate any major diversion of the waterways. The construction and rehabilitation of CD works along the corridors will however

involve some minor temporary diversion of waterways, which can impact the existing aquatic habitat. However, the impact will last as long as construction continues.

7.5.3 Run-off and Drainage

201. One of the unavoidable aftermaths of road construction is the increased surface run off. The addition of hard paved shoulders, which essentially increase paved impervious surface, will cause increased surface runoff along the roadsides. Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow of water into the ground. The increased runoff from the project has been worked out as follows:

202. Increase in runoff (cum.) = increase in runoff co-efficient due to construction * annual rainfall in the area (m) * area of the newly constructed surface.

203. The increase of the black top width has been considered as per the cross section proposed. The runoff coefficient used for the calculations are 0.2 for red sandy and reddish brown loam, 0.15 for recent sandy and 0.55 for black cotton soil. The black top has a run-off coefficient of 0.95. Increase in the runoff co-efficient has been worked out as the difference between the runoff co-efficient of black top surface and different soil types. The increased run-off so calculated is estimated to be 1,224.00 cum.

204. Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, as the proposed corridor has been designed with drains to take care of runoff, surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which shall take care of the increased runoff.

7.5.4 Water Requirement for Project

205. The water requirement for construction depends on the climatic conditions, type of equipment, type of material available, mix design, type of construction plant and number of people working on the project. With the following assumptions the approximate water quantity required for the project has been calculated.

- 8-10% of weight of soil for the embankment construction
- 7-8% of weight of soil for sub grade construction
- 5-6% of weight of GSB materials for GSB and WMM
- 150 liters/ cum for concrete

206. The water requirement has been assumed based on past project experiences and on the strict quality control basis. Domestic requirement of 100 liters per worker has been assumed. For this project about 140 resident workers have been considered. Details of the water requirement assessed for the project are presented in **Table 7-7**.

Table 7-7: Water Requirement for Construction works

Sl. No	Water Requirement	Cum/day
1	Permanent works (cum/day)	25
2	Dust Suppression at work zone in (cum/day)	40

3	Curing (cum/day)	15
4	Laboratory (cum/day)	10
5	Haul Roads (cum/day)	20
6	Crusher (cum/day)	20
7	Plant Cleaning and workshop washing in (cum/day)	15
8	Domestic Purpose in (cum/day)	15
	Total Requirement(cum/day)	160

207. Daily water requirement for the permanent works has been calculated assuming the construction period of 2 years.

7.5.5 Water Quality

208. No permanent impact is anticipated on water quality due to the road improvement project. Construction activities will temporarily deteriorate surface water quality near the alignment in terms of its turbidity. Proper drainage measures will be taken along the road corridor like:

- Drainage arrangements to be in tune with the site condition and include forming of drainage layer, longitudinal, cross and toe drains on either side of formation
- Wherever required, suitable sub surface drains shall be provided for full width of formation
- During construction period, suitable barrier will be used to protect the adjoining water bodies from the falling earth materials and dust raised to avoid sedimentation
- Water from lake and ponds/ tanks will not normally be used to meet the water requirement for construction purposes

MITIGATION MEASURES

7.5.6 Loss of Water Bodies

209. The impacts on the lake, ponds and other surface water bodies like drains and nalas have been avoided to the extent feasible. Even during construction, care will be taken to see that impact on the lakes, ponds coming along the alignment is minimized. When the excavation is undertaken in the wet area of the water body, the banks will be protected, such that the slopes are not steeper than 1 vertical to 2 horizontal. Other measures for improvements for the water bodies include:

- Desilting of tank bed
- Clearing and shaping inlet and outlet channels
- Reconditioning sluice or weir (if any)
- Renovating steps or bathing ghat (if any)

210. The impact on the Rayapur tank shall be mitigated by desilting the water body to maintain the actual volume of water within the reduced area (after acquisition of land in the tank area). The following table illustrates the depth proposed in the tank to maintain the actual volume of water.

Table 7-8: Mitigation measure at Rayapura Tank

Sl.no	Particulars	RHS	LHS	Total area in Sq.m	Area in Acres
1	Existing Area of Lake	11806.46	6545.22	18351.68	4.53

2	Area affected due to BRTS	3844.27	3040.12	6884.39	1.70
3	Area available after land acquisition	7962.19	3505.10	11467.29	2.83
4	Existing volume of the lake as per Minor Irrigation Dept, Dharwad	40000	cum		
5	Current Depth of the lake	2.18m			
6	Depth required to maintain 40000 cum after loss of land	3.49m			
7	Actual Desiltation required for BRTS implementation	1.31m			
8	Volume of silt that would be generated	15005.5cum			

Source: CEPT Estimation, 2012

211. The current capacity of the Rayapur tank is estimated to be 40000 cum with an average depth of 2.18m. After the land acquisition, it is estimated that nearly 37.5% of the surface area (1.70 acres) will be reduced. Since the lake development authority has already carried out the tank bund protection works as part of beautification of the tank. Due to this, the widening of the tank to compensate the surface area loss cannot be achieved. Hence it has been decided to deepen the tank to maintain the actual volume. It is estimated that deepening of the tank shall be done to an additional depth of 1.31m to maintain the actual capacity of water. The cost for deepening the tank is provided in the EMP.

7.5.7 Alteration of Cross Drainage Structures

- All cross drainage structures have been designed to handle a 50-year peak flood level. A detailed hydrological study had been carried to calculate the design discharge.
- Pipe drainages will be provided for diversion roads constructed for the construction of new bridges and culverts.
- Storm water from all longitudinal and Cross drainage works will be connected to the natural drainage courses.
- The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during the construction phase.
- Contractor will be responsible for removal of debris generated due to the dismantling of structure and earth generated due to the excavation of foundation, from the water course before the onset of monsoon.

7.5.8 Runoff and Drainage

212. Detailed drainage surveys and hydrological investigations have been undertaken and suitable design of culverts have been proposed to ensure that the project road does not obstruct the existing course of the surface water flow and alter the hydrological setting. Existing cross-drainage structures will be upgraded and additional cross-drainage structures will be provided at locations where the flow is obstructed at present. In many places, a wider waterway has been proposed. Adequately sized roadside drains will ensure that the ponding on the roadside after a storm event is reduced to a minimum. The cross drainage works have been designed to handle discharge from a 50-year peak flood event.

213. The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during construction. In sections along water courses, and close to cross-

drainage channels, earth, stone or any other construction materials must be properly disposed off so as not to block the flow of water. All necessary measures will be taken to prevent earthwork, stonework and other debris from impeding cross-drainage streams and water canals. Covered drains will be provided, which can also be utilized as foot path. Provision of cost for cross drainage structures and road side structures are included as part of engineering cost. Recharging pits for road side drains will be provided and the construction cost is included as part of Environmental Management Plan.

7.5.9 Water Requirement for Project

214. The contractor will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. The total requirement of water has been worked out as 160 to 170 cum/day. Wastage of water during the construction will be minimized. While working across or close to perennial water bodies, the Contractor will not impede or block any flow of water. Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals will be undertaken with prior permission. Care should be taken to minimise any disruption to the flows and to ensure that a high quality of water is maintained. The Contractor may use the natural sources of water subject to the provision that any claim arising out of conflicts with other users of the said natural sources will be his responsibility.

7.5.10 Water Quality

215. All wastes arising from the project will be disposed off, as per KSPCB norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and transported to the approved disposal sites. To avoid contamination of the various surface water bodies and drainage channels in the vicinity of the construction site, construction work close to the rivers or other water bodies will be avoided, especially during monsoon period. It will be ensured that any liquid construction waste discharged into the existing waterways is treated to the required standard. Construction of temporary or permanent devices to prevent water pollution due to increased siltation and turbidity shall be ensured. It will be ensured that no sanitary wastes from the labour camps are discharged into the nearby watercourses. Adequate sanitary measures in labour camps are essential in this regard. Various measures that have been proposed for the protection of water quality along the corridor have been detailed in the following sections.

216. **Silt Fencing:** Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses (refer section 4.2.5). The silt fencing consists of geotextile (MIRAFI 140N or equal) with extremely small openings supported by a wire-mesh mounted on a panel made up of angle frame (Refer **Figure 7-5**). Modules of 625 mm each are designed to allow ease of handling and construction. It is expected a single person will be able to drive the angles 300 mm into the ground by pressing from the top. The frame will be installed around stockpiles close to water bodies. The wire-mesh will provide structural stability and the

25x25x3 mm angle section will act as posts for the silt fencing. About 300m of silt fencing would be required in the project to protect the water bodies.

