SURAT

Trans-Vision 2030

COMPREHENSIVE MOBILITY PLAN

and

BUS RAPID TRANSIT SYSTEM PLAN

Volume-I: Executive Summary Report

PROJECT DPR SUBMITTED TO: MINISTRY OF URBAN DEVELOPMENT
GOVERNMENT OF INDIA

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An Initiative of

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BRTS	Bus Rapid Transit System
CEPT	Centre for Environmental Planning & Technology
CES	Consulting Engineering Services Pvt. Ltd.
CMIE	Centre for Monitoring Indian Economy
CNG	Compressed Natural Gas
CRRI	Central Road Research Institute
DCR	Development Control Regulation
DPR	Detailed Project Report
FSI	Floor Space Index
GIDB	Gujarat Infrastructure Development Board
GIDC	Gujarat Industrial Development Corporation
GSRTC	Gujarat State Road Transport Corporation
ITS	Intelligent Transport System
IRDP	Integrated Road Development Program
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
LRT	Light Rail Transit
MOU	Memorandum of Association
NMV	Non-motorised Vehicle
NUTP	National Urban Transport Policy
PCU	Passenger Car Unit
SEZ	Special Economic Zone
SMC	Surat Municipal Corporation
SPM	Suspended Particulate Matter
SUDA	Surat Urban Development Authority
TAZ	Traffic Analysis Zones
UP	Under pass
V/C	Volume / Capacity
ROW	Right of Way
ROB	Rail Over Bridge
RUB	Rail Under Bridge
RTO	Road Transport Office
RSPM	Respirable Suspended Particulate Matter

1. Executive Summary

1.1 Background

Surat is India's ninth and Gujarat's second most populous city with a population of 3 million (2001). It is the fastest growing city in India with a decadal growth rate of 85% from 1991-2001. Surat has made an important position in the world and national economy. The economy is based on the diamond trade, zari and textiles (power looms). The textile and diamond units of Surat region contribute to:

- 42 % of the world's total rough diamond cutting and polishing
- 70 % of the nation's total rough diamond cutting and polishing
- 40 % of the nation's total diamond exports
- 40 % of the nation's total man made fabric production
- 28 % of the nation's total man made fibre production
- 18 % of the nation's total man made fibre export
- 12 % of the nation's total fabric production

The intensification of oil and gas exploration activities has led to expansion of the economic base to gas based industries at Hazira. In parallel to the industrial expansion, Surat emerged as a major center for trade and commerce in the region and a silent evolution has been that of the informal sector.

Surat has been experiencing a 6% plus annual population growth since 60's, placing Surat 9th in terms of size countrywide (2001). Given the sound economic base, the city is located on the Delhi-Mumbai Industrial corridor. Several SEZ's are being set up outside the city limits. Rapid growth continuing, the city is expected to grow to accommodate 80 to 90 lakh people by 2031. Growth management is a major issue.

Despite the size and economic importance the city commands, Surat still does not have an efficient public transport system. It is to be noted that Surat is a migrant city and is faced with unfavorable income distribution. Incomplete network, missing hierarchy in road network system, poor quality of facilities for pedestrians and bicyclists, inadequate traffic management are some of the critical issues the city is faced with. The inner ring road, which is yet to be completed as a full ring, is faced with excessive dependency. The sustenance of Surat's growth can only be possible with the development of an efficient transportation system. The city and the state governments have initiated several measures to ameliorate the situation. The city bus services is operated by private contractors on a route contract basis offered to the people since August 2007. SMC in charge of allocating routes and services. In addition, SMC has fixed design standards for urban roads and has developed some roads to cater to non motorized transport such as bicycles as well as earmarked spaces for the informal sector. Other initiatives in decongesting city roads include grade separated junctions at key locations, paid parking and off street parking structures. Continuing with these, the effort in this report is to evolve a '**Comprehensive Mobility Plan**' and a "**Mass Transit Plan**' in the form of BRTS.

1.2 Vision

The city recognizes that the transportation systems do more than moving people:

- they provide access to employment, education, shopping, health, entertainment opportunities;
- they affect income levels of people,
- they affect land values, and
- they affect environment.
- In essence, they determine quality of life in an area.

The goal of the Surat Comprehensive Mobility Plan is to provide '***Integrated land use and transportation system, that minimizes the need for travel, provides choices for modes that are safe, socially, economically, financially and environmentally sustainable and provide a global image for the city'***. The attempt is to structure/restructure land use and transportation systems such that the outcome leads to minimizing travel through reduction in trips, trip lengths and shifting trips on to transit and non-motorized modes from personalized modes. While sustainability remains the key focus of the plan, as echoed in the city vision; ***"A Global City with Global Standards and Global Values"*** by the people of Surat, developing world-class standards would define the project specifications.

1.3 Comprehensive Mobility Plan

Being located on the proposed DMI Corridor, the city authorities recognise the need for taking a long term perspective and looking at a regional scale. Conceptually, the development pattern may be organized in different ways; Concentric growth Concept, Ring Town Concept, Corridor Development Concept and Corridor-Node Concept as shown in the map below.

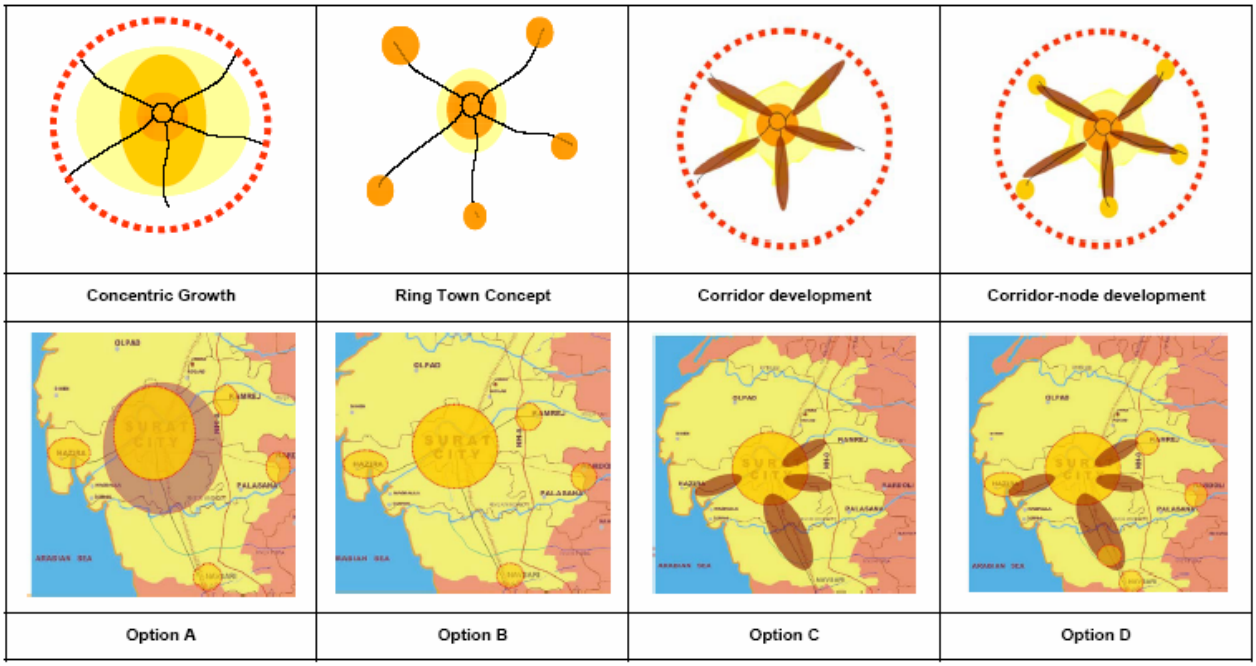
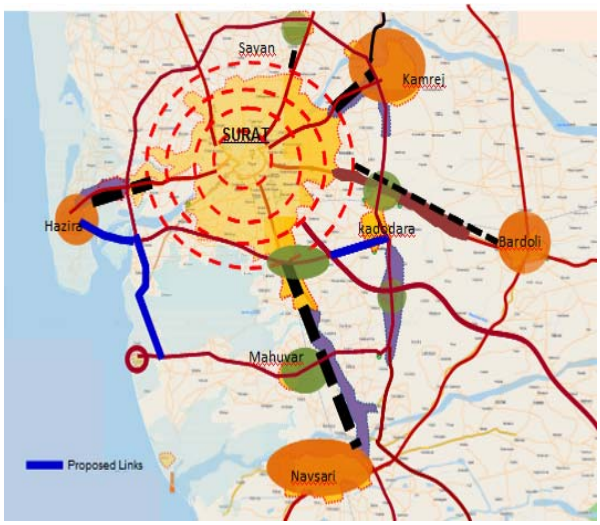


Figure 1: Conceptual diagrams of development patterns

Following the concept, a regional structure has been recommended to facilitate transit oriented development.

1.3.1 Structuring Regional Development

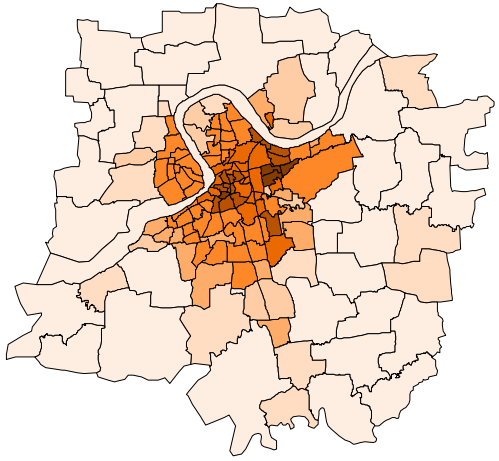
The analysis broadly identified the growth trends, settlement pattern and proposed a broad regional structure and also a network to connect these. As part of Urban-05 Vision, several proposals for location of various economic activities within the vicinity of Surat have been expressed. These include industrial nodes at Sachin and Kamrej, developing Surat and Navsari as twin cities and a corridor between Surat and Navsari with an intermediate node at Mahuva.



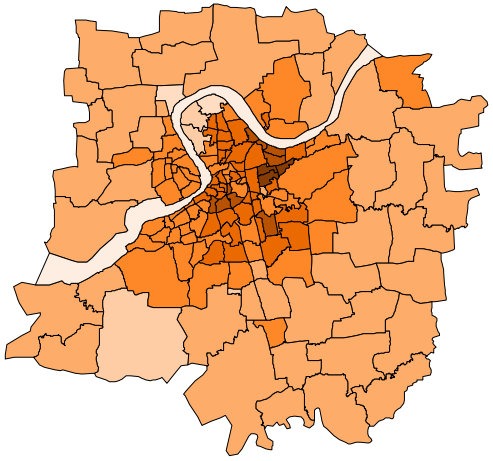
Map 1: Regional Nodes and Road Network

1.3.2 Structuring Urban Landuse:

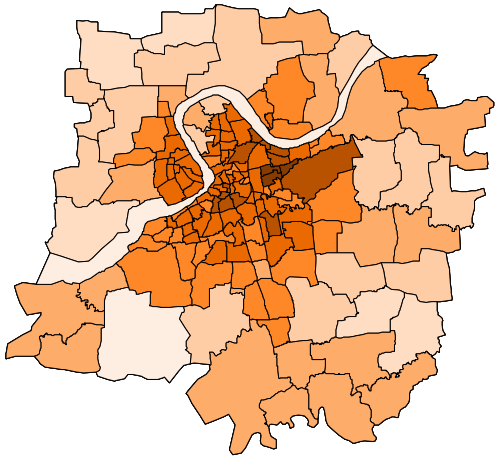
Structuring of urban landuse has also been attempted. Of the alternative forms, a corridor based land use structure has been recommended as represented in future population density maps below. While a dispersed trip pattern resulting from mixed land use such as Surat is desirable to keep trip lengths short, it is also essential to identify critical corridors which can be developed with higher density. These corridors will act as future public transport corridors and provide a viable demand for public transport.



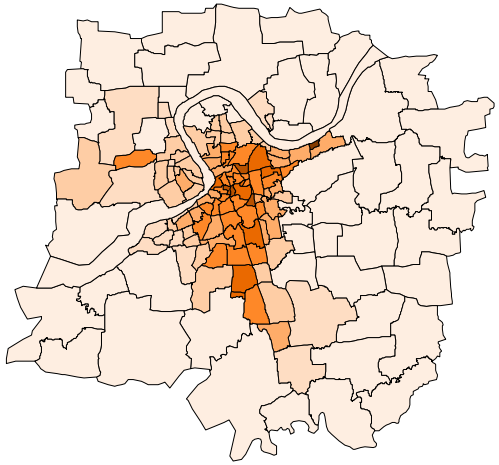
Population Density 2001



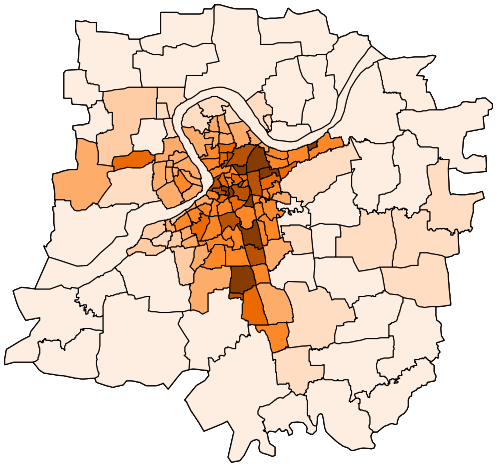
Scenario 1: Population Density 2031



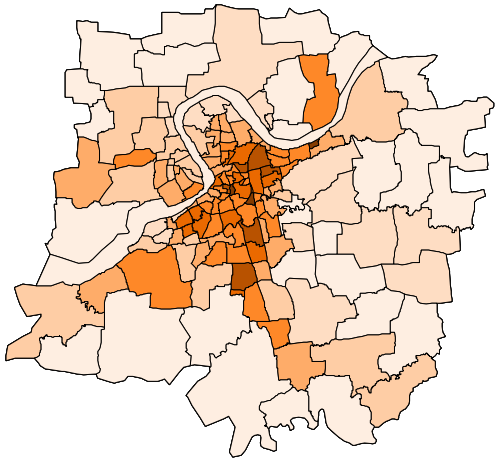
Scenario 2: Population Density 2031



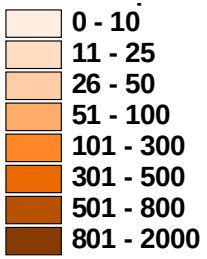
Employment Density 2005



Scenario 1: Employment Density 2031



Scenario 2: Employment Density 2031

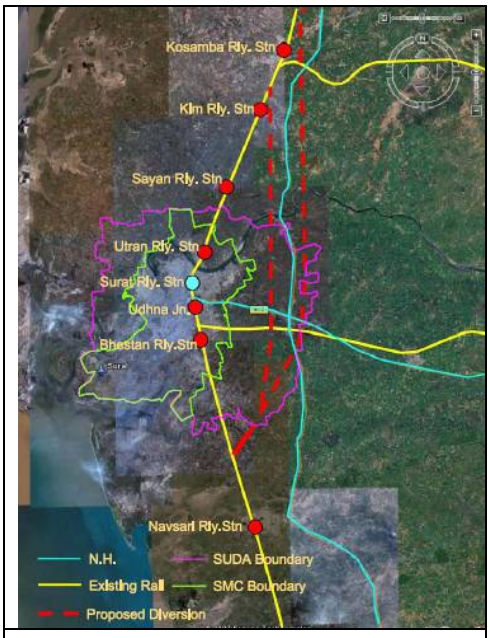


Legend

Map 2: Population and Employment Density

1.3.3 Structuring Regional Rail and Road Network

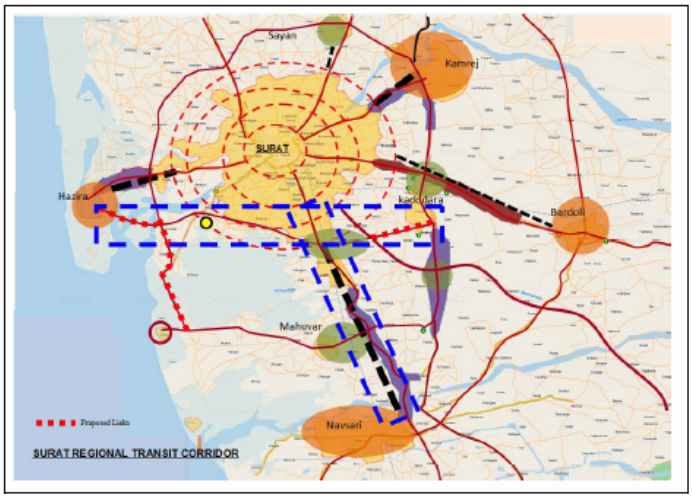
As the concentration of activities both within the urban areas and around the city increases, to distribute traffic, it is necessary to develop a network that enables bypassing traffic from urban roads. The proposals include extension to existing road network to connect emerging nodes.