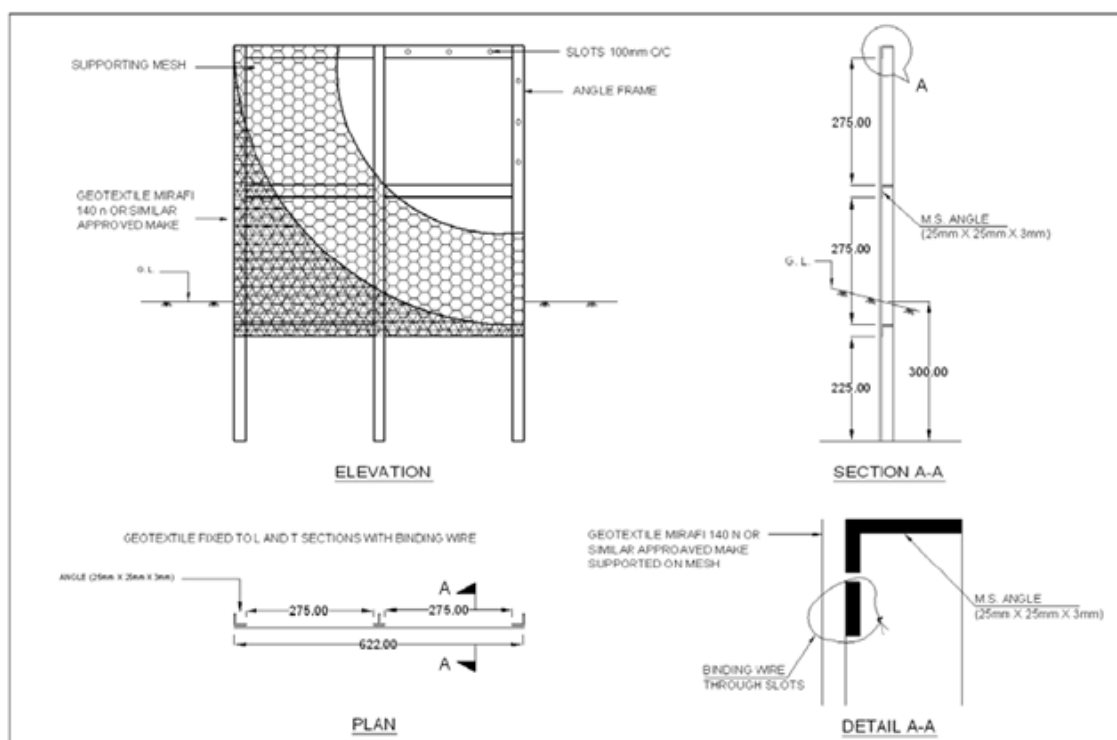


Figure 7-5: Silt Fencing

217. **Oil Interceptor:** Oil and Grease from road run-off is another major concern. During construction, discharge of Oil and Grease is most likely from vehicle parking areas of the contractors' camps. The source is well defined and restricted. The technique for the separation of oil and water is gravity separation. Enough detention time is provided to allow oil to float on to the surface.

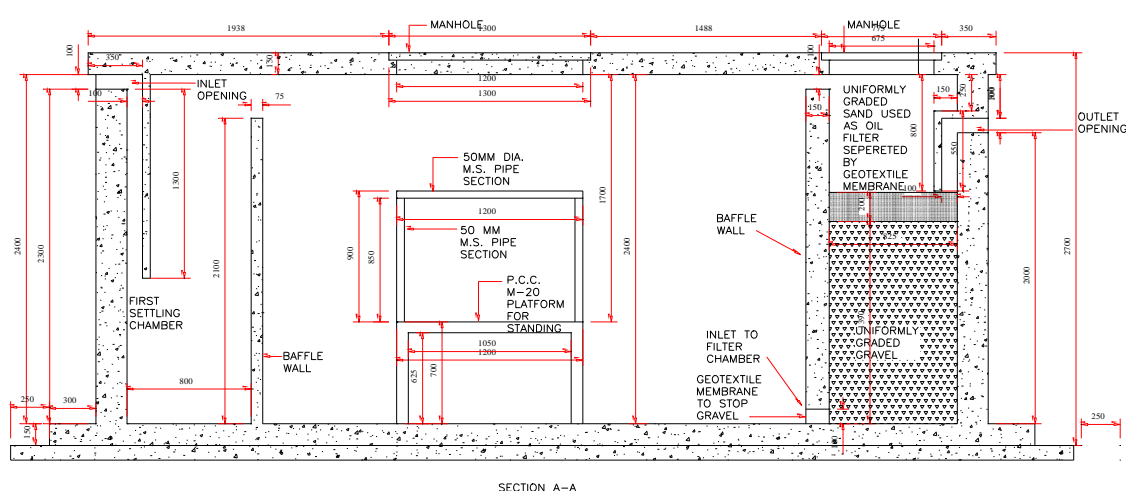


Figure 7-6: Oil and Grease Interceptor

218. The construction vehicle parking area, vehicle repair area and the workshops will be provided with oil interceptor. Slope of the prepared and paved site (1:40) ensures that all the wastewater flows into the interceptor before discharge. Periodic cleaning (once in a week) will be done from the outside by skimming off film of oil over the surface (**Figure 7-6**). Provides the details of the arrangement for the oil interceptor for the removal of oil and grease from 'point' sources.

219. The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body. In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided. The slopes of embankments leading to water bodies will be modified and rechannelised to prevent entry of contaminants into the water body.

7.5.11 Rainwater harvesting

220. As discussed in the section 2.2.12, rainwater harvesting structures are proposed to improve the groundwater recharge at terminal and depot location. Percolation wells shall be installed with necessary filters to remove the debris and other sediments getting into the RWH structure. The functioning of the RWH shall not immediately give a positive impact on the groundwater recharge. However, a long-term significant positive impact in terms of groundwater recharge shall be expected.

7.5.12 Water Treatment Plant

221. Sewage generated in the terminals and depots shall be treated using the DWATS system, which is an energy efficient system and it is effective against treating the organic wastes. This is a successful and a proven system. The functioning of the system is a positive impact in treating sewage waste water and it also controls land pollution.

222. Compact water treatment system shall be proposed at the terminals and depots. The waste water generated from the bus washing, toilets (treated water from DEWATS) and other sources shall be collected and will be treated to remove oil and grease, paint and other pollutants, which in turn will cause water pollution. The treated water shall be recycled for bus washing and gardening. The presence of WTP shall add positive impact to the project area by controlling water pollution.

7.6 Noise Environment

223. During the construction phase of the road, the major sources of noise pollution are vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are anticipated to produce noise levels in the range of 80 - 95 dB (A). The construction equipment will have high noise levels, which can affect the personnel operating the

machines. Use of proper Personal Protective Equipment (PPE) such as earmuffs will mitigate any adverse impact of the noise generated by such equipment.

224. The noise levels in the working environment are compared with the standards prescribed by Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by Government of India through model rules framed under the Factories Act. The acceptable limit for each shift being of 8-hour duration; the equivalent noise level exposure during the shift is 90dB (A). Hence, noise generated due to various activities in the construction camps may affect workers, if equivalent 8-hour exposure is more than the safety limit. ACGIH (American Conference of Government Industrial Hygienists) proposed an 8-hour Leq limit of 85 dB (A). Exposure to impulses or impact noise should not exceed 140 dB (A) (Peak acoustic pressure). Exposure to 10,000 impulses of 120 dB (A) is permissible per day.

225. The noise likely to be generated during excavation, loading and transportation of material will be in the range of 90 to 105 dB (A) and this will occur only when all the equipment operate together and simultaneously. This is however, is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 80 to 90 dB (A) in an 8-hour shift, for which all statutory precautions should be taken into consideration. However, careful planning of machinery selection, operations and scheduling of operations can reduce these levels.

226. As the project road passes through populated areas at villages and urban areas and several sensitive receptors such as colleges and religious institutions are located along the road, people in these places will be exposed to the high noise levels. To avoid significant impacts on human health, it is recommended to avoid construction work at these sections during night times and ensure that only minimum required machinery is deployed on the site.

227. Uninterrupted movement of heavy and light vehicles at high speeds may cause increase in ambient noise levels on the project road. It may have negative environmental impacts on the sensitive receptors close to the project road.

228. The existing noise level along the mixed traffic is between 64dB (A) - 68dB (A) in peak hours. During the operation phase, the traffic is expected to increase by 2.77 times by 2031. As the sound level is measured in logarithmic scale this increase in traffic will induce a minor increase of 0.44dB(A) of noise level. The recorded sound levels near the sensitive locations are observed to be high in comparison with the CPCB noise standards, hence provision of noise barriers are required as an mitigation measure to control the noise levels.

MITIGATION MEASURES

7.6.1 Sensitive Receptors

229. In environmental assessment, the presence of water bodies, settlements, hospitals, temples and institutional areas are considered as sensitive areas and suggests noise environment mitigations during the project construction and operation to be performed. The detail of the

receptors is detailed in **Table 7-9**. The details of mitigation measures to be followed for noise environment are discussed in the following sections.

Table 7-9: Sensitive Receptors location along Hubli – Dharwad Road

Sl.no	Temple	Chainage
1.	JG Commerce College	0/723
2.	KIMS	0/900
3.	Shukruta Hospital	1/425
4.	SK & HSK College	1/500
5.	KLE Pharmacy College	1/650
6.	PC Jabin College	1/900
7.	BVB College	1/950
8.	Lakshmi temple	2/000
9.	KLE Polytechnic	2/100
10.	Prerana PU College	2/250
11.	Banyan Kindergarten	2/400
12.	Ramalingeshwarar Temple	2/700
13.	Anjaneya Temple	3/200
14.	Temple	4/400
15.	Rukmani Temple	4/700
16.	Ganapathy Temple	4/700
17.	Private School	4/900
18.	GBS College	5/100
19.	Sana College	5/650
20.	Cancer Hospital	7/250
21.	Balamaruti Prajama Temple	7/800
22.	Iskcon Temple	9/200
23.	Temple	9/400
24.	Jai Sri Ram Temple	10/300
25.	SDM Medical College	11/900
26.	SDM Dental College	12/800
27.	JSS College	16/300
28.	Temple	16/500

Source: Detailed Assessment

7.6.2 Noise Mitigation

230. Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. The following mitigation measures need to be worked out by the contractor for the noise impacts associated with the various construction activities:

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB (A). If required, machinery producing high noise, as concrete mixers, generators etc, must be provided with noise shields and their usage timings can be regulated.
- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum. Workers in the vicinity of high noise levels must wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- Construction camps (**Annexure -8**) shall not be located 1000 m (1 km) from settlement areas. No hot mix, batching and aggregate crushing plants shall be located within 1000 m of sensitive land uses as schools, hospitals etc.

- Blasting when required shall be restricted to daytime hours. All the statutory laws, regulations, rules etc, pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed. Blasting will be carried out during fixed hours as permitted by the Engineer.

231. Mitigation of the noise effects during the operation of the project can be effected by the following options: (i) ***Modifications of the characteristics of the sources of noise generation*** or (ii) ***Introduction of an obstruction between source and receptor***.

232. As the modification of the characteristics of the vehicles / vehicle components etc, does not fall under the purview of this project, the second option of the introduction of an obstruction in the form of a noise barrier between the source of noise and the receptor along the road will be adopted.

7.6.2.1 Provision of Noise Barrier

233. All the identified sensitive receptors viz. education institutions and hospitals are having compound wall at the edge of the footpath/ road. It can be conclude that for most of the identified sensitive receptors the existing compound wall will be lost during the land acquisition for the proposed widening. Due to this, the sensitive receptors will be exposed to the direct sound generated from the construction site. For construction related noise impacts, mitigation measures are suggested in the *section 7.6.2*. Once the construction stage is over, the project corridor is exposed to increasing traffic. This in turn increases the noise intensity and cause noise pollution to the sensitive receptors. To mitigate the noise pollution, permanent noise barriers are suggested.

7.6.2.2 Type of Noise Barrier

234. It has been decided to have green barriers in addition to concrete barrier³ (compound wall). Survey conducted at 16 different locations along the existing mixed traffic corridor shows an intensity of 64dB (A) to 68dB (A). By 2031, with a rise of 177% of traffic as projected the noise intensity will vary between 64.5dB (A) to 68.5dB (A). As per CPCB, the suggested noise level at the sensitive location is 50dB (A) in day time and 40dB (A) in night time. Hence, there is a need to attenuate the noise level ranging from 14.5 dB (A) to 18.5 dB (A).

235. Attenuation of sound can be achieved by selection of type of noise barrier and exact height. To estimate the height of the noise barrier, Fresnel principle/ numbers and Pythagorean theory are used for calculation. Following **Table 7-10** depicts the actual height required near the sensitive receptors to attenuate the noise level. The formula used for calculating barrier height is $N = 2 d / \lambda$ and Pythagorean theory : $a^2 + b^2 = c^2$.

³ As per the discussion/ consultation had with the key members of the education institutions and hospitals, it can be concluded that all the sensitive receptors shall have new compound wall (loss of existing compound wall due to Land Acquisition). This has been decided in due care of safety of the students and local people visiting hospitals.

Table 7-10: Noise Barrier required at Sensitive Location

Sr. No.	Location Name	Chainage (L/R)	Setback Proposed RoW Edge (m)	Predicted Noise levels dB (A)	Noise level for Sensitive location dB (A)	Noise to be attenuated dB (A)	Height of the Noise barrier required (m)
1	JG Commerce College	0+723 - L	25.0	66.44	50	16.44	1.14
2	KIMS	0+900 - R	356.0	64.44	50	14.44	1.00
3	Shukruta Hospital	1+425 - L	6.0	66.44	50	16.44	1.63
4	SK & HSK College	1+500 - R	19.5	65.44	50	15.44	1.16
5	KLE Pharmacy College	1+650 - R	22.0	65.44	50	15.44	1.15
6	P C Jabin College	1+800 - R	35.0	66.44	50	16.44	1.00
7	BVB College	1+950 - R	125.0	68.44	50	18.44	1.00
8	KLE Polytechnic	2+100 - R	56.0	67.44	50	17.44	1.00
9	Prerana PU College	2+250 - R	51.0	64.44	50	14.44	1.00
10	Banyan Kindergarten	2+400 - R	30.0	64.44	50	14.44	1.10
11	Sana College	5+650 - L	26.0	64.44	50	14.44	1.12
12	Cancer Hospital	7+250 - L	57.0	66.44	50	16.44	1.05
13	SDM Medical College	11+900 - R	38.0	64.44	50	14.44	1.07
14	SDM Dental	12+800 - L	59.0	66.44	50	16.44	1.05
15	JSS College	16+300 - R	33.0	66.44	50	16.44	1.10

Source: CEPT Estimation, 2012

236. From the observation, it can be concluded that concrete wall of 1.0 to 2.0m is found to be more than sufficient in attenuating the increased noise level. In addition to this, green barrier (avenue trees, shrubs etc.,) are suggested as a landscaping measure along the sensitive location. The following **Figure 7-7** and **Figure 7-8** shows the concept behind the selection of noise barrier. The cost of the green barriers forms part of the project cost. Hence, not reflected in the EMP cost.

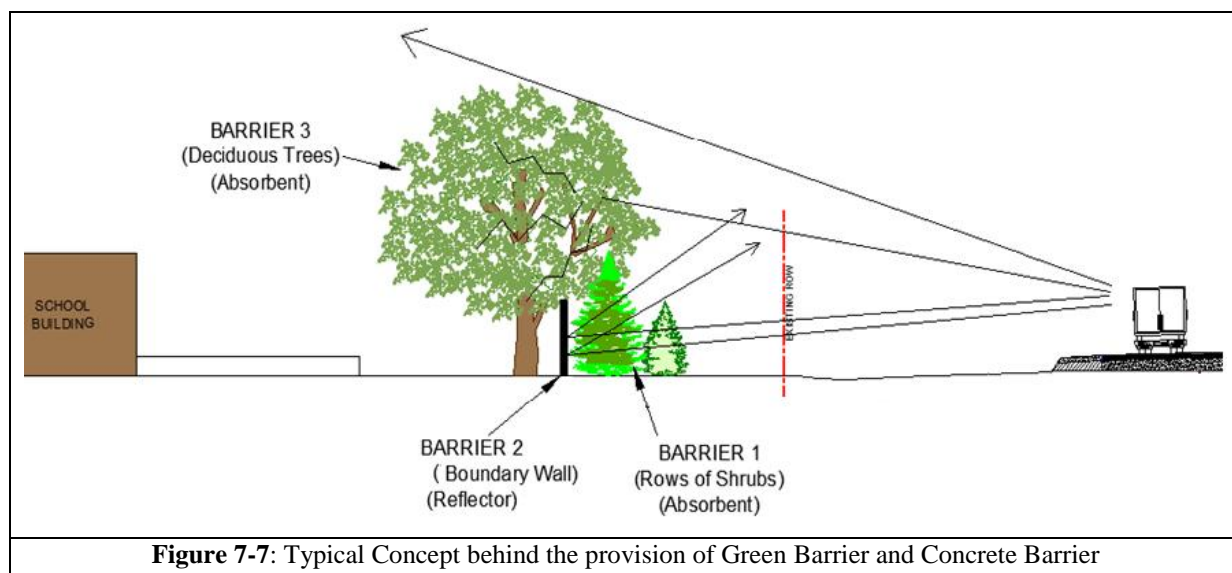


Figure 7-7: Typical Concept behind the provision of Green Barrier and Concrete Barrier

237. Species of trees recommended for landscaping considering local climate, soil condition and to reduce noise intensity are:

Table 7-11: Trees Species Identified to act as Green Barrier

<u>Canopy Tree Species - A</u>	<u>Medium Height Tree Species - B</u>	<u>Understory Tree And Shrub Species - C</u>
<i>Holoptelea integrifolia</i> <i>Sterculia foetida</i> <i>Sterculia urens</i> <i>Sterculia alata</i> <i>Tamarindus indica</i> <i>Sweitenia spp.</i> <i>Peltophorum pterocarpum</i> <i>Syzygium cuminii</i> <i>Terminalia spp.</i> <i>Haldinia spp</i>	<i>Aegle marmelos</i> <i>Diospyros Spp.</i> <i>Madhuca latifolia</i> <i>Mangifera indica</i> <i>Tecomella undulata</i> <i>Feronia elephantum</i> <i>Pongamia glabra</i> <i>Santalum album</i> <i>Garuga pinnata</i> <i>Sapindus mukorossi</i> <i>Shorea robusta</i> <i>Thespesia populnea</i> <i>Crateava religiosa</i> <i>Cordia rothi</i> <i>Cordia myxa</i> <i>Garcinia spp</i> <i>Putranjiva spp</i>	<i>Salvadora persica</i> <i>Pithecelobium dulce</i> <i>Abrus precatorius</i> <i>Butea monosperma</i> <i>Gliricidia sepium</i> <i>Murraya koenigii</i> <i>Murraya exotica</i> <i>Grewia asiatica</i> <i>Cordia rothi</i> <i>Capparis decidua</i> <i>Wrightia tinctoria</i> <i>Adhatoda vasica</i> <i>Thespesia populnea</i> <i>Tecomella undulata</i> <i>Cordia myxa</i>



Figure 7-8: Noise Barrier for Sensitive Locations along BRTS

7.7 Biological Environment

7.7.1 Forest Area

238. As discussed in section 4.2.8, the proposed BRTS project doesn't have forest / reserved forest areas in the corridor. Hence anticipating impact on Forest area is not envisaged.