Map 3: Regional Rail Corridor

Regional Freight Corridor: Large number of passenger and goods trains passes through the city of Surat. A proposal for third rail line corridor is also under consideration by Indian Railways. Indicative location of third railway line (by-pass line for freight) is proposed based on the following considerations. The same is being forwarded to the railway ministry by SMC for consideration.

Regional Transit Corridor: Developing high speed connectivity to 'Hazira-Airport-Sachin-Kadodra (50 Kms)' and 'Sachin-Navsari (20 Kms)' corridors is a priority action to be included as part of regional corridor development initiatives. Choice of technology in terms of LRT or BRT or any other forms may be carried out along with detailed corridor development feasibility studies and planning exercises. A feasibility study is to be undertaken.

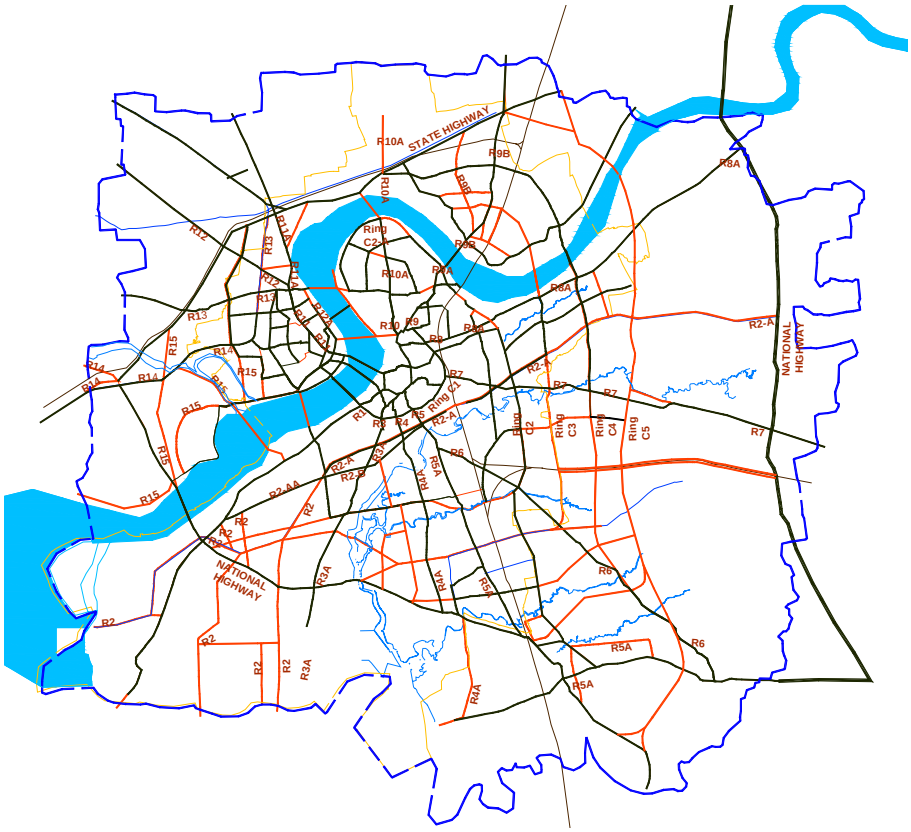


Legend:	
Existing and Proposed Activity Nodes	
Logistic Terminals/Goods Transport Terminals	
Regional Transit Corridor	
Airport	

Map 4: Regional Transit Corridor

1.3.4 Structuring Urban road Network

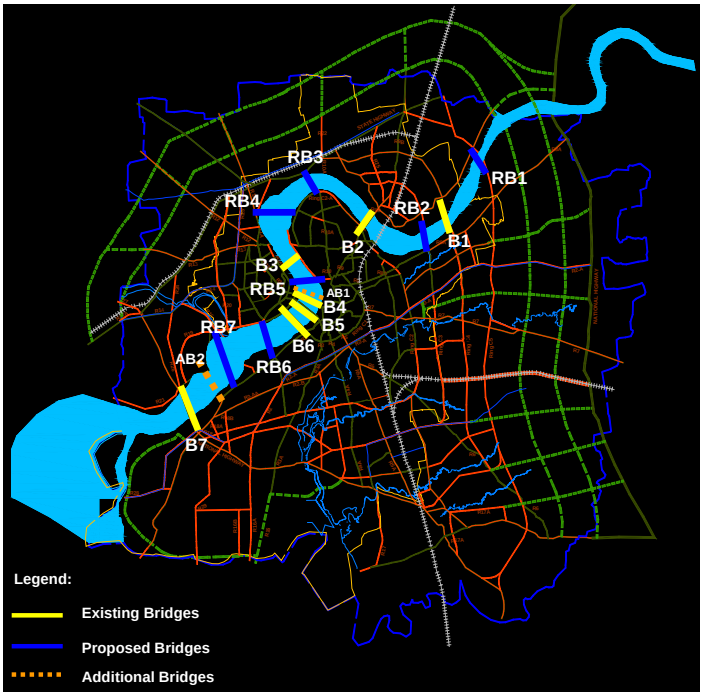
The objective is to establish a road hierarchy by designating roads as regional and urban Roads. Further urban roads are classified as arterial, sub-arterial, collector/distributor and local streets. This is an important step towards managing traffic, wherein design and management of roadway would be done according to prescribed standard.



Map 5: Urban road network restructuring-ring and radial pattern

1.3.4.1 Connectivity across the river

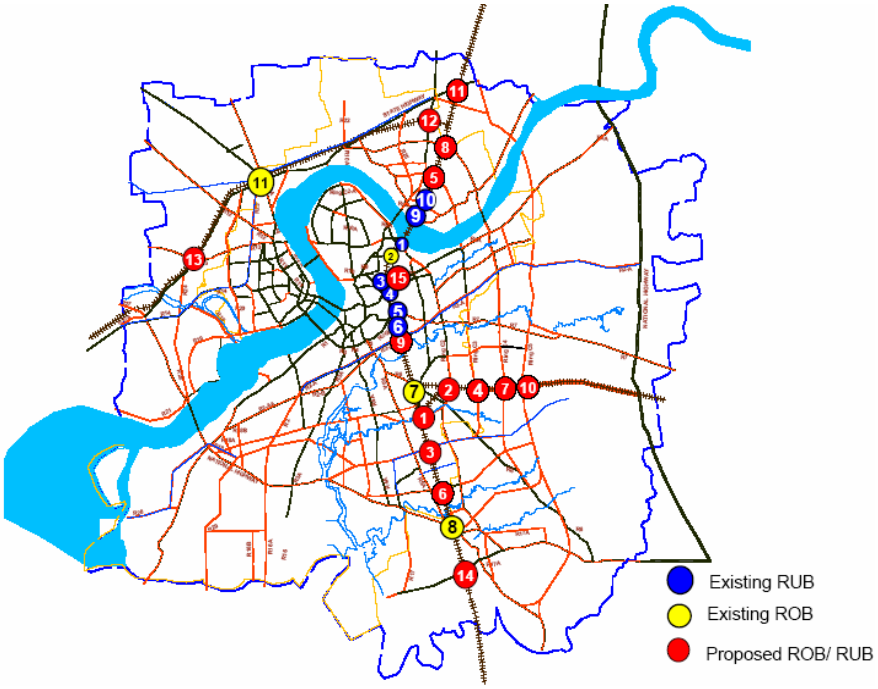
River Tapi crosses the city at its centre. The urban road restructuring proposal involves strengthening the connectivity across the east and west part of the river. River bridges at new locations based on the ring and radial road network are hereby proposed.



Map 6: Existing and proposed river bridges

1.3.4.2 Connectivity for the urban roads across the rail corridors through Rail over bridges

Rail over bridges are proposed to ease the connectivity across the urban rail crossings.