7.7.2 Wild Life

239. There are no threatened / endangered animals in the project corridor. The public consultation and the secondary information reveals that few animals namely cat - *Felis chaus*, squirrels - *Funambulus pennant*, Hare - *Lepus nigricollis nigricollis*, Common mongoose - *Herpestes edwardsi*, Common rat snake - *Ptyas mucosus* and Green whip snake - *Ahaetulla nasutus* are the common seen/ available in the project area. Most of the listed animals are night dwellers, hence construction activities in day time doesn't have any impact on animals of project corridor.

7.7.3 Tree Cutting

240. Trees falling within the RoW shall be cut. As per detailed assessment 1750 trees, out of which 10% are fruit bearing will be affected due to the project. The tree species are mostly Banyan trees (*Ficus benghalensis*), Eucalyptus (*E. angophoroides*), Common Fig tree (*F. carica*), Plantain (*Musa paradisiaca*), coconut trees (*Cocos nucifera*), sal (*Shorea robusta*), Teak (*Tectona grandis*), bamboo trees (graminaceous plant), Pine (*Pinus pinea*) and Mango tree (*Mangifera indica*).

7.7.4 Removal of Vegetation

241. Existing road side vegetation and agriculture area are likely to get impact due to the BRTS proposal. The portion falling within the RoW will be fully utilised for widening purpose, which leads to a permanent impact on vegetation. However, the suggested landscaping will mitigate the loss of vegetation.

MITIGATION MEASURES

7.7.5 Forest Area

242. There is no forest area identified within/ surrounding project corridor, it is evident from the reconnaissance survey and secondary information's collected from Forest Department and Survey of India.

7.7.6 Wild Life

243. There is no wildlife recorded in the project area, however, the construction and operation phase of the project doesn't possess threat to other faunal population available. There are no endangered species reported in the site and hence, no impacts are anticipated and mitigation measures are not required.

7.7.7 Trees and Vegetation

244. Though no endangered flora exists within the project area, trees within the road Right of Way need to be cleared for construction of the road. As per assessment and inventory approximately 1750 trees, out of which 10% are fruit bearing trees will be affected due to the project. As a compensatory measure, 200 trees per km are proposed to be planted along the corridor. Accordingly, KRDCL has deposited Rs 27.24 Lakhs with Forest Department for the said purpose.

245. The roadside landscaping suggested aims at not only providing shade but also improving the aesthetic quality of the road. 1296 trees are suggested for all infrastructure sites (except CBT due to space constraints) so as to maintain visual characteristics and uniformity in terms of landscape.

Sl.no	Infrastructure Site	Trees to be planted within proposed landscape area
1.	CBT Hubli	0
2.	Hubli OCBS - Ranichennamma	239
3.	BRTS Depot Hubli – Airport Road	260
4.	Divisional Workshop - Hubli	210
5.	Depot and Regional Terminal at Hosur Circle	342
6.	BRT Depot Dharwad	167
7.	OCBS Dharwad	78
	Total	1296

Source: Design

7.8 Socio-Economic Environment

7.8.1 Fear of Uncertainties Regarding Future

246. These normally become long lived, given the length of time, which elapses between initial surveys and commencement of construction. Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation. These involve:

- Uncertainty of the amount of land/property to be acquired,
- Time of acquisition and evacuation,
- Extent and amount compensation,
- Provision of alternative land or job, etc.

7.8.2 Inducement of Land Prices

247. Once the project becomes common knowledge, there may be an incidence of unscrupulous speculators moving in to purchase land at what might seem to be advantageous prices, prior to the commencement of the official procedures. Such impact is more likely to occur in the case of urban fringe areas during the design and pre-construction phase.

7.8.3 Inducement of Squatter Influx

248. Squatters may attempt to occupy land along and adjacent to the proposed alignments, in the hope of receiving compensation or some other inducements to leave when construction commences. Such squatters could cause undue pressure on local resources such as water and firewood, which could result in conflicts with those who are harvesting the resources presently.

7.8.4 Loss of Utilities and Amenities

249. Site clearance involves removal of various assets, utilities and amenities that are:

- Natural (trees, bushes and grasslands), and
- Physical structures (public or private assets and utilities)
- Relocation of utilities like electricity, water and telephone lines

250. For people dependent on the above, this constitutes economic loss for some time before these are restored to their previous status. These have been further discussed in the RAP.

7.8.5 Public Health and Safety

251. Impacts on Public health and safety may arise during the phases of pre-construction, construction and operation phases. During the pre-construction and construction phases, dismantling of the structures for CoI clearance and road construction activities may result in the following health hazards:

- Dismantling of properties has psychological impacts on their owners and others associated with them.
- Debris generated on account of the above mentioned activities.
- Labour Camps during construction period can bring the following problems.
- In the case of non-local labour (if so is arranged by the contractor), labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries. These labourers hired from outside can have clashes with the local population on account of cultural and religious differences. The influx of a large work force to an area, already hard pressed for basic services (medical services, power, water supply, etc.), can impose additional stress on these facilities.
- If alternative fuels are not made available to the workforce, there is a likelihood that trees will be cut down for cooking or heating purposes.
- In sanitary conditions in the labour camps might also result in impact on health of labourers as well as the local population. Transmission of diseases is also facilitated by the migration of people. During the construction phase work, crews and their dependents may bring with them a multitude of communicable diseases including sexually transmitted diseases (STDs) like AIDS. This is more so if the nature of the project requires more male-workers, who have migrated from other parts of the state or country.

252. Allied activities during construction period may cause local disruption.

- During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas.

- Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities.
- Traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.
- There will be some impact on land during construction, limited mainly to temporary acquisition to cater to road diversion or traffic detours and establishment of labour camps.

253. Accidents and Safety

- Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas. Especially where the residential area is on one side and their agricultural land and other facilities are on the other side of the highway. In rural areas it was seen that cattle also cross the highways near the settlement.

7.8.6 Land Use Changes

254. Land use changes along the BRTS corridor are anticipated. These shall bring about a change in the characteristics of the adjacent lands. There would be succession of land uses and higher return uses would displace the lower returns uses. This phenomenon will occur at major intersections and in settlement areas along the project corridors.

7.8.7 Disturbance to the Road Side Services

255. Along the highway, near settlements, small shops get attracted to serve the local people as well as the highway users. A composite socio-economically inter-dependent has been developed as a consequence. The shops serve dual purpose by providing income and employment to locals as well as service to the road users. It is likely that due to implementation of the project some of the shops may get displaced. This would cause negative impact on the livelihood of people as well as loss of service to the local people and road users.

7.8.8 Removal of Encroachments and Squatters

256. The potential impacts likely to arise from clearance of encroached residential areas (especially in settlements along the project corridors) may involve loss of valuable residential space to the residents. In the case of squatter settlements, displacement might lead to loss of shelter if adequate measures are not taken for their resettlement. Compensation may not be enough for the effected persons to gain access to shelter. Other impacts include disturbance to family and community life and increased distance from their workplace. In such cases the displaced persons may again resort to squatting.

7.8.9 Sensitive Cultural Properties

257. A total of 12 cultural properties (places of worship) are under direct impact due to the corridor improvement. Care will be taken to minimize the impact, in a worst case/ fully affected structures will be compensated, if it is located in the private land. However, governments GO on removal of encroachment on public land shall be strictly followed.

**Figure 7-9: Temple at Km 3/200****Figure 7-10: Mosque at Km5/300****Table 7-12: Cultural Properties along the project corridor**

Sl.no	Temple	Chainage
1.	Lakshmi Temple	2/000
2.	Ramalingeshwarar Temple	2/700
3.	Anjaneya Temple	3/200
4.	Temple	4/400
5.	Rukmani Temple	4/700
6.	Ganapathy Temple	4/700
7.	Mosque	5/300
8.	Balamaruti Prajama Temple	7/800
9.	Iskcon Temple	9/200
10.	Temple	9/400
11.	Jai Sri Ram Temple	10/300
12.	Temple	16/500

Source: socio- economic survey

MITIGATION MEASURES

7.8.10 Fear of Uncertainties Regarding Future

258. The project is only of upgradation of the existing road, and within the confines of the existing RoW, the fear of uncertainties is most likely limited to the people squatting and encroaching in the RoW. At places where the community utilities are to be affected a certain amount of anxiety will be among the people in that particular community. To remove such fear from the people, public participation sessions were/will be conducted in different stages of project, viz. pre-design, design, pre-construction and construction.

259. In the pre-design stage, a comprehensive socio-economic survey (**Annexure - 9**) was conducted to prepare baseline status of the households squatting or encroached upon the RoW. During the survey each households were contacted/interviewed and they were explained about the purpose of the survey, need of the project and benefits associated with the project etc.

260. The second stage of public participation was in the form of village meetings, focus group discussion, individual interviews, voluntary and academic institution consultation. The third stage of participation session will start before pre-construction. The SPV/ KRDCL will verify and consult the individual PAPs with the help of RAP consultant for distribution of ID card. At this stage the PAPs will be explained about their entitlement and R&R framework.

261. People likely to be displaced will be informed in advance through RAP consultant by a time bound programme about resettlement to remove fear of uncertainty. During the construction stage the consultation process will continue to avoid any inconvenience to the community at any point of time.

7.8.11 Inducement of Land Prices

262. As the project becomes common knowledge, the land prices along the corridor will increase to some extent. For geometric improvement of highway, extra additional land may be required; KRDCCL will decide the actual cost of such land. The actual cost of land may be different from induced land cost.