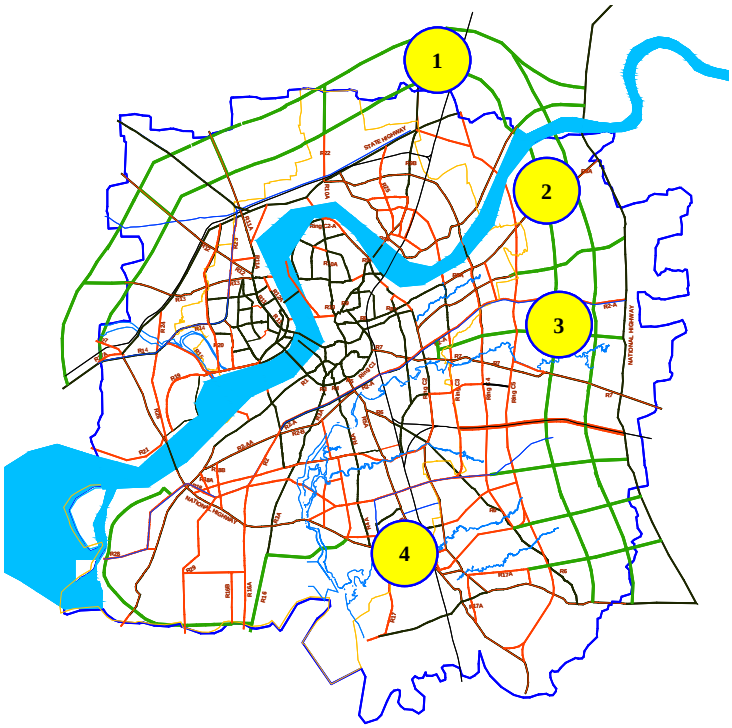


Map 7: Existing and proposed rail over bridges/ Underpasses

1.3.5 Developing terminals

1.3.5.1 Goods Terminal:

Due to absence of organized goods terminal in the city, heavy trucks are plying on congested city roads and causing fatal accidents. Based the origin-destination of goods movement, four potential locations (one in each direction of major goods entry) were examined and proposed.



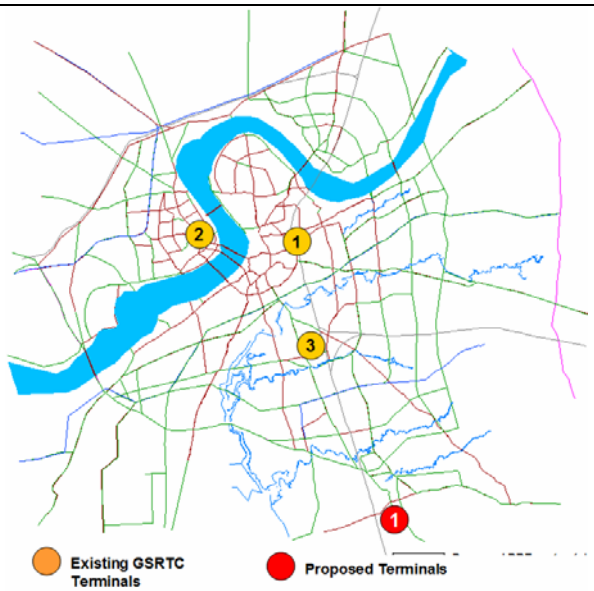
Proposed locations:
1.Gothan
2. Laskana
3. Kadodara Road
4. Sachin Road

Map 8: Proposed Goods Terminals

1.3.5.2 Regional Passenger Transport Terminals:

The GSRTC regional terminal and the private bus parking places are located in close proximity to several activity nodes within the city. Due to the movement of these congestion created is high. Though in terms of physical location they are in the centre, in terms of time distance it is not the same. Decentralized terminal development is proposed at three locations.

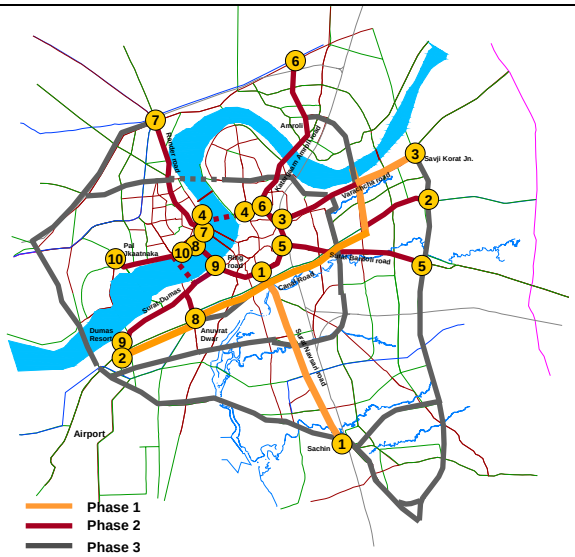
- Existing locations should be used as urban transit terminal and terminal for some limited regional services
- New regional terminals should be developed for both public and private transport services.
- On street parking of regional transport buses is to be banned.



Map 9: Proposed Regional Bus Terminals

1.3.6 Developing Transport Systems

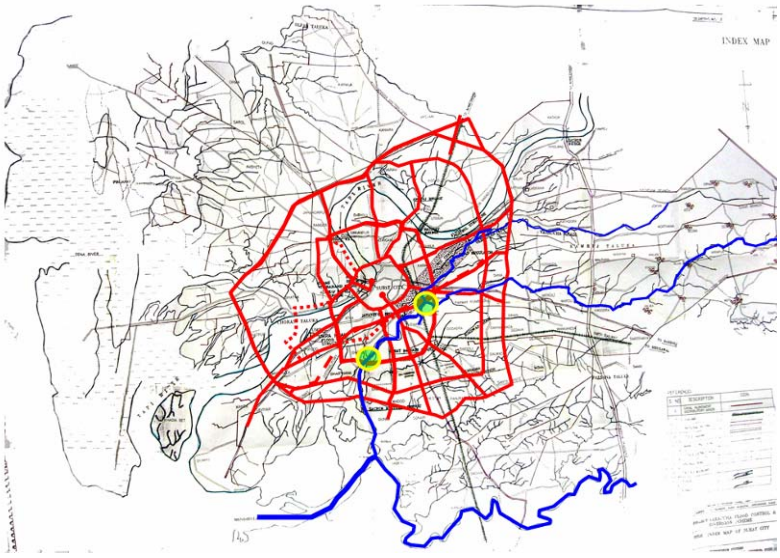
Keeping the demand and other conditions as a basis, arterial road network of about 125 kilometers in length has been identified for developing the Bus Rapid Transit System in Surat. Further about 30 kms of circular network has been identified for implementation during the phase-1 of the project. LRT option was also analysed. The option did not provide any significant additional benefits.



Map 10: BRTS Phasing of Corridors

1.3.7 Plan for Non-motorized movement

Bicycle tracks are planned on arterial network. The proposal is to provide segregated bicycle facilities on all arterial roads (35 meters and wider). The natural drains in the city are also proposed to be developed as urban spaces with pedestrian and bicycle facilities.



Map 11: Showing the khadi/creek in Surat along with the proposed road network

Estimated cost of redevelopment of natural drains (clearing, lining etc.,) inclusive of bicycle and pedestrian facility over 60 kms of primary drainage network works out to Rs. 180 Crores. Pedestrian and bicycle facilities on other roads is included in the respective road development works.

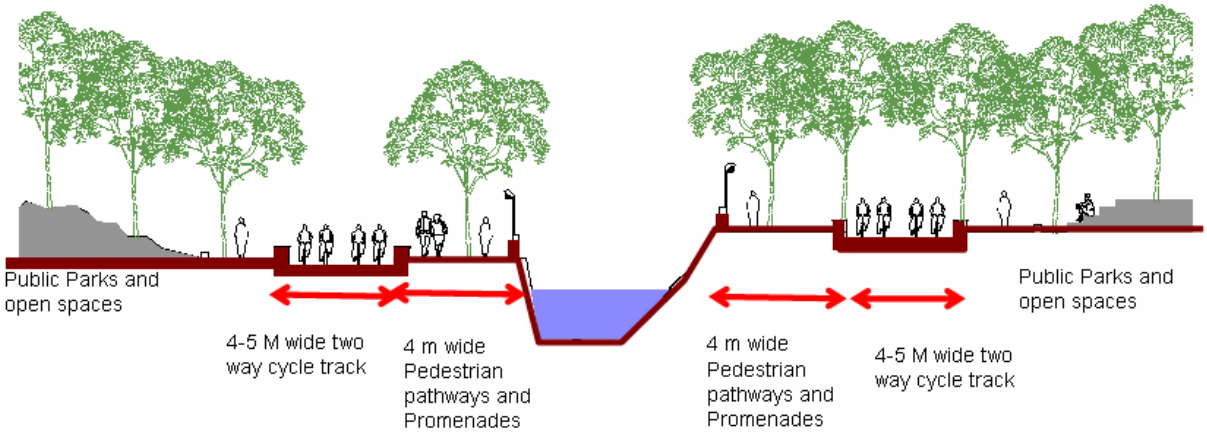


Figure 2: Proposed Cross Section across the Khadi Edge

1.4 The BRTS Plan

BRTS consists of several components designed to function together so as to generate superior services, which are comparable with other mass rapid transit system including metro rail system. Some or all of these elements are integrated to form BRTS, which will ensure fast, reliable, secure, high capacity service, which also has a distinct identity. The project in Surat uses several of these to put together an integrated system.