7.8.12 Inducement of Squatter Influx

263. Once the project becomes common knowledge, people may attempt to occupy the land along the corridor in anticipation of compensation. To avoid such, the dates of base-line socio-economic survey have been considered as cutoff date for identification of project affected people, who are eligible for compensation. The cut off dates will be used to establish whether a person located in the right way qualifies as a PAP for the disbursement of compensation. All the PAPs recorded during socio-economic baseline survey are eligible for compensation after verification by SPV/ KRDCCL.

7.8.13 Loss of Utilities and Amenities

264. The site clearance for construction of road may result in loss or relocation of certain utilities and amenities, viz. electricity, water and telephone line etc. People dependent upon these utilities and amenities may experience inconvenience and economic loss. Though such impacts are unavoidable keeping in mind the scale of work, but every care will be taken in co-ordination with concerned departments, to restore the facility within shortest possible time to avoid any prolonged hardship or inconvenience to the community. Similarly other utilities like water source etc. will be constructed or replaced at appropriate place with the consent of community prior to dismantling the existing one.

7.8.14 Public Health and Safety

265. During the Pre-construction and Construction Phases dismantling of the structures for CoI clearance and road construction may result in health hazards. To minimise this potential negative impact the following recommendations should be adopted:

- To avoid the psychological impacts due to the demolition of properties on the owners and other tenants. The advance notice as per RAP will be given to the owners of the affected properties. An advance notice will be served at least four months before construction commences. For squatters needing relocation, all R&R activities will be undertaken and entitlements will be completed before construction starts.
- Debris generated from the demolition of properties will be properly disposed of to avoid the health problems in the safeties. Earth material, if required will be dumped in borrow areas as

approved by the engineer. Borrow areas will be filled to avoid health hazards from stagnant water collecting in these areas. The contractor will make all arrangements for dismantling and cleaning up of debris. Implementation will be as per the approval and direction of the engineer.

266. During the construction period the potential negative community impacts arising from imported labour in the labour camps will be avoided as per following: -

- All contractors will be encouraged to recruit the local people as labourer at least for unskilled and semi-skilled jobs. This would automatically reduce the magnitude of impact expected due to outside labour. Wherever the local labourers are not available the contractor should ensure the following provision for imported labour
- The additional stress on the facilities like medical services, power, water supply due to a labour camp in a local area will be avoided by the contractor providing these facilities for the labourers as per the direction of the Engineer
- In areas where environment resources are abundant, construction workers shall be instructed how to protect natural resources, fauna, flora and aquatic life. In such areas hunting and unauthorised fishing are prohibited
- In the labour camps, all temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing

267. Allied activities during construction period may cause local disruption:

- In the construction phase, there may be inconvenience to the local people as well as the highway passengers due to traffic jams and congestion, loss of access and other road accident risk as a result of construction. Detailed traffic control plans shall be prepared and submitted to the engineer for approval 5 days prior to commencement of work on any section of road. In the preparation of the traffic control plan special consideration shall be given to the safety of pedestrians and workers at night.

268. Accidents and Safety

- To avoid the accidents during construction phase, contractor shall take all necessary measures to ensure traffic safety. The contractor will provide, erect and maintain barricades, including signs marking flags lights and flagmen as required by the Engineer.
- In the operation phase, traffic control measures such as speed breakers and sign boards (including speed limits) will be provided and strictly enforced in residential areas, near schools and water bodies like ponds and wells.

7.8.15 Landuse of Changes

269. As regards land use changes, it is likely that the impact would be very minimal. Since the project is upgradation/ widening of road within the available ROW, the possibility of major land acquisition is not envisaged. In design stage utmost care has been taken to keep the land acquisition at minimal for road realignment and geometric purpose. The probable impact on road-side business and trees within ROW has been reduced and avoided through design.

7.8.16 Disturbance to the Road Side services

270. Along the highway, near settlements, small shops serve the local people as well as highway users. Some of these shops are within the RoW. To avoid any impact on livelihood of people dependent on roadside business, the cleaning of such informal establishment will be carried out as phase-wise resettlement programme. Loss of livelihood of the displaced shop owners will be compensated as per assistance or entitlements in Entitlement Framework.

7.8.17 Removal of Encroachments and Squatters

271. The impact due to removal of encroachments and squatters will be avoided by implementation of phase-wise resettlement action programme. To avoid the severance of impact, advance notice will be given to the encroachers and squatters. The notice will be given three months prior to construction phase starts. Relocation of all such impacted persons will be as per R&R schedule.

7.8.18 Sensitive Culture Properties

272. The impacts due to project on the sensitive community facilities or institution along the project corridor such as education institution, health facilities and others like ponds and cultural community assets are avoided to maximum extent in the design phase of the project. For affected sensitive communities, compensation as per assistance (or) entitlements in Entitlement Framework.

7.8.19 Avoidance of Disruption and Safety Risks during the Construction Stage

7.8.19.1 Loss of Access

273. At all times, the Contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses will not be undertaken without providing adequate provisions.

274. The works will not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.

7.8.19.2 Traffic Jams, Congestion and Safety

275. Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of road. The traffic control plans will contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.

276. Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Engineer. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.

277. The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water, if necessary.

278. The Contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement.

7.8.20 Safety of the Workers

279. **Risk from operations:** The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention No. 62 as far as applicable to the contract. The contractor will supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workmen. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

280. **Risk from electrical equipment:** Adequate precautions will be taken to prevent danger from electrical equipment. No material at any of the sites will be so stacked or placed so as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, be free from patent defect, in good working order and will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.

281. **Risk at hazardous activity:** All workers employed on mixing asphaltic material, cement, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Workers engaged in stone breaking activities, will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.

282. The use of any herbicide or other toxic chemical will be strictly in accordance with the manufacturer's instructions. The Engineer will be given at least 6 working days' notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site will be kept and maintained up to date by the Contractor. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.

283. **Risk of lead pollution:** No man below the age of 18 years and no woman will be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks

will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

284. **Risk caused by force de majeure:** All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.

285. **Risk from explosives:** Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor will not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor will take every possible precaution. He will comply with appropriate laws and regulations relating to the import, handling, transportation, storage and use of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer.

286. The Contractor will at all times make full liaison with and inform well in advance and obtain such permission as is required from all government authorities, public bodies and private parties who so ever concerned or affected or likely to be concerned or affected by blasting operations.

287. **Malarial risk:** The Contractor will, at his own expense, conform to all anti-malarial instructions given to him by the Engineer; including filling up any borrow pits which may have been dug by him. Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometer or so of their breeding place. Thus borrow pits and any other water bodies created during the construction process should be situated 1 to 2 km away from the human settlements. Pits dug up closer than these will be adequately drained to prevent water logging.

288. Similarly compensatory measures for filling up part of the water bodies situated adjacent to the project corridors will be directed towards deepening of the water bodies concerned. This way the capacity of the water body remains the same, while water surface available for breeding of mosquitoes is reduced. This will have an additional advantage of decreased evaporation losses.

289. **First aid:** At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory Rules of Tamil Nadu. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to take injured or ill person(s) to the nearest hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided.

290. **Potable water:** In every workplace, at suitable and easily accessible places, a sufficient supply of cold potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided. All water supply storage will be at a distance of not less than 15m from any latrine, drain or other source of pollution.

291. Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well will be properly chlorinated before water is drawn from it for drinking water. All such wells will be entirely closed in and be provided with a trap door, which will be dust proof and waterproof. A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once a month.

292. **Sanitation Facilities:** There will be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. Except in workplaces provided with water-flushed latrines connected with a water borne sewage system, all latrines will be provided with dry-earth system (receptacles) which will be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles will be tarred inside and outside at least once a year. If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular language will be provided. There will be adequate supply of water, close to latrines and urinals.

293. Unless otherwise arranged for by the local sanitary authority, arrangement for disposal of excreta will be made through anaerobic decomposition. Excreta will be disposed of by putting a layer of night soils at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (by then it will turn into manure).

7.8.21 Safety Measures during Operation Stage

294. Traffic safety measures are inbuilt into the project design and specifications. These would take care of the safety aspects in the operation stage. Following components are provided with safety aspects in view.

- Foot paths are provided throughout the cross section for urban area
- Non-motorized vehicles are stream lined to travel in a separate lane
- Local traffic will be stream lined to travel in service road
- Specify speed limit and de-restriction signs at the entry and exit to each urban or village area, which has street lighting. These signs will be shown on the road plans and will be subject to local agreement or modification prior to erection.
- Provide cattle crossings where there is a need for a cattle crossing

7.9 Solid Waste Management

295. Waste materials have the potential to cause adverse environmental impacts during generation, storage, transport and disposal. The principal adverse effects relate to dust, water quality, general health and safety and visual impacts. It is estimated that about 9,837cu.m of Spoil, overburden or mine wastes, 15005.5 cu.m of silt (tank deepening) from Rayapura Tank and about 11,862 cu.m of Construction or demolition wastes debris will be generated during the entire

road construction period. The municipal solid waste generated from the construction camp and labour camp is estimated to be 100kg/day. For each anticipated waste category, the potential environmental impacts are highlighted and appropriate mitigation measures/disposal options recommended below.

- Avoiding and/or minimising waste generation where practical by improvements or changes in the project design or site procedures;
- Reusing/recycling/recovering materials where possible and thereby negating / minimising disposal requirements (e.g. by waste segregation according to type, separation of recyclable materials such as metal, reuse of wood from site hoarding/concrete formwork, utilisation of excavated material for filling or landscaping)
- Ensuring that all treatment and disposal options comply with best practice and all relevant guidelines and legislation.