1.4.1 BRT System and Corridors

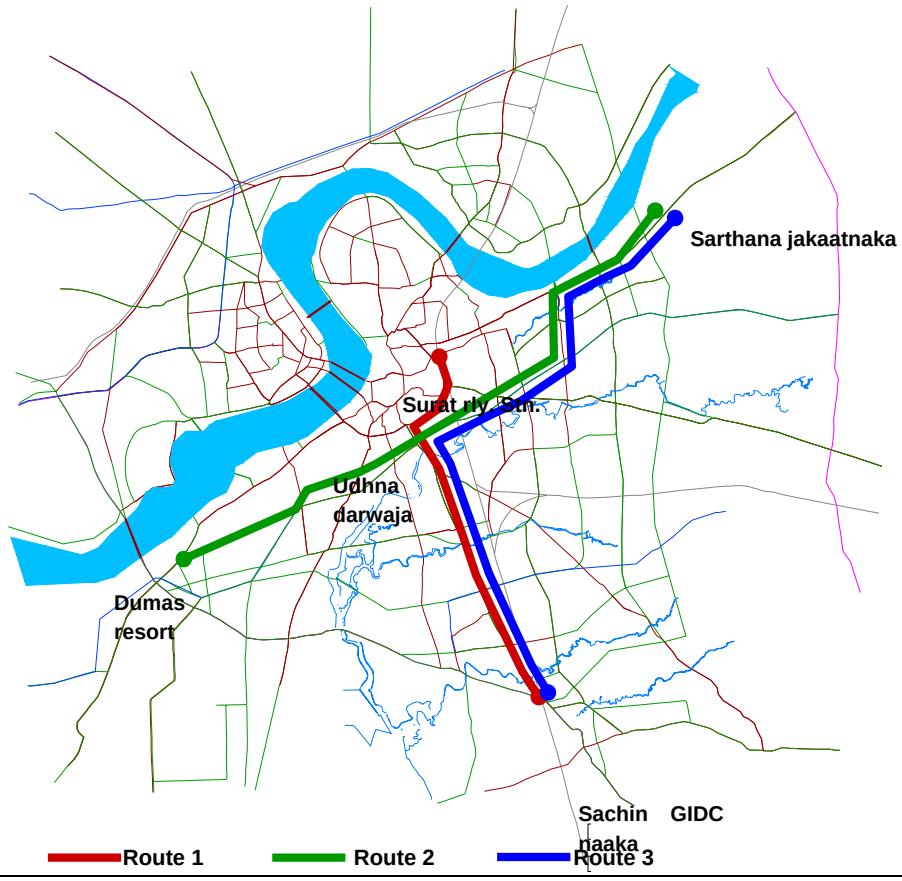
The primary objective of the initiative is to make Surat more accessible. Here the term more accessible is used to include physical, social and economic accessibility. This is achieved through a set of interrelated investment and policy decisions.

The BRT system plan is developed keeping the following as guiding principles:

- Given the present low levels of public transit patronage, the prime task of the initiative at this stage is to develop a market for public transport.
- To choose options which are technically feasible to implement (road width, corridor length, fewer bottlenecks-junctions, level crossings, flyovers etc)
- To minimize environmental and social adversity issues, and
- To ensure system wide impact.

System wide impacts include relief from congestion, improved safety, maximization of the ridership serving the needs of the poor, to provide opportunities for transit-oriented development/ promote compact city, and enable integration with other modes. The expected impacts have to be citywide and not limited to small areas. Keeping these as a basis, in line with the travel demand, arterial road network of about 125 kilometers in length has been identified for developing the Bus Rapid Transit System in Surat. Further about 30 kms of network has been identified for implementation during the phase-1 of the project. These are expected to provide greater accessibility to amenities and opportunities for mobility in Surat.

The selected corridors have been depicted in the map below



Map 12: Proposed BRT routes

1.4.2 Roadway Design:

The proposed cross sections as per the available ROW are presented below.

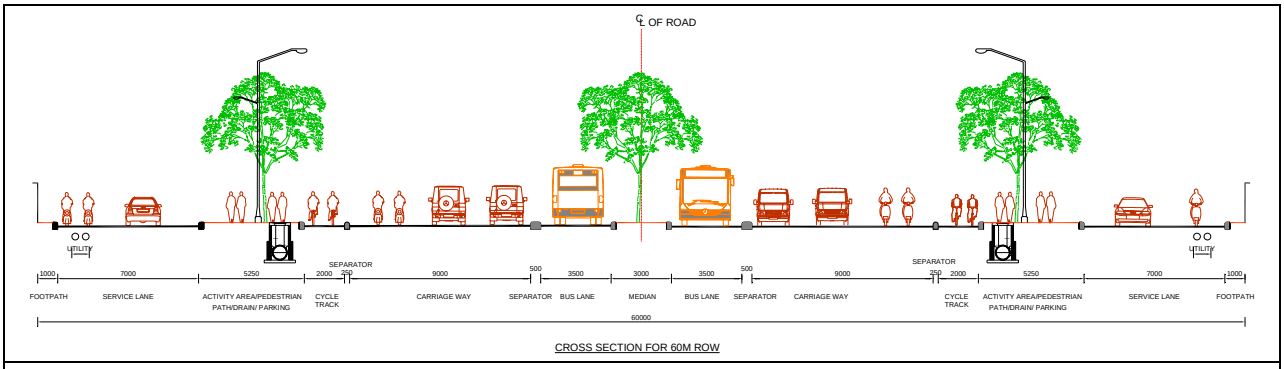


Figure 3: Typical Cross section for 60 m cross section

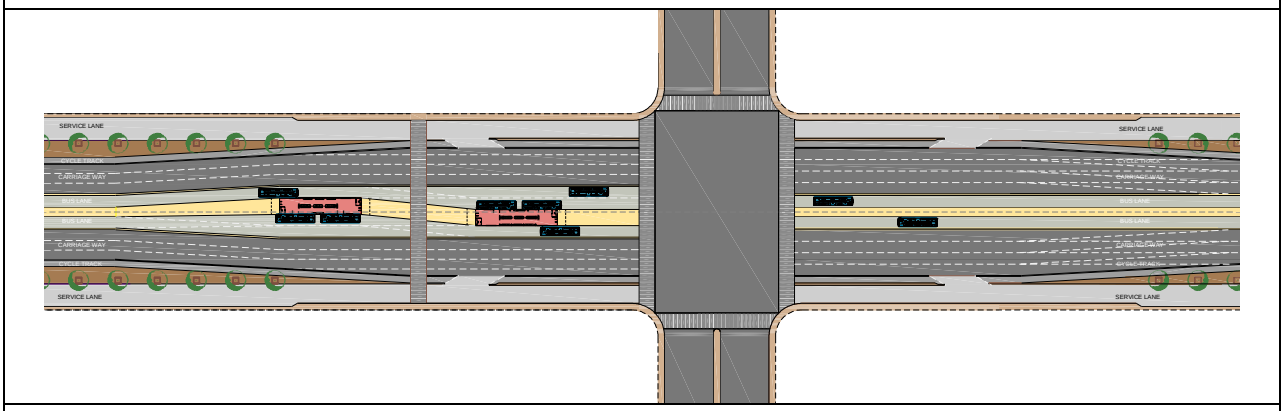


Figure 4: Junction Design for 60 m cross section

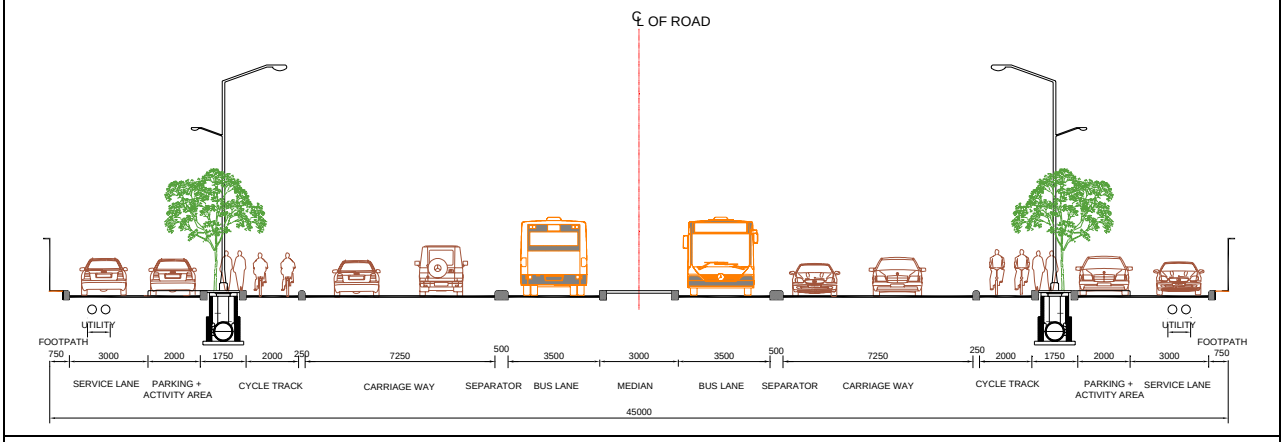


Figure 5: Typical 45 m RoW cross section

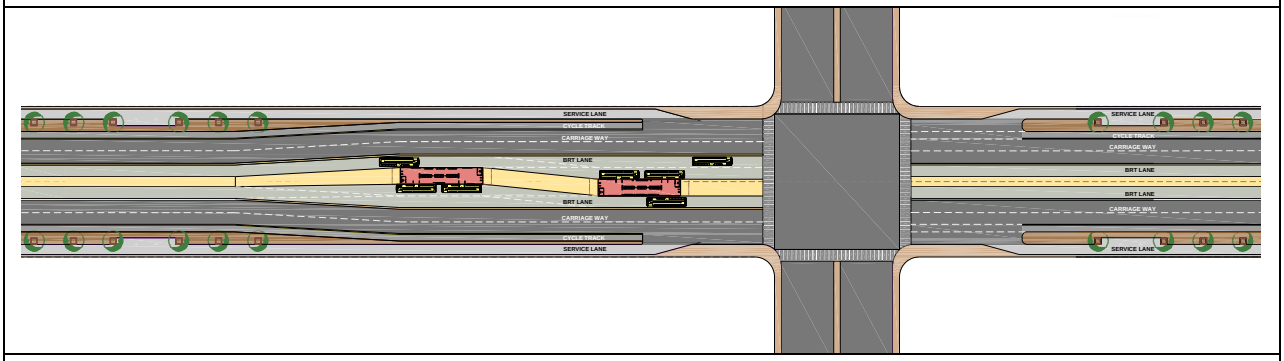
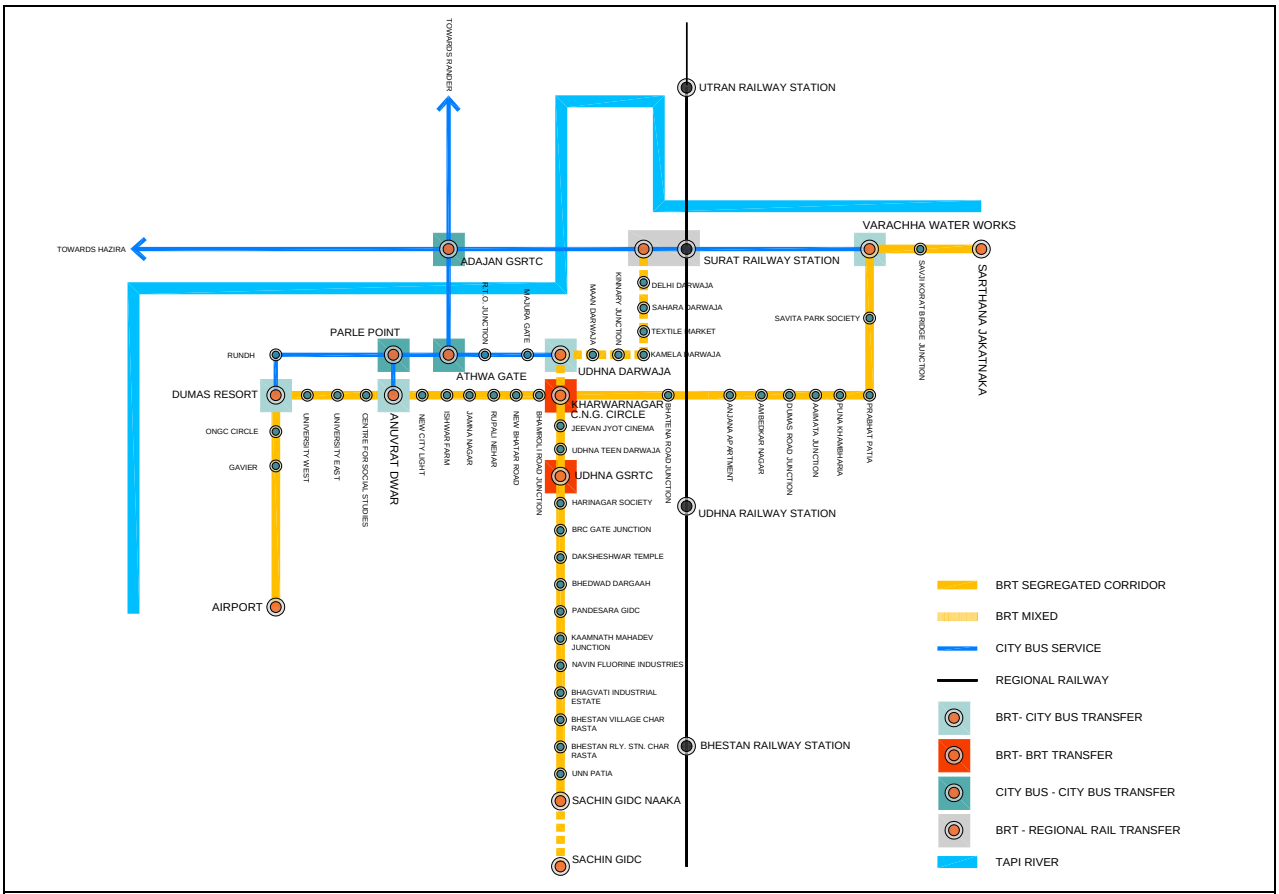


Figure 6: Typical Junction Design for 45 m RoW

Drainage is a critical issue and has been included as part of the project design and costing. Similarly other relevant utilities and amenities have been integrated.

1.4.3 Bus Stations

There are 41 bus stations planned in phase 1. Three terminals have been proposed. There are 10 interchange stations proposed.



Map 13: Integrated Transit System for Surat, Transit Line Diagram

The stations are located on the median. Stations will have provision for ticketing, display, audio systems and other support infrastructure. Off-board ticketing systems are proposed at all the stations on the corridor. Use of smart card is expected to be extensive.

1.4.4 Planning of Bridges and Flyovers

Two flyovers have been proposed as part of phase 1 BRT. Widening of an existing bridge over a 'khadi' has also been proposed.

1.4.5 Vehicles

The proposed system will have semi low floor/ low floor buses, which are convenient for people to board and alight. They will be accessible to the physically challenged.

1.4.6 Services

The city with the completion of BRTS and with the new private bus service would be able to provide a range of public transit services. The highest would include a rapid bus which would be as good as a metro to that of an ordinary bus services to connect interior residential areas operated as feeder roots. The services proposed are grouped into three categories.