296. The following specific measures should therefore be adopted during the detailed design and construction stages of the project to minimise waste generation:

Detailed Design

- Minimizing excavation requirements as far as possible.
- Balancing cut and fill requirements.
- Evaluating the potential for maximizing the re-use of excavated materials for example, within landscape mounds.
- Considering treatments for unsuitable excavated materials e.g. upgrading of subsoil to top soils by mixing with compost.
- Providing an area within the construction site to allow for sorting and segregation of materials.

Construction

- Segregating waste materials according to type to facilitate re-use and recycling.
- Separation of inert construction and demolition materials for either re-use on-site or use as public fill.
- During demolition works, segregating materials at source as far as practical.
- Co-ordinate material deliveries to site in order to minimize storage times on site and the likelihood of causing damage.
- Consider on site mulching of vegetation to reduce bulk and review opportunities for possible use within landscaping areas.
- Training site staff in waste minimization practices.

297. In accordance with good practice, accurate site records should be maintained throughout the construction works detailing the quantities of materials; a) generated on site; b) reused on site; and c) disposed off site, together with disposal routes/locations.

7.9.1 Wastes Generated from Site Clearance and Excavated Materials

298. All materials should be re-used or transported off site as soon as possible to minimize the potential for adverse environmental impacts. It is recognized that some stockpiling of materials

will be required in some instances although these should be segregated in terms of material type as far as practical to facilitate material re-use (i.e. top soil for landscaping, suitable fill for engineering works).

299. All excavated material should be handled in a manner that minimises the release of fugitive dust (especially during hot and dry weather) and where possible the movement of material should be kept to a minimum. Within the stockpile area, the following measures should be in place to control potential impacts.

- Covering material during heavy rainfall;
- Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin);
- Controlling the excessive use of water during spraying to prevent the generation of runoff contaminated with elevated levels of suspended solids;
- Segregation of the surface water system for the stockpile area and the fitting of silt traps where appropriate;
- Locating stockpiles to minimize potential visual impacts;
- Minimizing land intake of stockpile areas as far as possible;
- Provide fencing within designated areas to separate sensitive habitats and prevent stockpiling in unsuitable locations; and designate appropriate haulage roads.

300. A reduction in the total volume of excavated materials requiring offsite disposal will be achieved as far as possible by optimizing the re-use of suitable material on-site. Both excavated material which cannot be re-used on site and inert construction and demolition materials will require disposal at low lying areas.

7.9.2 Inert Construction and Demolition Material

301. Inert construction and demolition materials such as wood and metal should be separated out from other materials for recycling. All recyclable material should be clearly segregated and stored in appropriate skips/containers or stockpiled. Segregation of material will aid in the potential for re-use of material and in final disposal, if necessary. Material recycling or re-use reduces both the need for new construction materials and subsequent collection, transportation and disposal costs. Only when materials cannot be reused should they be disposed of to filling areas.

7.9.3 Chemical Wastes

302. Chemical waste, as defined in the Hazardous Wastes (Management and Handling) Amendment Rules, 2000, will require disposal by appropriate and approved means. Potential hazards associated with the inappropriate handling of these materials include:

- Effects on human health (i.e. dermal and toxic effects with respect to site workers);
- Phototoxic effects to vegetation;
- Contamination of the soil, groundwater's and surface water following spillage;
- Risk of fire or explosions; and

- Discharge of chemical wastes to sewer and potential disruption of the sewage treatment works.

303. Chemical wastes should be stored in a locked, fully bunded area which is impermeable to both water and the waste being stored. The waste storage area should also be covered to prevent rainfall from accumulating within the bunded areas. The bunded area must have a volume of either 110% of the largest container or 20% by volume of the chemical waste stored in that area. Appropriate spill absorption material should be stored near the storage area in order to clean up any minor spill events. The risks associated with chemical waste storage and handling can be further minimized by:

- Designation of an appropriate, well ventilated storage area;
- Minimization of waste production and recycling/reprocessing for certain waste liquids where appropriate (e.g. oils, solvents);
- Careful handling of waste fuel and oil residues;
- Use of appropriate and labelled (Hindi and English) storage containers;
- Storage of wastes remote from sensitive receivers (e.g. drains, residential properties and water bodies); and
- Education of workers on the concepts of site cleanliness and appropriate waste management procedures.

7.9.4 Municipal Waste

304. Municipal wastes generated by site workers have a potential to cause impacts in terms of nuisance, insects and vermin. This may give rise to adverse environmental impacts for both site workers and site neighbours which could include:

- Odour nuisance if putrescible material is not collected on a frequent basis;
- Wind-blown material causing litter problems;
- Vermin and pests in the waste storage area if it is not well maintained and cleaned regularly; and
- Adverse visual impacts.

305. A temporary refuse collection facility should be set-up by the contractor and wastes should be stored in appropriate containers prior to collection and disposal. A private waste collection firm may be commissioned by the site contractor to remove the waste regularly (daily basis), to the satisfaction of the Engineer.

8. ENVIRONMENTAL MONITORING PLAN

306. The monitoring programme is devised to ensure that the envisaged purpose of the project is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP
- To suggest improvements in the management plans, if required
- To satisfy the statutory and community obligations

307. The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Monitoring plan for performance indicators and reporting system is presented in the following sections.

8.1 Performance Indicators

308. Physical, biological and environmental management components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators (PIs). The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution;
- Environmental management indicators to determine compliance with the suggested environmental management measures
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed

309. The Performance Indicators and monitoring plans prepared for Project Implementation are presented in **Table 8-1**.

Table 8-1: Performance Indicators for Project Implementation

Sl. No.	Indicator	Details	Stage	Responsibility
A	Environmental	Condition Indicators and Monitoring Plan		
1	Air Quality	The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the Monitoring Plan prepared (Refer Table 8-5)	Construction	Contractor under the monitoring of SPV/ KRDCL
			Operation	SPV/ KRDCL through approved monitoring agency
			Pre-Construction	SPV/ KRDCL through approved monitoring agency
2	Noise Levels		Construction	Contractor under the monitoring of SPV/ KRDCL
			Operation	SPV/ KRDCL through approved monitoring agency
			Pre-Construction	SPV/ KRDCL through approved monitoring agency
3	Water Quality		Construction	Contractor under the monitoring of SPV/ KRDCL
			Operation	SPV/ KRDCL through approved monitoring agency
			Pre-Construction	SPV/ KRDCL through approved monitoring agency

Sl. No.	Indicator	Details	Stage	Responsibility
4	Soil Quality			monitoring agency
			Construction	Contractor under the monitoring of SPV/ KRDCL
			Operation	SPV/ KRDCL through approved monitoring agency
B	Environmental Management Indicators and Monitoring Plan			
1	Construction Camps	Location of construction camps have to be identified and parameters indicative of environment in the area has to be reported	Pre-construction	SPV/ KRDCL
2	Borrow Areas	Location of borrow areas have to be identified and parameters indicative of environment in the area has to be reported.	Pre-construction	SPV/ KRDCL
3	Tree Cutting	Progress of tree removal marked for cutting is to be reported	Pre-construction	Forest Department to SPV/ KRDCL
4	Tree Plantation	Progress of measures suggested as part of the Strategy is to be reported	Construction	Forest Department
C	Management & Operational Performance Indicators			
1	Survival Rate of Trees	The number of trees surviving during each visit will be compared with the number of saplings planted	Operation	Forest Department/ SPV/ KRDCL
2	Status Regarding Rehabilitation of Borrow Areas	The PU will undertake site visits to determine how many borrow areas have been rehabilitated in line with the landowner's request and to their full satisfaction.	Operation	The SPV/ KRDCL will be responsible for a period of three years.
3	Soil Erosion	Visual monitoring and operation inspection of embankments will be carried out once in three months.	Operation	The SPV/ KRDCL will be responsible for a period of three years.

8.2 Monitoring Parameters and Standards

310. The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:

8.2.1 Ambient Air Quality Monitoring (AAQM)

311. The air quality parameters viz: Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Hydro-Carbons (HC), Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Ammonia (NH₃), Ozone (O₃), Lead (Pb), Benzo (a) pyrene (BaP), Arsenic (As) and Nickel (Ni) shall be regularly monitored at identified locations from the start of the construction activity. The air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards as given in **Table 8-2**. The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan **Table 8-5**.

Table 8-2: National Ambient Air Quality Standards

Sl. No	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
1	Sulphur Dioxide (SO ₂), µg/m ³	Annual* 24 hours**	50 80	20 10	-Improved West and Gaeke -Ultraviolet fluorescence
2	Nitrogen Dioxide (NO ₂), µg/m ³	Annual* 24 hours**	40 80	30 80	-Modified Jacob & Hochhieser (Na-Arsenite) -Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM ₁₀ µg/m ³	Annual* 24 hours**	60 100	60 100	-Gravimetric -TOEM -Beta attenuation
4	Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ³	Annual* 24 hours**	40 60	40 60	-Gravimetric -TOEM -Beta attenuation
5	Ozone (O ₃) µg/m ³	8 hours* 1 hours**	100 180	100 180	-UV photometric -Chemiluminescence -Chemical Method
6	Lead (Pb) µg/m ³	Annual* 24 hours**	0.50 1.0	0.50 1.0	-AAS/ICP method after sampling on EMP 2000 or equivalent filter paper -ED-XRF using Tefloa filter
7	Carbon Monoxide (CO) µg/m ³	8 hours* 1 hours**	02 04	02 04	-Non Dispersive Infra Red (NDIR)spectroscopy
8	Ammonia (NH ₃) µg/m ³	Annual* 24 hours**	100 400	100 400	-Chemiluminescence -Indophenol blue method
9	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05	-Gas chromatography based continuous analyser -Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) particulate phase only, µg/m ³	Annual*	01	01	-Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As) µg/m ³	Annual*	06	06	-AAS/ICP method after sampling on EMP 2000 or equivalent filter paper
12	Nickel (Ni) µg/m ³	Annual*	20	20	-AAS/ICP method after sampling on EMP 2000 or equivalent filter paper

*Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals

**24 hourly or (8 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

8.2.2 Noise Quality Monitoring

312. The noise levels shall be monitored at already designated locations in accordance with the Ambient Noise Quality standards given in **Table 8-3**. The duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan **Table 8-5**.