1. BRT Exclusive Services
2. BRT feeder serives

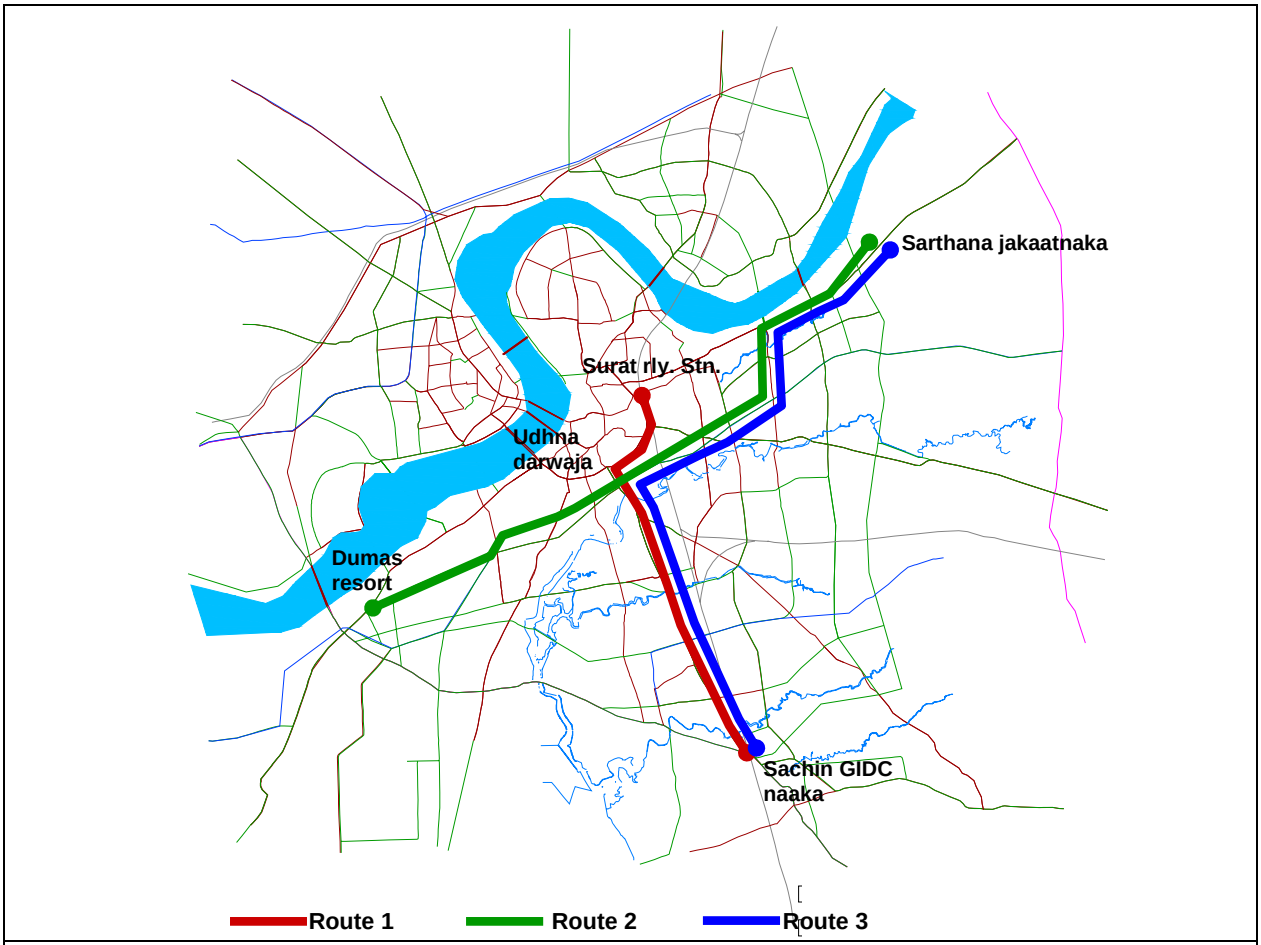
The proposed mix is to include AC (25%) /Non-AC buses, express and ordinary buses as well as ladies special, school special service etc. The expected fleet size of transit service is 125 for phase 1.

1.4.7 Route Structure and Fare Collection:

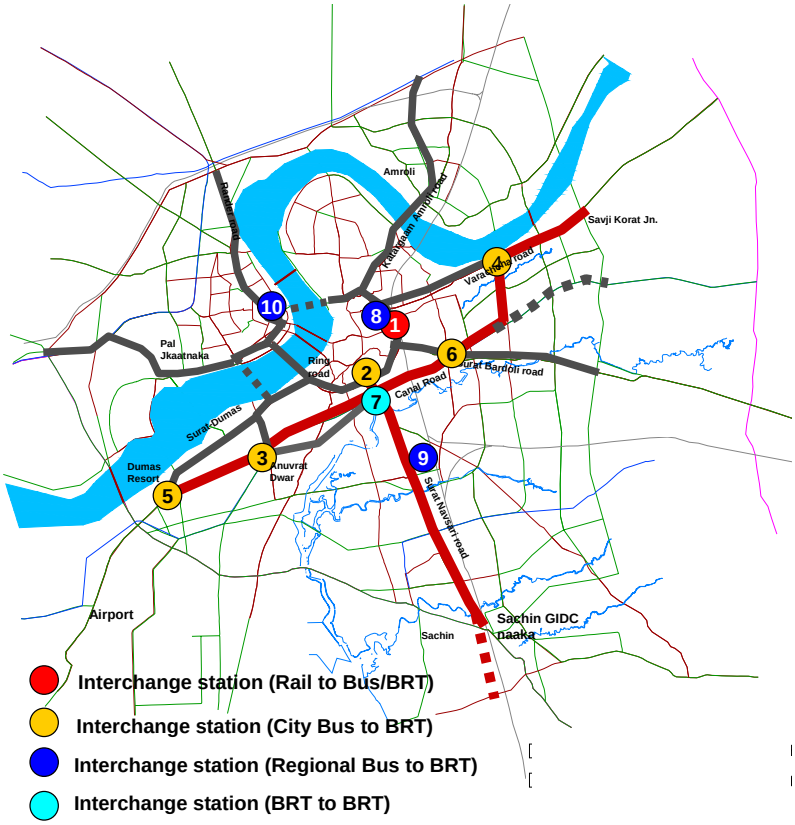
An exclusive system of operation is suggested, where BRT buses will ply on segregated routes from head station to head station and be supported by feeder services at terminals and important nodes enroute.

Three **'BRT Exclusive Routes'** have been designed. They run from West Surat (Dumas resort) to East Surat (Varachha road), from Central Surat (railway station) to South Surat (Sachin) and from East Surat (Varachha road) to South Surat (Sachin). A major interchange station is planned at the Kharwarnagar CNG junction. Initially it is estimated that 3 minute frequency on either side, which over time will be increased to a bus a minute.

The map below shows the proposed routes in phase 1.



Map 14: Proposed BRT routes



Interchange locations:

Rail to City Bus/BRT:
1. Surat Railway Station

City Bus to BRT:
2. Udhna Darwaja
3. Anuvrat Dwar
4. Varachcha water works
5. Dumas resort
6. Aaimata junction (puna jakaatnaka)

BRT to BRT:
7. Kharwarnagar CNG circle

Regional Bus to BRT:
8. Delhi Darwaja
9. Udhna GSRTC Bus stop
10. Adajan Patia

Map 15: Proposed BRT routes and interchange stations

Fare Rate and Collection: A flat fare is recommended for phase 1. Off board ticketing will be considered with smart cards.

1.4.8 ITS Applications

To improve customer convenience, speed, reliability, safety and to build an image of modern system, extensive use of ITS applications are proposed.

They cover:

- Automatic Vehicle Location Information
  - On board stop announcements
  - Next Vehicle Displays
- Use of Smart Cards
- Surveillance & Security Systems

1.4.9 Institutional Framework / Systems Operations

The Surat Municipal Corporation is the lead implementing agency of the project.

Roadway Development: The road way infrastructure development will be undertaken by SMC. Operation and maintenance of the roadway and other services and utilities will be performed by the SMC directly or through private contract mode.

Bus Procurement and Operations: Bus procurement will be through private participation.

Special Purpose Vehicle (SPV): A special purpose vehicle (SPV) will be constituted by SMC. The Board of Directors of the SPV will consist of the representatives of the government agencies and chaired by the municipal commissioner, SMC.

Board of SPV

Commissioner SMC	Chairperson
Dy. Commissioner	Member
Secretary Finance (GoG)	Member
Secretary UDD (GoG)	Member
Secretary Transport (GoG)	Member
CEO SUDA	Member
Municipal Councilors (2)	Members
Technical Experts (2)	Members
Representative RTO	Member
CEO, SPV	Member
Eminent citizens (2)	Members

The CEO, who will be responsible for bus operations, will be hired from the market.

The role of SPV will include planning of services, selection of operators, monitoring of service quality, fare revisions, coordination with relevant departments and future BRTS system expansion plan.

Private operators will be procuring buses as per the specifications decided by the authorities and operating services under the overall supervision and regulation of the SPV. It is envisaged that private operators will selected through competitive bidding will carry out bus operations. A kilometer scheme is being contemplated for the proposed system.

Monitoring: Professional services for periodic demand assessment, services planning and service quality monitoring will be obtained from academic institutions.

Establishment of UMTA: In line with the directive of the Government of India, the city is examining various models to set up UMTA as an apex transport agency.

1.5 Project Scope

Development of BRTS network over 125 kms. has been scheduled in two phases. As part of the project a corridor covering a length of about 30 kms has been identified as phase-1 main corridor. Detailed cost break-up for Phase-I is given in table below. These estimates have been revised based on detailed engineering design of a sample stretch. The cost estimates include development of the entire roadway including roadway amenities and facilities, drainage and IT & other operating services. Adopting element-wise rates, the estimates for each of the corridor stretches has been estimated. The estimates of bridges have been made based on detailed engineering done for some of the identified bridges. Base cost works out to Rs. 469 crore and with 5% escalation; the total cost is Rs. 495 crore.

Table 1: Project Scope and Base Costs

Sl No	Particulars	Length (km)/No/Sqm	ROW (m)	Unit Rate (Rs.)	Cost In Rs	Remarks
Phase I						
1	Surat Navsari road	10.20	60/45	130,491,487	1,331,013,167	
2	Dumas Resort- Sarthana Jakaatnaka (via canal road) road	19.70	60/45	131,781,983	2,596,105,058	
3	**Bridges Flyover & ROB**					
a	Kharvarnagar road Jn.on Surat Navsari road (Udhana Vahan Depo)	0.66	6 Lane		157487859	
b	At Puna Kumbharia old octroi post.(Aaimata Road)	0.945	6 Lane		274038142	
c	Bridge on Khadi behind Udhana Vahan Depot	0.105	2 Lane		24586918	Widening of existing khadi Bridge
4	**Pedestrian Subways**					
a	Kharwarnagar CNG circle	1		12,500,000	12,500,000	
b	Udhna Teen Rasta	1		12,500,000	12,500,000	
c	Udhna ST Bus stop	1		12,500,000	12,500,000	
d	Bhestan Village cross road	1		12,500,000	12,500,000	
e	Udhna Darwaja	1		12,500,000	12,500,000	
5	**Bus stops**	33		3,000,000	99,000,000	
6	**Terminals & Depots**					
a	Sachin GIDC Naka	1000		7,500	7,500,000	land will be provided by SMC.\Cost includes workshop & office space.\Size indicate builtup area
b	Sarthna Jakatnka	1000		7,500	7,500,000	
c	Kharwarnagar CNG circle	1000		7,500	7,500,000	
7	**Interchanges & Stations**					
a	Udhna Darwaja	1		5,000,000	5,000,000	BRT to city Bus
b	Kharwarnagar CNG circle	1		6,000,000	6,000,000	BRT to BRT
c	Anuwratdwar	1		4,000,000	4,000,000	BRT to city Bus
d	Udhana ST Bus stop	1		4,000,000	4,000,000	BRT to State Transport
e	Regional Railway station	1		4,000,000	4,000,000	BRT to Railway
8	**ITS Application**	lumsum		100,000,000	100,000,000	
	Total (without escalation)				**4,690,231,145**	
	Total (with 5% escalation over a period of 3 years)				**4,954,945,454**	

Note: *(1) Roadway costs include roadway construction, footpath, vehicular and bicycle parking, bus stations, passenger amenities such as kiosks, toilets, lighting et c..*

(2) Buses are through private companies. Hence Depot infrastructure will be built using private participation.

1.5.1 Project Financing of Phase-1 BRTS

The project has been forwarded to Government of India for support under JNNURM. SMC and the State governments have earmarked their share of the proposed expenditure. Buses as stated earlier are to be procured through PPP mode.

Table 2: Project Funding Pattern

Agency	%age	2008-09	2009-10	2010-11	Total
GOI - JNNURM	50	602,337,815	925,551,302	949,583,610	2,477,472,727
GoG	20	240,935,126	370,220,521	379,833,444	990,989,091
SMC	30	361,402,689	555,330,781	569,750,166	1,486,483,636
Total	100	**1,204,675,631**	**1,851,102,604**	**1,899,167,219**	**4,954,945,454**
%age		24.3	37.4	38.3	100.0

1.6 Land Use Restructuring

It is observed that bus transit development results into changes in the land use and built form. It has also been observed that when development concentrates along BRTS corridor, transit patronage increases. In view of this it is imperative that the potential of land use transformations be exploited to strengthen BRT project. A policy to encourage rebuilding activity in the area using higher FSI is being contemplated. It is envisaged that all new developments in the vicinity of BRT corridor (250 Mts) will have the permission to build up to FSI 1.8 plus an additional F.S.I of 1. With this the densities on the corridor is likely to increase by 2.5 times. Through impact charges value capture is expected. This would involve modification in the proposals of the Development Plan and obtaining the sanction from the state. Revenues from advertisements and parking are also envisaged.

1.7 Economic Evaluation

Bus Rapid Transit Plan for Surat is a multifaceted project which integrates land use and transport, various forms of public transport services as well as other motorized and non-motorized modes through various physical, operational and policy interventions to achieve the objective of making Surat an accessible and competitive city. Given this multi-dimensional nature of the project, anticipated impacts are numerous and some measurable and some qualitative.

As part of the first phase activity, 30 kms of network has been identified. The result of these would be in the form of savings in vehicle operating costs and travel time savings which have been estimated. Based on these benefits and costs for 30 kms of network, following rates have been obtained. In addition, following benefits are also expected.

- Increased Public Transit Patronage
- Efficient Public Transit Operations
- Efficient Mixed Personalized Transit Operations
- Reduction in Accidents
- Improved Air Quality

Table 3: Economic Analysis Summary

Projection for 2010 to 2030	
Economic Internal Rate of Return without value of time(EIRR)	34.5 %
Economic Internal Rate of Return (EIRR) with value of time	49.8 %

1.7.1 Profitability of Bus Operations

As the private operators will be operating the buses on kilometer scheme, the feasibility of the bus operations was studied in isolation. The bus cost was assumed to be 24, 41 and 50 lakh for semi-low floor, low floor non-ac and Low floor-AC buses. The revenue earned per bus depends on various factors such as fare prices, the capacity of the buses, the vehicle utilization per day as well as the average occupancy of the bus during the day. Considering the above based on Ahmedabad experience, operations were simulated. From the analysis, it is evident that viability of bus operations is subject to fare revision and some amount of support from non-fare revenue.

Table 4: Extent of Viability Gap (in %)

Extent of Viability Gap as % of Bus Cost			
Bus Type	**Cost of Bus (in Lakh Rs.)**	**At Current Fare**	**Fare Revision by +20%**
Low Floor-AC	50.0	117	90
Low Floor-Non-AC	41.0	91	59
Semi Low Floor	25.0	80	26
Note: Bus costs are estimated at 2008 prices			

Table 5: Extent of Viability Gap (in Lakh Rs.)

Extent of Viability Gap (% of Bus Cost) in Lakh Rupees									
Bus Type	**At Current Fare Level**					**With Upward Fare Revision by 20%**			
	Cost of Bus (in Lakh Rs.)	**2010**	**2016**	**2021**	**Total**	**2010**	**2016**	**2021**	**Total**
Low Floor-AC	50.0	7254	7956	14684	29894	5580	6120	11295	22995
Low Floor-Non-AC	41.0	4626	5074	9365	19065	3000	3290	6072	12361
Semi Low Floor	25.0	2480	2720	5020	10220	806	884	1632	3322

1.8 Way forward

BRTS is a new concept for India. Planning and design of BRT in India has to be evolved with experience. The experience gained through building the roadway would throw up solutions to several of issues needing clarification. Further this would also be the time to design other stretches and other operational elements of BRT.

Such a large project will have several issues to deal with. A Steering Committee at the city level is proposed. Formation of UMTA and an SPV is under consideration. It is proposed to operationalize the Bus Rapid Transit System in Surat by end of 2009.