Table 8-3: National Ambient Noise Quality Standards

Area Code	Category of Zones	Limits of Leq in dB(A) Day*	Night*
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zone **	50	40

* Daytime shall mean from 6.00am to 10.00 pm and Night shall mean from 10.00 pm to 6.00 am

*** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicles horns, loud speakers and bursting of cracking are banned in these zones.*

8.2.3 Water Quality Monitoring

313. Water quality parameters such as pH, BOD, COD, DO coliform count, total suspended solids, total dissolved solids, Iron, etc. shall be monitored at all identified locations during the construction stage as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications, presented in **Table 8-4**. The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan **Table 8-5**.

Table 8-4: National Standard of Water

Sl. No	Parameters	IS:2296 (Class C)	Method Adopted
1	pH	6.5-8.5	pH meter
2	BOD (3 days 27 ⁰ C)	3.0	DO-Azide modification of Winkler's method
3	Temperature (⁰ C)	NS	Thermometer
4	Dissolved oxygen	4	Azide Modification of Winkler's method
5	Color (Hazen)	300	Visual Comparison method
6	Fluorides (F)	1.5	SPANDS method
7	Chlorides (Cl)	600	Argentometric Titration
8	Total Dissolved Solids	1500	Gravimetric Analysis
9	Sulphates (SO ₄)	400	Barium Chloride method
10	Iron (Fe)	50	Phenanthroline method
11	Oil and Grease	0.1	Partition – Gravimetric method
12	Nitrates	50	Chromotropic acid
13	Chromium (Cr ⁶⁺)	0.05	Atomic Absorption Spectrophotometry
14	Cadmium (Cd)	0.01	Atomic Absorption Spectrophotometry
15	Lead (Pb)	0.1	Atomic Absorption Spectrophotometry
16	Copper (Cu)	1.5	Atomic Absorption Spectrophotometry
17	Cyanide (CN)	0.05	Chloramine-T-method
18	Selenium (Se)	0.05	Atomic Absorption Spectrophotometry
19	Arsenic (As)	0.2	Atomic Absorption Spectrophotometry
20	Phenols	0.005	Spectrophotometer
21	Detergents	1.0	Spectrophotometer
22	DDT	Absent	Spectrophotometer
23	Total Coliform (MPN/100 ml)	5000	Multiple Tube Fermentation Technique

NS: Not specified; Brackets ([]) indicates extended limits. All the values in mg/l if otherwise mentioned

8.2.4 Monitoring Plans for Environment Condition

314. For each of the environmental components, the monitoring plan specifies the parameters to be monitored; location of the monitoring sites and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities. The monitoring plan for the various environmental condition indicators of the project in construction and operation stages is presented in **Table 8-5**. Monitoring plan does not include the requirement of arising out of Regulation Provision such as obtaining NOC/ consent for plant site operation.

Table 8-5: Environmental Monitoring Plan

Attribute	Project Stage	Parameter	Special Guidance	Standards	Frequency	Duration	Location	Implementation
Air	Construction	SO ₂ , NO _x , RPM, SPM, O ₃ , Pb, CO, NH ₃ , C ₆ H ₆ , BaP, As and Ni	High volume sampler to be located 50m from the plant in the Downwind direction. Use method specified by CPCB for analysis	Air (prevention and Control of Pollution) Rules, CPCB, 2009	Three seasons per year	24 hours Sampling	Along the road Hot mix batching plant	Contractor under the supervision of Engineer in charge
	Operation ⁴				Two seasons in a year for three years		Along the road	Contractor under the supervision of Engineer in charge
Water	Construction	All essential characteristics and some of desirable characteristics as decided by the Environmental Specialist of the CSC and SPV/ KRDCL	Grab sample collected from source and Analyse as per Standard Methods for Examination of Water and Wastewater	Indian Standards for Inland Surface Waters (IS: 2296, 1982)	Four seasons per year	Grab Sampling	Along the road Surface water sources	Contractor under the supervision of Engineer in charge
	Operation				Three seasons for three years			Contractor under the supervision of Engineer in charge
Noise	Construction	Noise levels on dB (A) scale	Equivalent noise levels using an integrated noise level meter kept at a distance of 15 from edge of pavement Equivalent noise levels using an integrated noise level meter kept at a distance of 15 from edge of pavement	MoEF Noise Rules, 2000	Three seasons per year	Leq in dB(A) of day time and night time	Along the road Hot mix / batching plant	Contractor under the supervision of Engineer in charge
	Operation				Three seasons per year for three years.		Along the road	Contractor under the supervision of Engineer in charge
Soil	Construction	Monitoring of Pb, SAR and Oil & Grease	Sample of soil collected to acidified and analysed using absorption Spectrophotometer	Threshold for each contaminant set by IRIS database of USEPA until national	Four seasons per year	Grab Sampling	Along the road Hot mix / batching plant	Contractor under the supervision of Engineer in charge

⁴ Parameters to be monitored for Operation stage is same as Construction stage

Attribute	Project Stage	Parameter	Special Guidance	Standards	Frequency	Duration	Location	Implementation
				standards are promulgated				
	Operation				Three seasons for three years		Along the road	Contractor under the supervision of Engineer in charge
Borrow area	Construction	As per Guidelines	Visual Observation	-	Once in a month	-	Borrow area location	Contractor under the supervision of Engineer in charge
Tree plantation	Operation	As per Design			Quarterly	-	Areas where plantation is being done	Contractor under the supervision of Engineer in charge
Health and Safety	Construction	As per World Bank EHS Guidelines	-	Environmental, Health and Safety (EHS) standards	Quarterly	-	Construction and Labour Camp sites	Contractor under the supervision of Engineer in charge

8.2.5 Reporting System

315. Reporting system for the suggested monitoring program operates at two levels as:

- Reporting for environmental condition indicators and environmental management indicators (except tree cutting indicator)
- Reporting for operational performance indicators at the SPV/ KRDCL level

316. Contractor and Engineer operate the reporting system for environmental condition and environmental management indicators (except tree cutting). The Environmental Cell of SPV/ KRDCL will operate the reporting system for environmental management tree cutting indicator and operation performance indicators. The SPV/ KRDCL will set the targets for each activity envisaged in the EMP beforehand and all reports will be against these targets.

317. Contractor will report to the Engineer on the progress of the implementation of environmental conditions and management measures as per the monitoring plans. The Engineer will in turn report to the SPV/ KRDCL on a quarterly basis which will be reviewed. Along with these reports, Environmental Cell of the SPV/ KRDCL shall report progress of tree cutting, compensatory plantation, landscaping and survival rate as per the monitoring plan. Reporting formats have been prepared, which will form the basis of monitoring, by the Engineer and/or the Environmental Cell as required and presented as **Annexure-7**.

Table 8-6: Summary details of Reporting

Format No.	Item	Stage	Contractor	Supervision Consultant (SC) / Concessionaire		Project Implementation Unit (SPV/ KRDCL)
				Supervision	Reporting to SPV/ KRDCL	Oversee / Field Compliance Monitoring
			Implementation & Reporting to SC			
EM1	Identification of Disposal Locations	Pre-Construction	One Time	One Time	One Time	One Time
EM2	Setting up of Construction Camp	Pre-Construction	One Time	One Time	One Time	One Time
EM3	Borrow Area Identification	Pre-Construction	One Time	One Time	One Time	One Time
EM4	Tree Cutting	Pre-Construction	-	-	-	Quarterly
EM5	Tree Plantation	Construction	-	-	-	Quarterly
EM6	Top Soil Monitoring	Construction	Quarterly	Continuous	Quarterly	Quarterly
EM7	Construction Safety	Construction	Quarterly	Continuous	Quarterly	Quarterly
EC1	Pollution Monitoring	Construction	As Per Monitoring Plan	Quarterly	Quarterly	Quarterly
EC2	Pollution Monitoring	Operation	-	-	-	As Per Monitoring Plan
OP1	Survival Rate of Trees	Operation	-	-	-	Quarterly
OP2	Status Regarding Rehabilitation of Borrow Areas	Operation	-	-	-	Half Yearly

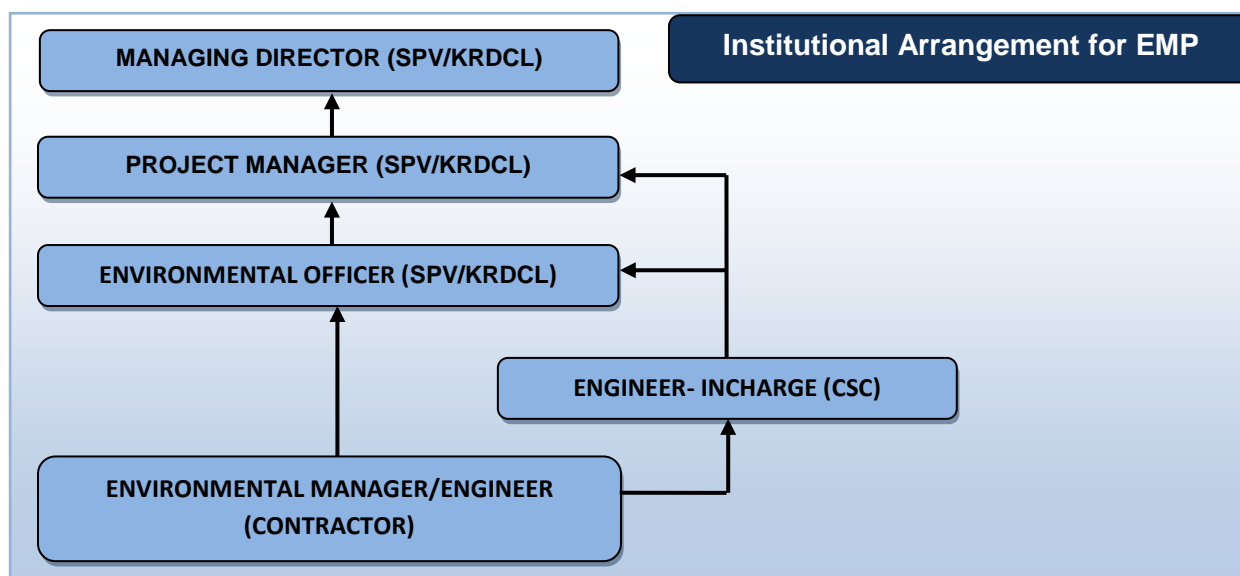
8.3 Institutional Setup

318. The Environmental Management Plan, EMP process does not stop once a project (planning and design) has obtained approval for implementation. During implementation of project, Construction Supervision Consultant (CSC) and Contractor will be responsible for

ensuring that the environmental commitments made to regulatory agencies, lending agencies and other stakeholders during the EIA process are met. To execute EMP is a combined responsibility of all three parties involved i.e. SPV; KRDCL and CSC indicative responsibility mechanism has been presented in **Table 8-7**, as developed for upgradation projects.

Table 8-7: Institutional Responsibilities

System	Designation	Responsibilities
Coordinating/Facilitating Agency	Managing Director (SPV/KRDCL)	<ul style="list-style-type: none"> • Overview of the project implementation • Ensure timely budget for the EMP • Coordination with different state level committee, to obtain Regulatory Clearances • Participate in state level meetings • Monthly review of the progress.
	Project Manager (SPV/KRDCL)	<ul style="list-style-type: none"> • Overall responsible for EMP implementation • Reporting to various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation • Coordination with SPV/KRDCL Staff (Environmental officer). • Responsible for obtaining Regulatory Clearances • Review of the progress made by contractors • Ensure that BOQ items mentioned in EMP are executed as per Contract provisions.
	Environmental Officer (SPV/KRDCL)	<ul style="list-style-type: none"> • Assisting Project Manager in overall implementation of EMP • Review of periodic reports on EMP implementation and advising Project Manager in taking corrective measure. • Conducting periodic field inspection of EMP implementation • Assisting Project Manager to reporting various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation • Preparing environmental training program and conducting the same for field officers and engineers of contractor
Implementing/ Monitoring Agency	Engineer- Incharge (CSC)	<ul style="list-style-type: none"> • Act as an “Engineer” for supervising EMP implementation • Responsible for maintaining quality of EMP envisioned in Detail Project Report • Maintaining progress reports on EMP implementation • Periodic reporting to SPV/KRDCL about the status of EMP implementation • Work in close coordination with Environmental officer (SPV/KRDCL) and contractor
Executing Agency	Environmental Manager / Engineer of Contractor	<ul style="list-style-type: none"> • Responsible for ensuring the implementation of EMP as per provision in the document. • Directly reporting to the Project Manager of the Contractor • Discussing various environmental/social issues and environmental/social mitigation, enhancement and monitoring actions with all concerned directly or indirectly • Assisting his project manager to ensure social and environmentally sound and safe construction practices • Conducting periodic environmental and safety training for contractor’s engineers, supervisors and workers along with sensitization on social issues that may be arising during the construction stage of the project • Assisting the SPV/KRDCL on various environmental monitoring and control activities including pollution monitoring; and • Preparing and submitting monthly/bio-monthly reports to SPV/KRDCL on status of implementation safeguard measures



8.4 Environmental Budget

319. Budgetary estimates for environmental management in the project include all items envisaged as part of the EMP. The environment budget includes provisions for various environmental management measures (other than measures considered under good engineering practices) and the environmental monitoring costs. Budgetary provisions for the road and BRTS components are presented in **Table 8-8** and **Table 8-9**.

Table 8-8: Budgetary Provisions for Environmental Management Measures for Road Component

S. No.	Item	Unit	Rate (in INR)	Quantity	Cost (in INR)
A	CONSTRUCTION PHASE				
1	<i>Mitigation Measures</i>				
1.1	Oil Interceptors	Number	5000	8	40,000.00
1.2	Recharge pits	Number	20000	20	400,000.00
1.3	Silt Fencing	Length (m)	900	300	270,000.00
1.4	Deepening of Ponds	Number	250000	3	750,000.00
2	<i>Tree Plantation and Protection</i>	Afforestation is taken care by Forest Department, Karnataka			
2.1	Trees				
2.2	Brick Tree Guards				
3	<i>Monitoring of Environmental Attributes during Construction Activity</i>				
3.1	Air Quality				
3.1.1	Monitoring of Air Quality near Hot mix plants	No. of Samples	6000	54	324,000.00
3.1.2	Monitoring of Air Quality at Critical Locations	No. of Samples	6000	72	432,000.00
3.2	Noise Levels				
3.2.1	Monitoring of Noise Level at Equipment Yards	No. of Samples	4000	54	216,000.00
3.2.2	Monitoring of Noise Levels at Critical Locations	No. of Samples	4000	72	288,000.00
3.3	Water Quality	No. of Samples	6000	96	576000
3.4	Soil Quality	No. of Samples	6000	72	432000
4	Enhancement of Cultural Properties				
4.1	Fully affected	Number	100000	5	500000
5.1	Partially affected	Number	75000	7	525000
	Environmental Budget During Construction Phase				4,753,000.00
B	OPERATION PHASE				
1	Monitoring of Air Quality during Operation Phase				
1.1	Monitoring of Air Quality at Critical Locations	No. of Samples	6000	45	270,000.00

S. No.	Item	Unit	Rate (in INR)	Quantity	Cost (in INR)
1.2	Monitoring at additional locations	No. of Samples	6000	36	216,000.00
2	Monitoring of Noise during Operation Phase				
2.1	Monitoring of Noise Levels at Critical Locations	No. of Samples	4000	45	180,000.00
2.2	Monitoring at additional locations	No. of Samples	4000	18	72,000.00
3	Monitoring of Management & Operational Performance Indicators				
3.1	Status of Redevelopment of Borrow Areas	No. of trips	5000	5	25,000.00
	Environmental Budget During Operation Phase				763,000.00
	Sub Total (A+B)				5,516,000.00
	Grand Total INR. (Environmental Budget Exclusive of Cost of Measures Included Under Good Engineering Practices, A+B+10% contingency)				6,067,600.00

Table 8-9: Budgetary Provisions for Environmental Management Measures for BRTS Component

S. No.	Item	Unit	Rate (in INR)	Quantity	Cost (in INR)
A	CONSTRUCTION PHASE				
1	Mitigation Measures				
1.1	Oil Interceptors	Number	5000	6	30,000
1.2	Recharge pits	Number	20000	10	2,00,000
2	Tree Plantation and Protection				
2.1	Trees	Covered under project cost			
2.2	Landscaping				
3	Monitoring of Environmental Attributes during Construction Activity				
3.1	Air Quality				
3.1.1	Monitoring of Air Quality near Hot mix plants	No. of Samples	6000	36	2,16,000
3.1.2	Monitoring of Air Quality at Critical Locations	No. of Samples	6000	18	1,08,000
3.2	Noise Levels				
3.2.1	Monitoring of Noise Level at Equipment Yards	No. of Samples	4000	36	1,44,000
3.2.2	Monitoring of Noise Levels at Critical Locations	No. of Samples	4000	18	72,000
3.3	Water Quality	No. of Samples	6000	36	2,16,000
3.4	Soil Quality	No. of Samples	6000	48	2,88,000
	Environmental Budget During Construction Phase				12,74,000
B	OPERATION PHASE				
1	Monitoring of Air Quality during Operation Phase				
1.1	Monitoring of Air Quality at Critical Locations	No. of Samples	6000	24	1,44,000
1.2	Monitoring at additional locations	No. of Samples	6000	12	72,000
2	Monitoring of Noise during Operation Phase				
2.1	Monitoring of Noise Levels at Critical Locations	No. of Samples	4000	36	1,44,000
2.2	Monitoring at additional locations	No. of Samples	4000	18	72,000
3	Monitoring Soil Quality	No. of Samples	6000	12	72,000
	Environmental Budget During Operation Phase				5,04,000
	Sub Total (A+B)				17,78,000
	Grand Total INR. (Environmental Budget Exclusive of Cost of Measures Included Under Good Engineering Practices, A+B+10% contingency)				19,55,800